

## Identifying characteristics of a competence-based agricultural higher education system: a literature review

The Journal of Agricultural Education and Extension

Saadvandi, M.; Abbasi, Enayat; Biemans, H.J.A.; Zarafshani, K.; Farhadian, Homayoun

<https://doi.org/10.1080/1389224X.2023.2192706>

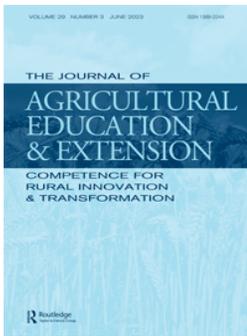
This publication is made publicly available in the institutional repository of Wageningen University and Research, under the terms of article 25fa of the Dutch Copyright Act, also known as the Amendment Taverne.

Article 25fa states that the author of a short scientific work funded either wholly or partially by Dutch public funds is entitled to make that work publicly available for no consideration following a reasonable period of time after the work was first published, provided that clear reference is made to the source of the first publication of the work.

This publication is distributed using the principles as determined in the Association of Universities in the Netherlands (VSNU) 'Article 25fa implementation' project. According to these principles research outputs of researchers employed by Dutch Universities that comply with the legal requirements of Article 25fa of the Dutch Copyright Act are distributed online and free of cost or other barriers in institutional repositories. Research outputs are distributed six months after their first online publication in the original published version and with proper attribution to the source of the original publication.

You are permitted to download and use the publication for personal purposes. All rights remain with the author(s) and / or copyright owner(s) of this work. Any use of the publication or parts of it other than authorised under article 25fa of the Dutch Copyright act is prohibited. Wageningen University & Research and the author(s) of this publication shall not be held responsible or liable for any damages resulting from your (re)use of this publication.

For questions regarding the public availability of this publication please contact [openaccess.library@wur.nl](mailto:openaccess.library@wur.nl)



# The Journal of Agricultural Education and Extension

## Competence for Rural Innovation and Transformation

ISSN: (Print) (Online) Journal homepage: <https://www.tandfonline.com/loi/raee20>

## Identifying characteristics of a competence-based agricultural higher education system: a literature review

Mahsa Saadvandi, Enayat Abbasi, Harm Biemans, Kiumars Zarafshani & Homayoun Farhadian

**To cite this article:** Mahsa Saadvandi, Enayat Abbasi, Harm Biemans, Kiumars Zarafshani & Homayoun Farhadian (2023): Identifying characteristics of a competence-based agricultural higher education system: a literature review, *The Journal of Agricultural Education and Extension*, DOI: [10.1080/1389224X.2023.2192706](https://doi.org/10.1080/1389224X.2023.2192706)

**To link to this article:** <https://doi.org/10.1080/1389224X.2023.2192706>

 [View supplementary material](#) 

 Published online: 03 Apr 2023.

 [Submit your article to this journal](#) 

 Article views: 122

 [View related articles](#) 

 [View Crossmark data](#) 



# Identifying characteristics of a competence-based agricultural higher education system: a literature review

Mahsa Saadvandi <sup>a</sup>, Enayat Abbasi <sup>a</sup>, Harm Biemans <sup>b</sup>, Kiumars Zarafshani <sup>c</sup>  
and Homayoun Farhadian <sup>a</sup>

<sup>a</sup>Department of Agricultural Extension and Education, College of Agriculture, Tarbiat Modares University (TMU), Tehran, Iran; <sup>b</sup>Education and Learning Sciences (ELS), Wageningen University & Research, Wageningen, Netherlands; <sup>c</sup>Department of Agricultural Extension and Education, College of Agriculture, Razi University, Kermanshah, Iran

## ABSTRACT

**Purpose:** This study attempts to determine a set of characteristics for each educational component in the competence-based agricultural education system.

**Design:** This study reviewed 95 articles published in four relevant scientific journals to determine the characteristics of a competence-based higher agricultural education system. These characteristics were determined based on competence-based education principles.

**Findings:** The results of this review indicated that, based on the CBE principles, the competencies for agricultural educational components identified in the reviewed articles could be summarized in 22 categories.

**Practical implications:** The main practical implication is that the universities can consider the results of this study as a set of guidelines in the admission of qualified learners and educators, revising curriculum and organizing dynamic learning environment in line with the CBE characteristics.

**Theoretical implications:** The results of this study could take CBE principles one step further in that, determining characteristics of a competence-based higher agricultural education system can be a guideline on how these principles could be implemented in an education system.

**Originality/value:** This study is original because it tries to bring CBE principles as a valuable theory into practice by the agricultural education systems.

## ARTICLE HISTORY

Received 20 November 2021  
Accepted 15 March 2023

## KEYWORDS

competence-based education; agricultural higher education system; learner; educator; curriculum; learning environment

## 1. Introduction

Many scholars agree that educational programs should be compatible with the needs of professional sectors and society (Mulder et al. 2009; Pande and Chandrasekharan 2016), and those graduates should possess sufficient competencies to play an active role in this regard. On this basis, competence-based education (CBE) was designed, to improve the relationship between professional sectors and societies on the one hand and education

**CONTACT** Enayat Abbasi  enayat.abbasi@modares.ac.ir  Department of Agricultural Extension and Education, College of Agriculture, Tarbiat Modares University (TMU), 1497713111 Tehran, Iran

 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/1389224X.2023.2192706>.

© 2023 Wageningen University

systems on the other, and to improve graduates' competencies (Mulder 2017). CBE is an educational paradigm with the primary goal of empowering graduates for ethical, practical, and balanced participation in their future jobs and society (Mulder et al. 2009). To achieve this goal, CBE is focused on professional problems in the educational program and seeks to integrate knowledge, attitudes and skills, and develop self-responsibility and career and citizenship competencies among the students (Sturing et al. 2011; Wesselink et al. 2007). CBE has gained worldwide attention, given the desirable features mentioned, and many education systems are willing to use this approach. However, most definitions, concepts, and principles are formulated from a theoretical rather than an empirical position; thus, many educational systems face problems implementing this educational paradigm (Van den Berg and De Bruijn 2009; Wesselink et al. 2007). Accordingly, this study aims to provide more practical information for applying CBE through identifying the characteristics of a competence-based higher education system. Due to the high contribution of the agricultural sector in different countries' development and providing food security (Pawlak and Kołodziejczak 2020), agricultural education systems worldwide need to be competence-based to make a relationship with the labor market and provide competent workforces for this labor. Hence, this study focused on identifying the characteristics of a competence-based agricultural higher education system.

The results of previous studies confirm the importance of CBE in agricultural higher education systems in different countries. For instance, Saadvandi et al. (2019) concluded that Iranian agricultural graduates are not competent enough to enter the labor market. In two other research, it was found that teamwork skills of agricultural students need to be strengthened (Khoshnodifar et al. 2020a, 2020b). Miller et al. (2006) believe that agricultural graduates in Southern California compared with business graduates have a lower understanding of basic business principles. Modak et al. (2018) argue that many agricultural graduate and postgraduate students are deprived of taking advantage of agricultural enterprise for their self-employment due to a lack of entrepreneurial competency. Given that agricultural graduates are the output of the agricultural higher education system, their inefficiency to succeed in the labor market is affected by disruptions to other components of the agricultural higher education system, such as educators, the learning environment, and the curriculum. In this regard, Hovakimyan et al. (2021) concluded that the shortcomings of the agricultural curriculum in Armenia led to inefficient graduates who are not competent enough to manage the labor market problems. About the learning environment, the study by Pouratashi (2019) indicated that Iranian agricultural students are unfamiliar with the real work environments therefore they have poor performance in the labor market. According to what was expressed about the shortcomings of agricultural higher education, and the concept and applications of CBE, it could be concluded that implementing CBE could assist the agricultural higher education in overcoming these shortcomings. However, a set of guidelines for implementing CBE is unavailable in the literature. Therefore this study aimed to prepare these guidelines for the agricultural higher education system worldwide based on a systematic review.

### **1.1. Competence-based education**

The idea of competences was introduced in higher education to bridge the gap between the education system and the labor market (Koenen, Dochy, and Berghmans 2015). By

taking the core professional problems as the starting point in CBE, education can be better aligned with the labor market. Intrinsically, CBE empowers students to apply what they have learned in the education system, so that they can solve problems, carry out tasks and function effectively in their profession (Mulder 2001). While CBE has become a dominant trend in education systems in several countries, research regarding its design is still ongoing (Misbah et al. 2015).

Van den Berg and De Bruijn (2009) describe four aspects to CBE: (i) learning by self-steering by making students responsible for their own learning; (ii) spending sufficient time on learning in the workplace; (iii) meaningful learning through the connection of learning and the workplace; and (iv) flexibility in the content of the learning trajectory (Van den Berg and De Bruijn 2009).

Another CBE model has been developed that emphasizes the relationship between education and practice (Gruppen, Mangrulkar, and Kolars 2012). In this model, there are five characteristics for defining competence in CBE: (i) competence focuses on performance in terms of the educational results rather than its process; (ii) competence reflects the expectations of stakeholders outside the educational program; (iii) competence is expressible in terms of measurable behavior; (iv) competence is based on a standard for judging individual competence independently; and (v) competence informs learners and other stakeholders about what is expected from them transparently.

Although these models help to improve the definition of the main characteristics of CBE, more transparency is needed in terms of its operationalization (i.e. what should it look like in practice?). In this regard, Dutch researchers have developed a more practical framework to define what a competence-based curriculum and the learning environment should look like. Although this practical framework was developed in the Dutch context, it has been used to investigate educational programs in various countries, including the Netherlands (Wesselink et al. 2007), Ethiopia (Mulder, Eppink, and Akkermans 2011), and Indonesia (Misbah et al. 2015).

This framework, generated by Mulder (2001, 2004), initially consisted of eight theoretical principles. These were elaborated by Wesselink et al. (2007) using a literature study and a Delphi study with educational experts. Wesselink et al. (2007) developed a model with a viable consensus and tested their model in three vocational education institutions in the Netherlands. Another study was later conducted to validate this model (Sturing et al. 2011). In the validation process, one of the existing principles was divided into two separate principles ( $P_6$  in the left column of Table 1), and one new principle was added to the framework (see  $P_8$  in the right column of Table 1). Therefore, the new version of the CBE framework includes ten principles. Table 1 shows two versions of the CBE principles and the corresponding variables (Sturing et al. 2011; Wesselink et al. 2007).

These principles can be divided into two categories: some referring to the 'what' aspects of the curriculum (principles 1, 2, 5, and 10), and others (principles 3, 4, 6, 7, 8, and 9) to the 'how' aspects of the curriculum (Mulder 2017). Although many of these principles are not unique to CBE, it is their combination that makes them so. In other words, CBE is the result of the active integration and interrelation of all these principles. This means that, to realize CBE, a selection of the principles is insufficient. Therefore, if the competencies required for a job are taken as the starting point of an education program, all parts of an educational system including educators, learners, curriculum,

**Table 1.** Two versions of CBE principles and corresponding variables.

CBE principles and variables developed by Wesselink et al. (2010)		CBE principles developed by Sturing et al. (2011)
Principle	Variable	
P <sub>1</sub> : The competencies on which the program is based are defined	V <sub>1-1</sub> : Construction of a competence profile V <sub>1-2</sub> : Usage of the competence profile	P <sub>1</sub> : The study program is based on core tasks, working processes and competences
P <sub>2</sub> : Vocational core problems are the organizing unit for (re)designing the curriculum (learning and assessment)	V <sub>2-1</sub> : Role of vocational core problems in development of curricula V <sub>2-2</sub> : Role of vocational core problems in assessment	P <sub>2</sub> : Complex vocational core problems are central
P <sub>3</sub> : The competence development of students is assessed before, during and after the learning process	V <sub>3-1</sub> : Assessment of prior competencies V <sub>3-2</sub> : Formal rewarding V <sub>3-3</sub> : Provision of feedback V <sub>3-4</sub> : Flexibility in assessment moment and method	P <sub>3</sub> : Students are regularly assessed for various purposes
P <sub>4</sub> : Learning activities take place in a range of authentic situations	V <sub>4-1</sub> : Authenticity V <sub>4-2</sub> : Variation V <sub>4-3</sub> : Connection between learning in school and learning in practice	P <sub>4</sub> : Learning activities take place in different concrete, meaningful vocational situations
P <sub>5</sub> : Knowledge, skills and attitudes are integrated in learning and assessment processes	V <sub>5-1</sub> : Integration of knowledge, skills and attitudes	P <sub>5</sub> : Knowledge, skills and attitudes are integrated in learning and assessment
P <sub>6</sub> : Self-responsibility and self-reflection/reflection is encouraged in students	V <sub>6-1</sub> : Self-responsibility V <sub>6-2</sub> : Self-reflection V <sub>6-3</sub> : Students' learning questions	P <sub>6</sub> : Students are challenged to reflect on their own learning P <sub>7</sub> : The study program is structured in such a way that the students increasingly self-steer their learning
–	–	P <sub>8</sub> : The study program is flexible P <sub>9</sub> : The guidance is adjusted to the learning needs of the students
P <sub>7</sub> : Teachers both at school and in practice fulfill their roles as coaches and experts equally	V <sub>7-1</sub> : Coaching on the learning process V <sub>7-2</sub> : Coaching on the content	
P <sub>8</sub> : A basis for students to achieve an attitude of lifelong learning is realized	V <sub>8-1</sub> : Development of professional identity V <sub>8-2</sub> : Development of learning competencies	P <sub>10</sub> : In the study program, attention is paid to learning, career and citizenship competences

and learning environment should also be adjusted. To change the 'what' aspect of the educational program, changing the 'how' aspect is inevitable. Therefore, to convert a traditional education system into CBE, all the components should be adjusted. Various components of the higher education system are described in the following section.

## 1.2. The higher education components

The higher education system has a number of components, and numerous categorizations have been made in this regard. In this study, a four-part segmentation of the higher education system – including the educator, learner, curriculum, and learning environment – have been used (Newcomb, McCracken, and Warmbrod 1986) to develop a set of guidelines to become competence-based in any education system.

Each of these components has a specific role in CBE:

- (1) Educator: Due to the crucial role of educators in a CBE system, one of the 10 CBE principles is dedicated to expressing the role of educators. According to this principle, educators should facilitate the learning process and help learners as a coach (Wesselink et al. 2017).
- (2) Learner: most of the CBE models emphasize the learners' competencies as the education system's output that can play an active role in society (Mulder 2017; Wesselink et al. 2017). Due to the importance of the learner in the education system, two positions for them was considered: admission and graduation.
- (3) Curriculum: the design of a curriculum based on the core professional problems is a central principle of CBE. A competence-based curriculum can tie the education system to the labor market.
- (4) Learning environment: in CBE, learning activities are expected to take place in a range of meaningful and authentic situations (concerning the labor market), and preparing these situations requires an authentic learning environment. Obviously, an abstract and isolated environment without connection with the labor market cannot lead to CBE.

Based upon the CBE principle and the role of each component in an educational system, the research question is formulated as follow:

What are the characteristics of the educational components in a competence-based higher agricultural education system?

## 2. Research method

The systematic literature review is a method to summarize and present the overviews of knowledge derived from a body of literature. Moreover, this method is known as the research synthesis to provide a comprehensive and unbiased synthesis of many relevant studies in a single document (Aromataris and Pearson 2014). Since several studies investigated the characteristics of the agricultural higher education system components, it is required to collect and organize these characteristics into coherent categories and adjust them with the CBE principles to provide a set of guidelines for CBE implementation. Accordingly, this study aimed to find and adjust the defined characteristics of agricultural higher education components with CBE principles through the systematic review method.

Following Slavin (1986), researchers should explicitly determine and explain their research criteria. Therefore, a systematic search strategy including three steps was used to search and collect relevant publications. The first step identified relevant publications using four key journals and research keywords. In the next step, yielded publications

were screened based on the research criteria, and in the last step, publications were assessed for eligibility against the prespecified inclusion and exclusion criteria. These three steps are presented below.

## 2.1. Identification

It is common to consider scientific databases such as Web of Science and Scopus in conducting a literature review. However, depending on the research purpose, it is also possible to select a number of key journals. Since this study focused on the agricultural higher education system, four main scientific journals in the domain of agricultural education were selected to access the appropriate articles. These journals include the *Journal of Agricultural Education*, the *Journal of Agricultural Extension and Education*, the *Journal of International Agricultural and Extension Education*, and the *North American Colleges and Teachers of Agriculture (NACTA)*. The purpose and scope of these journals were checked through their websites<sup>1</sup> to ensure their relevance. These journals published the highest numbers of papers related to this research's objectives from different parts of the world.

After selecting journals, the research keywords were selected based on the research objectives. Synonyms and related terms with selected keywords also were identified using Merriam Webster's Online Thesaurus. Table 2 shows all the research, keywords.

## 2.2. Screening

The keywords yielded a large number of articles related to different components of the agricultural competence-based education system. The articles' titles and abstracts were

**Table 2.** Research keywords.

Educational pillars		Keywords
Learnera	Entering the education system	Admission Criteria Admission Characteristic Admission Competence Admission Requirement
	Exiting the education system	Student Competence Student Characteristic Learner Competence Learner Characteristic Graduate Competence Graduate Characteristic
Educator		Teacher Competence Teacher Characteristic Educator Competence Educator Characteristic Faculty Member Competence Faculty Member Characteristic Instructor Competence Instructor Characteristic
Curriculum		Curriculum Competence Curriculum Characteristic Content Competence Content Characteristic
Learning Environment		Learning Environment Competence Learning Environment Characteristic

<sup>a</sup>Since learners have different characteristics when entering and exiting the higher education system, we consider different characteristics for these two positions.

screened in the first screening level, and many irrelevant articles were removed. In the next level, further screening was carried out to distinguish between articles that focused on the characteristics of each component of the agricultural higher education system and those that only referred to these characteristics.

### 2.3. Assessing the eligibility

Screening the titles and abstracts and, if necessary, the full text of the articles yielded 248 articles that included related keywords or phrases in their text. Further screening indicated that some of these articles did not focus on any characteristics of the agricultural higher education system's components as main or sub-theme; instead, they only used related literature or made related suggestions based on their findings. Accordingly, the articles' eligibility was assessed, and the articles with no findings regarding the characteristics of agricultural higher education components were excluded from the review.

Figure 1 shows articles exclusion and inclusion in different steps. Moreover, a complete list of 95 articles that were included in the review is presented in appendix 1.

After determining included articles, content analysis was used to answer the research question. Firstly, in open coding, the statements expressing the 'characteristics of the different agricultural higher education system' were extracted. Then, all extracted codes were categorized in the axial coding process; at this stage, three researchers, through constantly comparing the data, ordered the categories expressing the characteristics of different agricultural higher education system components. Finally, all characteristics were adjusted to CBE principles, and irrelevant characteristics were removed. According to Fleiss Kappa coefficient, the overlap of the three researchers' decisions was sufficient (Fleiss Kappa = 0.86).

## 3. Findings and discussion

As mentioned above, the learner is one of the leading educational components and, to enter any academic field, learners should possess some characteristics to be successful. In CBE principles, this point is considered as 'Assessment of prior competencies'. The results show that, according to 12 reviewed articles, three main categories of characteristics should be assessed to admit learners to the agricultural competence-based higher education system. These include high school background, individual characteristics, and the skills dimension of agriculture (Table 3). Previous studies confirm the importance of high school background in the admission of learners to the higher agricultural education system (Garton, Ball, and Dyer 2002; Sasidhar and Reddy 2012). However, considering this factor alone cannot guarantee the quality of entering learners. Sasidhar and Reddy (2012) believe that a focus on high school background in the admissions procedure to higher agricultural education presents more opportunities for urban learners. This is because more educational facilities are available in cities, so that urban learners are more likely to obtain admission while rural learners will be denied. This phenomenon is known as 'urban bias'.

Accordingly, to educate professional graduates who are interested in working in the agricultural sector, other characteristics – in addition to educational background – should be taken into account for admission to the higher agricultural education

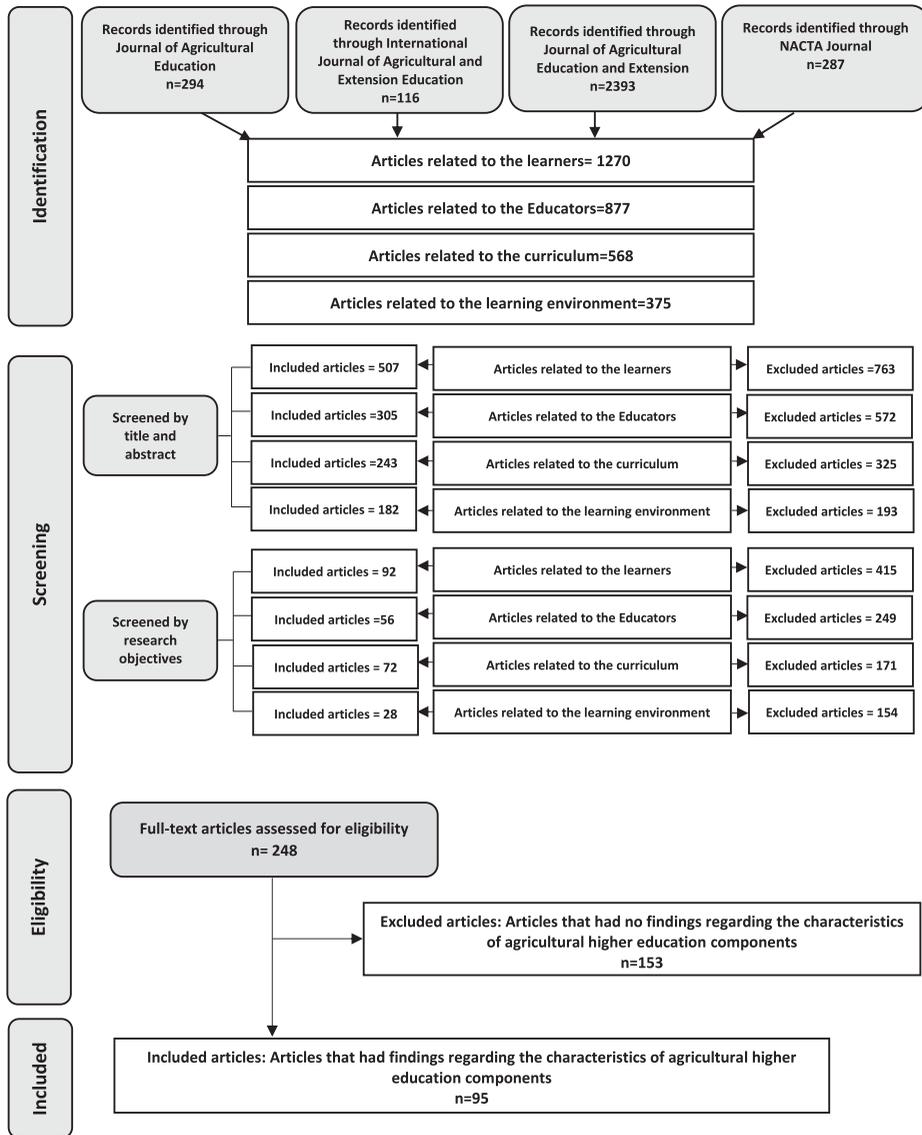


Figure 1. Articles exclusion and inclusion in different steps.

system. Based on the results, individual characteristics and experience are two important characteristics for admission.

One of the main components of an education system with a vital role in realizing CBE is the educator. According to CBE principles, educators both at school and in practice fulfill their roles as coaches and experts equally. Based on this principle, educators should establish a learning process that considers learners' needs both in the education system and in society. To identify the characteristics of a trainer based on agricultural competence, 30 articles were analyzed, and 96 characteristics were extracted. These characteristics were classified into six major categories: 'teaching and evaluation method', 'professional skills', 'scientific ability', 'personal skills', 'communication skills',

**Table 3.** Categorized characteristics of the agricultural competence-based learners' admission.

Category	Characteristics	F
Considering high school background	Considering high school records	7
	Considering high school work experience	3
	Recommendations of high school staff (excellent, good or fair)	3
	High school extracurricular activities (did or did not participate)	2
	Considering student's background at school	2
Considering individual characteristics	Merit-based admissions instead of gender-based	3
	Considering students' ability to adapt to work in rural areas	3
	Considering student's learning style	3
Taking into account the skills dimension of agriculture	Considering an opportunity for rural youth for entering rural-based agricultural sector	3
	Work experience on a farm, or in agribusiness	2

Criterion:  $F \geq 2$ .

and 'management skills' (Table 4). In all these categories, and according to CBE principles, educators are expected to consider the connection between the education system and the labor market.

For instance, concerning the scientific ability of educators in the competence-based higher agricultural education system, findings showed that, in addition to having up-to-date knowledge and information, a number of characteristics are crucial. These include the ability to integrate agriculture with other sciences, an awareness of internship requirements, and sufficient knowledge of the labor market. Furthermore, communication with the job market and the ability to determine appropriate centers for apprenticeship training are essential characteristics of educators that have been emphasized in previous studies (Smalley, Retallick, and Paulsen 2015; Strong and Harder 2011).

One of the basic principles of CBE is a curriculum design based on the vocational core problems; therefore, a competence-based curriculum should cover the required competencies of learners to solve professional issues to be successful in the labor market. The results, based on the review of 34 relevant articles, indicate that characteristics of a competence-based curriculum fall into five categories. These are: 'improving technical skills', 'improving personal skills', 'improving analytical skills', 'comprehensiveness', and 'improving management skills' (Table 5). Although 'curriculum' was considered as the main keyword for finding relevant articles, most of the yielded articles concentrated on 'content.' Therefore, the results are attributed to content. All the categories mentioned relate to empowering learners to enter the labor market and achieve professional success. For instance, characteristics in the personal skills category, such as decision-making capabilities, accepting responsibility, and working independently, all concern the development of the agricultural graduates' personal skills so that they can perform well in professional situations.

The technical skills category also emphasizes improving the linkage between the education system and the labor market. This category is vital for ensuring that agricultural graduates acquire sufficient technical expertise to be competent in their future professions.

The comprehensiveness of the competence-based curriculum means considering various aspects of knowledge and skills. Creating a comprehensive mindset and a broader horizon fall into this category. Developing interdisciplinary perspectives, encouraging diversity in ideas, considering general skills rather than focusing on

**Table 4.** Categorized characteristics of the agricultural competence-based educator.

Category	Characteristics	F
Teaching and evaluation method	Uses appropriate assessment strategies to evaluate learning (developing performance-based assessment instruments)	16
	Uses technology in teaching	16
	Is well organized	11
	Gives synthesized principles and theory	9
	Uses appropriate teaching methods / uses a variety of teaching techniques	9
	Questions techniques	8
	Makes good presentations (organized presentation, offering little or no variation in delivery system, well planned and delivered with appropriate use of media)	8
	Uses student evaluations to improve teaching	7
	Teaches in multicultural classrooms	7
	Applies learning styles of students and faculty	7
	Teaches using experiments	6
	Is able to explain and transfer subject, e.g. provide an alternative explanation for example when learners are confused	6
	Applies clarity in teaching	6
	Teaches analytical skills (creative thinking, decision-making skills, problem-solving)	5
	Gets students engaged in teaching and learning	4
	Develops student leadership	4
	Creates the perfect course syllabus	3
	Encourages critical thinking skill development	3
	Makes organized and articulate presentations, utilizing a variety of appropriate styles and media	3
	Applies active learning strategies	3
Enables independent, self-reliant learning	3	
Professional skills	Is honest, moral, and ethical	20
	Has knowledge of academic requirements and process involved	11
	Develops school and community relationships	9
	Shares knowledge of teaching and learning with colleagues and others	9
	Has knowledge of students' goals and interests	7
	Is knowledgeable about university policies	4
	Serves as a role model for students	4
	Conducts research projects in workplace based on relevance and need	3
	Is accessible and available (i.e. after class)	3
	Impacts on course or curriculum development; peer mentoring to improve teaching; policy; standards; or other developments at the unit, department or college level; changes in enrollment	3
Scientific ability	Has professional discipline	3
	Has field-specific theoretical knowledge	23
	Teaches agriscience – integrating science and agriculture	8
	Provides information when asked about employment	6
	Understands requirement for internships	5
	Gives new information, not only what is in the book	5
Personal skills	Has excellent knowledge of the practical subject matter	3
	Is aware of the content needed in the training program	15
	Understands how demographics (e.g. culture, ethnicity, and gender) affect the selection of various techniques used to meet student needs (issues related to the roles of women in agriculture)	10
	Enjoys teaching and exhibits a positive attitude toward the teaching profession	7
	Cares for individuals (willingness to take the time required to meet student needs; answers questions and does not embarrass students; helps students meet requirements; helps students with problems (personal and academic); takes the time to visit the workplace with students)	7
	Possesses analytical skills (problem-solving, decision-making, leadership, conflict resolution, evidence-based reasoning)	6
	Is trustworthy and sincere	5
	Is capable of solving problems and multi-tasking (managing complex tasks)	4
Communicational skills	Coordinates activities with local agricultural organizations and activities	27
	Works well with alumni and advisory groups (community relations)	15
	Develops relationships with fellow teachers and administrators	10
	Communicates well with others	9

*(Continued)*

**Table 4.** Continued.

Category	Characteristics	F
Management skills	Applies appropriate classroom management skills	14
	Directs students to plan a supervised agricultural experience (SAE) project (guides students in the selection and/or expansion of their SAE; has sound SAE knowledge; actively supervises and encourages SAE projects; develops SAE opportunities for students)	12
	Directs students to conduct an SAE project (assists students in solving problems associated with their SAE programs; directs students in keeping records of their SAE; effectively supervises SAE projects)	11
	Plans, organizes, conducts, and evaluates field trips	6
	Acts as facilitator to students (identifies and solves learning difficulties)	6
	Sets clear goals	3
	Directs student laboratory experiences	3

Criterion:  $F \geq 4$ .

details, and integrating agricultural science with the social sciences are some of the features that demonstrate curriculum comprehensiveness.

In terms of management skills, the curriculum is expected to enhance the learner's ability to work with and for others, as well as to develop different resource management skills. Accordingly, a competence-based curriculum needs to have characteristics such as improving the ability to work as a team, developing the ability to collaborate with others, improving change management ability, enhancing leadership skills, and improving the ability to manage professional problems in the workplace.

Developing analytical skills is another aspect of the competence-based curriculum. This aspect is important for enabling learners to analyze different issues and to combine educational content with previous experience and knowledge for use in their professional positions.

According to the goals and principles of CBE, the learning environment in CBE is generally characterized as having three main elements: (1) improve technical skills, (2) improve personal development, and (3) improve communication skills (Pant 2012; Witteveen, Put, and Leeuwis 2010). Some scholars believe that the learning environment elements affect the content in an 'educational design' (Kuijpers, Meijers, and Gundy 2011). However, in this study, these elements fall on the category of learning environment. The results, based on the analysis of 12 articles, indicate that the characteristics of a CBE learning environment do indeed fall into three main categories: 'improving technical skills', 'improving personal development', and 'improving communication skills' (Table 6). To improve technical skills, the learning environment needs to provide the required conditions and facilities and a favorable atmosphere. Accordingly, characteristics such as providing the contexts and resources for putting knowledge into practice, providing opportunities to apply knowledge, and providing opportunities to conduct a project in the field are all included in the improving technical skills category. Previous studies have confirmed the importance of the learning environment in terms of providing the means to improve technical skills (Biemans and Van Mil 2008; Pant 2012). Also, the learning environment should provide context for the learners' values, interests, and ideas, to enable them to promote their individual development. Therefore, in the personal development category, characteristics such as providing a positive and fun atmosphere, providing students with the opportunity to discover their interests using a variety of educational tools, and enabling them to integrate ideas, are considered.

**Table 5.** Categorized characteristics of the agricultural competence-based curriculum.

Category	Concept	F
Improving Technical Skills	Acquire off-campus occupational experience (moving outside the classroom boundaries)	10
	Encourage students to secure funding for profitability experience	8
	Provide effective opportunities to acquire or develop skills	7
	Methods of accessing, using and sharing information	7
	Teaching strategies: real world projects	5
	Able to apply knowledge / skills in workplace (transferring knowledge from the head to the hands)	4
	Design learning experience	3
Improving Personal Skills	Decision-making capabilities	9
	Encourage students to learn (lifelong learning – on the job)	7
	Able to accept responsibility	5
	Able to work independently	5
	Encourage and develop emotional skills, such as intuition, which are best suited to dealing with unexpected situations	5
	Flexibility	4
	Risk-taking	4
Improving Analytical Skills	Greater emphasis on developing problem-solving	13
	Analytical competencies (system analysis, information analysis, conceptualizing, rational analysis and prediction as a base for action)	4
	Encourage students to use their interpretations of experience to challenge and critique classroom theory	3
Improving Management Skills	Communication skills (writing, speaking and listening)	29
	Collaborate with others	9
	Conflict and dispute management	5
	Organization and time management	5
	Leadership skills	5
	Teamwork	4
	Able to work under pressure	4
	Change management (initiating, adjusting, adapting, being continuously aware)	3
Comprehensiveness	Broad knowledge (technical, management, planning, financial, administration, marketing, field-specific theoretical, local context, international law, rural sociology, environmental awareness)	12
	Cover all aspects of agriculture (ecological, economic, social, recreational, technical, productivity, marketing)	7
	Integrate ideas and agricultural as well as social science disciplines	6
	Holistic approach	4
	Curriculum should create by the forces of the work field (which articulate the societal demands for graduate attributes – demand-driven)	3

Criterion:  $F \geq 3$ .

Communication skills in CBE requires that learners at different levels learn how to communicate with others, first in the learning environment and then in the professional environment. Thus, a competence-based learning environment is expected to facilitate learners' relationships with different people inside and outside the education system. Providing easy interaction, emphasizing cooperative learning, and facilitating learners' interaction with farmers and others in the food system are some of the important characteristics in the communication skills category. The importance of interactions and communication skills in the learning environment has also been confirmed in previous studies (Mankin et al. 2004; Witteveen, Put, and Leeuwis 2010).

CBE, which pursues the primary goal of aligning the education system with the labor market, is designed to educate the specialist human resources needed to develop society. According to CBE principles, graduates should acquire career and citizenship

**Table 6.** Categorized characteristics of the agricultural competence-based learning environment.

Concept	Category	F
Improving Technical Skills	Consider contexts and resources to put knowledge into practice	3
	Learners see tangible results of their work	3
	Manage the enormous diversity of experiences learner will encounter	3
	Students have the opportunity to review the materials as often as required for use in both their academic and professional farming careers	2
	Projects in the field	2
	Practical tutor takes more of a facilitating or mentoring role	2
Improving Personal Development	Personal development and lifelong learning, and a basis to contribute to sustainable development of agriculture and food systems	13
	Environments to generate new ideas for actions	3
	Relaxed, laid-back and comfortable environment	3
	Humorous, positive and fun	2
	Rich in graphics, video and other media and educational materials, which help learners to discover things by themselves	2
	Require students to integrate ideas and agricultural as well as social science disciplines	2
	More emphasis placed on the students taking charge of their own learning	2
	Cooperative learning such as group work	6
Improving Communicational Skills	Interactive learning with discussion	4
	Easy interaction between student and facilitator (teacher)	3
	Make learners part of the discussion	3
	Interact with farmers and others in the food system	2
	Environments to share new unproven ideas	2

Criterion:  $F \geq 2$ .

competencies to enable them to play an active role in their professional life while also contributing to the prosperity of society. To teach these specialist and generalist skills, educational institutions need to make use of both extracurricular activities and the conventional teacher-learner classroom environment. For example, CBE allows for a traditional curriculum for students to acquire specialized knowledge in the discipline, while also providing opportunities for extracurricular activities to develop general skills. Therefore, the success of CBE could be reflected in the graduates' performance in society. The definitions and principles of CBE indicate that learners should have a clear professional identity in their minds and be prepared to enter the professional world. Also, they should have a set of citizenship competencies that enable them to play an active role in society. In previous studies, professional identity is defined as a social characteristic that is created with others through practical learning and professional experiences, and promoting professional identity enables individuals to play an active and useful role in society (Carlone and Johnson 2007). The results, based on 35 relevant articles, indicate that competence-based graduates should acquire five major skills, in the 'technical domain', 'communication domain', 'management domain', 'analytical domain', and 'personal domain' (Table 7). Due to the technical and practical nature of agriculture, graduates in this field need technical skills to succeed in the professional environment. For instance, one of the main reasons why technical knowledge and information are so important for agricultural graduates is that they will interact with farmers who expect answers to their questions. The importance of technical knowledge and information for agricultural graduates is mentioned in previous studies (Alibaygi and Pouya 2011; Corder and Irlbeck 2018; Suvedi, Ghimire, and Channa 2018). It should be noted that the importance of technical knowledge and skills should not lead to the neglect of other required skills for agricultural graduates.

**Table 7.** Categorized characteristics of the agricultural competence-based graduates.

Category	Characteristics	F
Technical Domain	Technical knowledge	31
	Technical skills	27
	Able to apply knowledge, skills and experience in workplace (transfer knowledge from the head to the hands)	8
	Marketing	8
	Prepare a business plan	7
	Use information technology	6
	Practical understanding	5
	Able to follow directions	4
Communication Domain	Communication skills (oral)	9
	Communication skills (written)	9
	Understand people's differences (sensitivity to others)	7
	Able to work in multicultural workplace	6
	Fluent in languages	6
	Collaborate with colleagues in own and other institution	6
	Listening skills	4
	Know one's mental models	4
Management Domain	Able to manage teamwork	18
	Financial management and budgeting skills	14
	Take action to generate empowerment and enlightenment	10
	Possess leadership abilities	9
	Possess change management skills	4
Analytical Domain	Able to solve problems on the job	13
	Possess decision-making skills	7
	Interpret data and make correct inferences	5
	Action to select and implement best alternative	5
	Possess the ability to think critically	4
Personal Domain	Cross-disciplinary thinking	4
	Has developed personal attributes (self-esteem, self-confidence)	40
	Has developed correct behavior	8
	Able to learn on the job (lifelong learning)	5
	Creativity, innovation and change (able to provide choices and alternative solutions)	5
	Informed about international law	5
	Able to work independently	4

Criterion:  $F \geq 4$ .

One other crucial skill for agricultural graduates is communication. For instance, agricultural graduates should be able to use various communication techniques such as oral and written communication to create and transmit messages so that they can apply their scientific skills to respond to the problems of a range of audiences in an agricultural context. Several studies have demonstrated the vital role of agricultural graduates' communication skills in their professional success (Jamaludin et al. 2019; Wilkes and Burns 2019). Moreover, graduates will face a dynamic and changing work environment and must be able to meet various job challenges. Therefore, building and enhancing management skills such as managing teams, financial management, leadership abilities, and change management, are vital. Various aspects of agricultural graduates' management skills have also been studied in previous studies and the importance of these skills for professional success has been confirmed (Corder and Irlbeck 2018; Unay-Gailhard et al. 2019).

Considering the dynamics and complexity of the professional environment in the agricultural sector, graduates – in addition to the aforementioned skills – also need analytical skills, including the ability to identify opportunities in a competitive environment, the ability to interpret and extract data, problem solving, critical thinking, and the power of rational reasoning. Pouratashi and Zamani (2019) also emphasize the need for

**Table 8.** Alignment of educational pillars' characteristics and CBE principles and variables.

Educational Pillars	Major Characteristics	Theoretical basis of CBE <sup>a</sup>		
		Principle	Variable	
<b>Learner</b>	Entering the education system	Considering academic records Considering individual characteristics Taking into account the skills dimension of agriculture	Students are regularly assessed	Assessment of prior competencies
	Exiting the education system	Technical Domain Communication Domain Management Domain Analytical Domain	In the study program, attention is paid to learning, career and citizenship competences	– Development of professional identity – Development of learning competencies
<b>Educator</b>	Personal Domain Teaching and evaluation method Professional skills Scientific ability Personal skills Communication skills Management skills	Teachers both at school and in practice fulfill their roles as coaches and experts equally	– Coaching on the learning process – Coaching on the content	
<b>Curriculum</b>	Improving Technical Skills Improving Personal Skills Improving Analytical Skills Improving Management Skills Comprehensiveness	Vocational core problems are the organizing unit for (re)designing the curriculum (learning and assessment) Learning activities take place in a range of authentic situations Knowledge, skills and attitudes are integrated	– Role of vocational core problems in development of curricula – Role of vocational core problems in assessment – Authenticity – Variation – Connection between learning in school and learning in practice	
<b>Learning Environment</b>	Improving Technical Skills Improving Personal Development Improving Communication Skills	Vocational core problems are the organizing unit for (re)designing the curriculum (learning and assessment) Learning activities take place in a range of authentic situations	– Role of vocational core problems in development of curricula – Role of vocational core problems in assessment – Authenticity – Variation – Connection between learning in school and learning in practice	

<sup>a</sup>Wesselink et al. (2010), Sturing et al. (2011).

analytical skills for critical, authoritative, and voluntary thinking and action to deal with uncertainty and complex situations. In addition, personal skills, such as self-motivating skills, the ability to accept responsibility, flexibility, and an understanding of the importance of professional competencies, are essential for agricultural graduates to succeed. This is because having these skills can improve an individual's ability to apply the other skills needed in the professional environment. In other words, developing personal skills helps graduates to develop the personality, motivation, positive attitude, and flexibility required to apply technical, communication, management, and analytical skills.

After determining the characteristics of the competence-based educational components, these characteristics were aligned with the CBE principles to ensure that they lead us to a set of guidelines to establish competence-based education system (Table 8). For example, as shown in Table 8, the CBE principle stating that 'students are regularly assessed' was aligned with 'consider academic records', 'consider individual characteristics', and 'take into account the skills dimension of agriculture'. Another example of aligning CBE principles with characteristics of the competence-based educational components is regarding the educators; in the CBE principles, it is mentioned that 'Teachers both at school and in practice fulfill their roles as coaches and experts equally.' Based on the results, educators should possess a list of characteristics to fulfill this role, including: 'teaching and evaluation method,' 'professional skills,' 'scientific ability,' 'personal skills,' 'communication skills,' and 'management skills.' Similarly, all of the extracted characteristics for the agricultural competence-based educational components aligned with CBE principles (see Table 8). If these characteristics are considered in the agricultural competence-based educational components, then it can be expected that agricultural graduates be competent enough to be successful in the labor market.

#### 4. Conclusion

Due to the global attention to CBE, many educational systems worldwide are willing to integrate this educational innovation into their programs. Hence, according to this demand, different definitions, concepts, and principles have been defined for CBE. Nevertheless, there are still numerous unanswered questions regarding how educational institutions can implement this innovation, one of which is what characteristics an educational system should have to be recognized as a competence-based system? Accordingly, this study seeks to take a further step in the CBE literature to make it more practical through a systematic literature review. Since agricultural education is a significant part of educational systems worldwide, this study focuses on the competency-based agricultural higher education system. Due to the multidisciplinary nature of agricultural education as a field of study, one can use variety of socio-psychological as well as behavioral theories. These theories allow agricultural education researchers to find themselves in a better position to apply CBE guidelines in their current theories which is rooted in socio-psychological as well as behavioral sciences. Thus, four main components for an agricultural education system, including learner, educator, curriculum, and learning environment, were considered, and a set of characteristics were extracted that are in line with CBE principles defined by Mulder (2001, 2004), Sturing et al. (2011), and Wesselink et al. (2007).

Reviewing the studies of more than four decades led to coherent characteristics of the competence-based education's components in 22 categories that could be helpful for

educational policymakers and universities to move toward CBE. It is to be noted that, the importance of interaction between educational systems and the labor market is already obvious to both agricultural education systems and policy makers. But something that has not been addressed much, is how to establish this interaction.

The results of this study can be used by educational policymakers and agricultural education systems as a set of guidelines to establish agricultural CBE and improve the interactions of the education system and the labor market. Educational policymakers can use these results to (re)design agricultural higher education systems in which different components interact with the labor market; this interaction leads to more applicability of educational output to the labor market. Universities can consider this study's results as a set of guidelines in the admission of qualified learners and educators, revising curriculum, and organizing dynamic learning environment in line with the CBE characteristics. Eventually, the practical suggestions of this research that could be used by universities and the policymakers of the agricultural higher education system are as follow; (a) designing professional development training programs for the educators based on the CBE principles in line with characteristics defined in this paper; (b) redesigning the curriculum regularly by engaging employers to meet CBE principles; (c) applying the defined characteristics of the agricultural competence-based learners' admission to admit more competent learners; (d) connecting the learning environment within the workplace either through holding regular visits to workplace or simulating workplace in the campus.

It is important to recognize that this research is limited in some ways. One of the significant limitations is the extent and dispersion of CBE components in relevant journals. This meant that, due to time and cost limitations, the researchers had to narrow their focus to a certain number of journal articles. Thus, there may be more characteristics of agricultural competence-based education than those reported in this article. We suggest that the articles published in a wider range of journals be examined in future studies in order to enumerate more characteristics for the competence-based agricultural higher education system.

In summary, this literature review presents a wide range of characteristics of a competence-based education' components with focus on CBE principles. But these characteristics are unique to agricultural higher education, therefore it is suggested to the other researchers to investigate the characteristics of a competence-based education in different fields.

## Note

1. [http://www.jae-online.org/index.php/philosophy\\_resources/89adb8fa-5c5e-4052-9778-d71ca9536949](http://www.jae-online.org/index.php/philosophy_resources/89adb8fa-5c5e-4052-9778-d71ca9536949), <https://www.echocommunity.org/attachments/article/267/Vol-9.3.pdf>, <https://www.nactateachers.org/index.php/contact-us>.

## Disclosure statement

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

## Notes on contributors

*Mahsa Saadvandi* is a Ph.D. graduated in agricultural extension and education from Tarbiat Modares University, Iran. Her dissertation title was 'Designing Competency- based Model in

Agricultural Higher Education’. Her research interests include ‘agricultural education and competence’ and ‘professional development’.

*Enayat Abbasi* is an Associate Professor at the Department of Agricultural Extension and Education, Faculty of Agriculture, Tarbiat Modares University, Iran. He teaches ‘lifelong education’, ‘agricultural education’ and ‘research method’ for graduate students. His research interests include ‘agriculture and environment education’, ‘teaching and learning in agricultural higher education system’.

*Harm Biemans* is an Associate Professor at the Department of Education and Learning Science at Wageningen University, the Netherlands. His research interests include ‘teaching and learning’, ‘pedagogy and education’, ‘professional development’ and ‘collaborative learning’.

*Kiumars Zarafshani* is a Professor at the Department of Agricultural Extension and Education, Faculty of Agriculture, Razi University, Iran. He teaches ‘lifelong education’, ‘agricultural education’, ‘agricultural entrepreneurship’ and ‘research method’. His research interests include ‘agricultural education’ and ‘agricultural entrepreneurship in higher education’. He established agricultural student cooperative in five agricultural faculties and now he is the advisor for most of agricultural student cooperative in Iran.

*Homayou Farhadian* is an Assistant Professor at the Department of Agricultural Extension and Education, Faculty of Agriculture, Tarbiat Modares University, Iran. He teaches ‘agricultural extension’ and ‘research method’. His research interests include ‘agricultural extension’ and ‘agricultural innovation system’.

## ORCID

*Mahsa Saadvandi*  <http://orcid.org/0000-0001-8343-3191>

*Enayat Abbasi*  <http://orcid.org/0000-0002-5238-7185>

*Harm Biemans*  <http://orcid.org/0000-0003-2955-8211>

*Kiumars Zarafshani*  <http://orcid.org/0000-0002-2574-6197>

*Homayoun Farhadian*  <http://orcid.org/0000-0003-0424-6107>

## References

- Alibaygi, A., and M. Pouya. 2011. “Needs Assessment of Senior Agricultural Students Regarding Sustainability Knowledge.” *African Journal of Agricultural Research* 6 (31): 6542–6546. <https://doi.org/10.5897/AJAR11.1414>
- Aromataris, E., and A. Pearson. 2014. “The Systematic Review: An Overview.” *AJN the American Journal of Nursing* 114 (3): 53–58. doi:10.1097/01.NAJ.0000444496.24228.2c
- Biemans, H., and M. Van Mil. 2008. “Learning Styles of Chinese and Dutch Students Compared Within the Context of Dutch Higher Education in Life Sciences.” *The Journal of Agricultural Education and Extension* 14 (3): 265–278. doi:10.1080/13892240802207700
- Carlone, H. B., and A. Johnson. 2007. “Understanding the Science Experiences of Successful Women of Color: Science Identity as an Analytic Lens.” *Journal of Research in Science Teaching* 44 (8): 1187–1218. doi:10.1002/tea.20237
- Corder, J., and E. Irlbeck. 2018. “Agricultural Communications Skills, Abilities and Knowledge Desired by Employers Compared to Current Curriculum: A Literary Review.” *Journal of Agricultural Education* 59 (4): 177–193. doi:10.5032/jae.2018.04177
- Garton, B. L., A. L. Ball, and J. E. Dyer. 2002. “The Academic Performance and Retention of College of Agriculture Students.” *Journal of Agricultural Education* 43 (1): 46–56. doi:10.5032/jae.2002.01046
- Gruppen, L. D., R. S. Mangrulkar, and J. C. Kolars. 2012. “The Promise of Competency-Based Education in the Health Professions for Improving Global Health.” *Human Resources for Health* 10 (1): 10–43. doi:10.1186/1478-4491-10-43

- Hovakimyan, H., M. Klimek, B. Freyer, and S. Vogel. 2021. "Participation in Higher Education Curricula Development in Armenia and Possible Effects for the Labour Market—The Case of an "Organic Agriculture" Master's Program." *Social Sciences* 10 (9): 331. doi:10.3390/socsci10090331
- Jamaludin, K. A., N. Alias, D. DeWitt, H. B. Kenayathulla, and A. R. A. Razzaq. 2019. "Employability Skills Valued by Employers in Malaysia." *Jurnal Kurikulum Pengajaran Asia Pasifik* 7 (2): 30–37.
- Jjuuko, R., C. Tukundane, and J. Zeelen. 2019. "Exploring Agricultural Vocational Pedagogy in Uganda: Students' Experiences." *International Journal of Training Research* 17 (3): 238–251. doi:10.1080/14480220.2019.1685161
- Khoshnodifar, Z., E. Abbasi, H. Farhadian, H. Sadighi, and M. Pouratashi. 2020a. "Comparative Comparison of Lecture and Team Member Teaching Design Methods in Agricultural Higher Education System of Iran." *Journal of Agricultural Science and Technology (JAST* 22 (4): 891–904.
- Khoshnodifar, Z., E. Abbasi, H. Farhadian, H. Sadighi, M. Pouratashi, and A. Alambaigi. 2020b. "Teamwork Behavior in Relation to Teacher, Student, Curriculum, and Learning Environment in Iranian Agricultural Higher Education System." *Journal of Agricultural Science and Technology (JAST)* 22 (6): 1431–1447.
- Koenen, A. K., F. Dochy, and I. Berghmans. 2015. "A Phenomenographic Analysis of the Implementation of Competence-Based Education in Higher Education." *Teaching and Teacher Education* 50: 1–12. doi:10.1016/j.tate.2015.04.001
- Kuijpers, M., F. Meijers, and C. Gundy. 2011. "The Relationship Between Learning Environment and Career Competencies of Students in Vocational Education." *Journal of Vocational Behavior* 78: 21–30. doi:10.1016/j.jvb.2010.05.005
- Mankin, K. R., K. M. Boone, S. Flores, and M. R. Willyard. 2004. "What Agriculture Students Say Motivates Them to Learn." *Journal of North American Colleges and Teachers of Agriculture* 48 (4): 6–11.
- Miller, S., L. Fredendall, W. Ferreira, and L. Nilson. 2006. "Identifying Competencies Possessed and the Skills Needed of Entry-Level College Graduate Agribusiness Employees". Research Reports 187459, Clemson University, Department of Agricultural and Applied Economics.
- Misbah, Z., J. Gulikers, R. Maulana, and M. Mulder. 2015. "Teacher Interpersonal Behaviour and Student Motivation in Competence-Based Vocational Education: Evidence from Indonesia." *Teaching and Teacher Education* 50: 79–89. doi:10.1016/j.tate.2015.04.007
- Modak, S., M. C. Patel, P. K. Pal, L. Das, and S. Nain. 2018. "A Study of Entrepreneurial Competencies of Post Graduate Students in Agriculture." *Indian Journal of Agricultural Sciences* 88 (9): 1391–1395. doi:10.56093/ijas.v88i9.83482
- Mulder, M. 2001. "Competence Development - Some Background Thoughts." *The Journal of Agricultural Education and Extension* 7 (4): 147–158. doi:10.1080/13892240108438822
- Mulder, M. 2004. "Education, competence and performance. On training and development in the agri-foodcomplex". Research Reports, Wageningen: Wageningen Universiteit.
- Mulder, M. 2017. *Competence-based Vocational and Professional Education*. Cham: Springer.
- Mulder, M., H. Eppink, and L. Akkermans. 2011. "Design, Implementation and Effectiveness of Capability-Oriented Workplace Learning in East-Africa." Annual Meeting of the American Educational Research Association, April 11, New Orleans.
- Mulder, M., J. Gulikers, H. Biemans, and R. Wesslink. 2009. "The New Competence Concept in Higher Education: Error or Enrichment?" *Journal of European Industrial Training* 33 (9): 755–770. doi:10.1108/03090590910993616
- Newcomb, L. H., J. D. McCracken, and J. R. Warmbrod. 1986. *Methods of Teaching Agriculture*. Dnville, IL: The Interstate Printers & Publishers, Inc.
- Pande, P., and S. Chandrasekharan. 2016. "Representational Competence: Towards a Distributed and Embodied Cognition Account." *Studies in Science Education* 53 (1): 15–48.
- Pant, L. 2012. "Learning and Innovation Competence in Agricultural and Rural Development." *The Journal of Agricultural Education and Extension* 18 (3): 205–230. doi:10.1080/1389224X.2012.670050

- Pawlak, K., and M. Kołodziejczak. 2020. "The Role of Agriculture in Ensuring Food Security in Developing Countries: Considerations in the Context of the Problem of Sustainable Food Production." *Sustainability* 12 (13): 5488. doi:10.3390/su12135488
- Pouratashi, M. 2019. "Higher Education and Activities to Improve Students' Employability Skills." *Journal of Education for Business* 94 (7): 433–439. doi:10.1080/08832323.2018.1548421
- Pouratashi, M., and A. Zamani. 2019. "University and Graduates Employability: Academics' Views Regarding University Activities (the Case of Iran)." *Higher Education, Skills Work-Based Learning* 9 (3): 209–304. doi:10.1108/HESWBL-12-2017-0103
- Saadvandi, M., E. Abbasi, H. Farhadian, Z. Zarafshani, and H. Biemans. 2019. "Teachers and Students' Perception of Competence-Based Education in the Agricultural Higher Education System (Case of a Student Cooperative in Iran)." *The Journal of Agricultural Education and Extension* 25 (4): 307–322. doi:10.1080/1389224X.2019.1627225
- Sasidhar, P., and P. G. Reddy. 2012. "SWOT Analysis of Veterinary and Animal Science Education in India: Implications for Policy and Future Directions." *The Journal of Agricultural Education and Extension* 18 (4): 387–407. doi:10.1080/1389224X.2012.684801
- Slavin, R. E. 1986. "Best-evidence Synthesis: An Alternative to Meta-Analysis and Traditional Reviews." *Educational Researcher* 15 (9): 5–11. doi:10.3102/0013189X015009005
- Smalley, S. W., M. S. Retallick, and T. H. Paulsen. 2015. "Relevance of Student Teaching Skills and Activities from the Perspective of the Student Teacher." *Journal of Agricultural Education* 56 (1): 73–91. doi:10.5032/jae.2015.01073
- Strong, R., and A. Harder. 2011. "Influence of Selected Personal Characteristics on Florida Master Gardener's Instructional Efficacy." *Journal of Agricultural Education* 52 (3): 27–35. doi:10.5032/jae.2011.03027
- Sturing, L., H. Biemans, M. Mulder, and E. De Bruijn. 2011. "The Nature of Study Programmes in Vocational Education: Evaluation of the Model for Comprehensive Competence-Based Vocational Education in the Netherlands." *Vocations and Learning* 4 (3): 191–210. doi:10.1007/s12186-011-9059-4
- Suvedi, M., R. Ghimire, and T. Channa. 2018. "Examination of Core Competencies of Agricultural Development Professionals in Cambodia." *Evaluation and Program Planning* 67: 89–96. doi:10.1016/j.evalprogplan.2017.12.003
- Unay-Gailhard, I., M. Bavorová, Z. Bednaříková, and E. V. Ponkina. 2019. "I Don't Want to Work in Agriculture!" The Transition from Agricultural Education to the Labor Market in Rural Russia." *Rural Sociology* 84 (2): 315–349. doi:10.1111/ruso.12245
- Van den Berg, N., and E. De Bruijn. 2009. *The Glass is Filling up. Knowledge About the Design and Effects of Competence-Based Vocational Education. A Review Study*. Amsterdam/ 's Hertogenbosch: ECBO.
- Wesselink, R., H. J. A. Biemans, J. T. M. Gulikers, and M. Mulder. 2017. "Models and Principles for Designing Competence-Based Curricula, Teaching, Learning and Assessment." In *Competence-based Vocational and Professional Education: Bridging the Worlds of Work and Education. (Technical and Vocational Education and Training: Issues, Concerns and Prospects; Vol. 23)*, edited by M. Mulder, 533–553. Cham, Switzerland: Springer International Publishing.
- Wesselink, R., H. J. Biemans, M. Mulder, and E. R. Van den Elsen. 2007. "Competence-Based VET as Seen by Dutch Researchers." *European Journal of Vocational Training* 40 (1): 38–51.
- Wesselink, R., A. M. Dekker-Groen, H. J. Biemans, and M. Mulder. 2010. "Using an Instrument to Analyse Competence-Based Study Programmes: Experiences of Teachers in Dutch Vocational Education and Training." *Journal of Curriculum Studies* 42 (6): 813–829. doi:10.1080/00220271003759249
- Wilkes, J., and A. Burns. 2019. "A Decade of Agriculture Graduates' Employability and Career Pathways." *International Journal of Innovation in Science Mathematics Education* 27 (4): 2–13.
- Witteveen, L., M. Put, and C. Leeuwis. 2010. "Learning About Complex Multi-Stakeholder Issues: Assessing the Visual Problem Appraisal." *The Journal of Agricultural Education and Extension* 16 (1): 39–54. doi:10.1080/13892240903533145