

# Virtual Communities of Practice to Promote Digital Agriculturists' Learning Competencies and Learning Engagement: Conceptual Framework

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**Abstract**—Virtual Communities of Practice (VCoPs) are networks of people who share a common interest and a desire to learn together in the same domain via ICT. The limitations of the existing concepts for developing VCoPs in general contexts are not explained in terms of the integration between virtual learning technologies and digital learning strategies used to promote expected learning outcomes in the agricultural sector. This research aims to propose the conceptual framework for developing the Virtual Communities of Practice through Digital Inquiry (VCoPs-DI Model) to promote digital agriculturists' learning competencies and engagement. The research methodology was divided into three stages: the first stage involves a literature review for document analysis and synthesis, the second stage involves constructing the conceptual framework, and the third stage involves evaluating the content validity index. The key results showed that the developed conceptual framework has three parts: (1) The fundamentals of concept formation were divided into four concept bases: (1.1) Communities of Practice (CoPs), (1.2) Virtual Learning Environments (VLEs), (1.3) Digital Learning Resources (DLRs), and (1.4) Critical Inquiry Method; (2) The identification of the manipulated variable was divided into two compositions: (2.1) VCoPs and (2.2) Digital Inquiry (DI); (3) The identification of the dependent variable was divided into two compositions: (3.1) Digital agriculturists' learning competencies, and (3.2) learning engagement. Findings from an expert's review show that the scale levels of the content validity index (SCVI) were 0.958. We anticipate that our conceptual framework could be used for reference as part of the design and development of the VCoPs model to promote learning in the agricultural sector.

**Keywords**—VCoPs; digital inquiry; digital agriculture; learning competencies; learning engagement

## I. INTRODUCTION

Many global issues, such as climate change, lack of natural resources, demographics, and food waste, are putting pressure on the overall sustainability of agricultural systems. In this digital age, traditional agricultural management approaches need to be radically transformed so that smart technologies can contribute to innovation and redesign the entire value chain to maintain the sustainability of the agricultural sector. Current advances in advanced digital technology tend to lead to the

fourth phase of the revolution in the agricultural sector, known as "Agriculture 4.0" [1].

Agriculture 4.0 in developing countries is characterized by low technological levels of technology. The main reasons for this are the high cost of advanced digital technology (e.g., 5G, cloud computing, Internet of Things, blockchain, data mining, artificial intelligence, augmented reality, virtual reality, etc.) and the dynamics of today's business environment. However, these types of systems are becoming increasingly important, especially for achieving the Sustainable Development Goals (SDGs), which are related to three specific goals: Zero Hunger (Goal 2), Clean Water and Sanitation (Goal 6), and Life on Land (Goal 15). One alternative to achieving this goal is to adopt Logistics 4.0 technologies and educational technology. This is because these technologies can address issues such as nutrition, food safety, and soil and water conservation [2].

Information and communication technologies (ICT), such as the Internet, e-mail, and videoconferencing, have made the human learning process more efficient and productive in terms of daily operations. However, ICT not only improves people's daily productivity but also supports the ability to share that information and tacit knowledge with both internal and external organizations as well as social networks. One of the most popular ways to share large amounts of information and tacit knowledge is through an informal learning environment such as a Community of Practices (CoPs) [3] or Virtual Community of Practices (VCoPs) [4].

Digital learning resources are characterized by being virtual spaces that learners can access through information and communication technology. Managing learning resources in a virtual space requires consideration of the media exposure and lifestyle of digital learners. Digital learning resources can be classified into five categories [5–7]: 1) search engines and translation tools; 2) data and storage management tools; 3) content creation, presentation, and publishing tools; 4) distance learning tools; 5) social networking tools.

The limitations of existing concepts for the development of VCoPs in general contexts are not explained concerning the integration between virtual learning technologies and digital

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learning strategies used to promote expected learning outcomes in the agricultural sector for digital learners of all ages, regardless of their background and geographical location [3–4]. Thus, this research paper focused on proposing the conceptual framework for the development of the Virtual Communities of Practice through Digital Inquiry (VCoPs-DI Model) to promote digital agriculturists' learning competencies and learning engagement that can be used for reference in the design and development of the VCoPs model by integration between virtual learning technologies and digital learning strategies used to promote learning in the agricultural sector in the future.

## II. RESEARCH OBJECTIVES

1. To synthesize the conceptual framework for the development of the Virtual Communities of Practice through Digital Inquiry (VCoPs-DI Model) to promote digital agriculturists' learning competencies and learning engagement.
2. To construct the conceptual framework for the development of the VCoPs-DI Model to promote digital agriculturists' learning competencies and learning engagement.
3. To validate the conceptual framework for the development of the VCoPs-DI Model to promote digital agriculturists' learning competencies and learning engagement.

## III. RESEARCH METHODOLOGY

Stage I: Synthesis of the conceptual framework for the development of the VCoPs-DI Model to promote digital agriculturists' learning competencies and learning engagement. This stage was a qualitative research method based on a literature review. The researchers conducted studies, analyzed, and synthesized research papers that included Communities of Practice (CoPs), Virtual Learning Environments (VLEs), Digital Learning Resources (DLRs), the Critical Inquiry Method, Digital Agriculturists' learning competencies, and learning engagement from ERIC, Scopus, and Web of Science online databases published during 2015–2021 using content analysis [8] of text data in research papers.

Stage II: Construct the conceptual framework [9] for the development of the VCoPs-DI Model to promote digital agriculturists' learning competencies and learning engagement was developed by conducting studies, analysis, and synthesis through content analysis in stage I.

Stage III: Validation of the conceptual framework for the development of the VCoPs-DI Model to promote digital farmers' learning competencies and learning engagement was an expert judgement by five educational technology experts on a four-point Likert scale for the Content Validity Index (CVI) [10] The scale used in this study was used and responses included 1 = Not Relevant, 2 = Somewhat Relevant, 3 = Relevant, and 4 = Highly Relevant. Researchers recommend that a scale with excellent content validity should be composed of I-CVIs of 0.78 or higher and S-CVI/UA and S-CVI/Ave of 0.8 and 0.9 or higher, respectively.

## IV. RESEARCH FINDINGS

### A. The First Stage

- The results of the synthesis of components of Communities of Practice (CoPs) as shown in Table I [11-18]:

TABLE I. RESULTS OF THE SYNTHESIS OF COMPONENTS OF CoPs

Components of CoPs	Reference							
	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
1. Purpose/ Vision/ Mission	✓	✓	✓	✓	✓	✓	✓	✓
2. Participant/ Members/ People	✓	✓	✓	✓	✓	✓	✓	✓
3. Perspective/ Paradigm/ Shared values/ Negotiation	✓	✓	✓	✓	✓	✓	✓	✓
4. Processes/ Methods/ Activity	✓	✓	✓	✓	✓	✓	✓	✓
5. Platforms/ Technology	✓	✓	✓	✓	✓	✓	✓	✓
6. Products/ Productivity	✓	✓	✓	✓	✓	✓	✓	✓

According to the result of the synthesis indicated in Table I, it can be summarized that the CoPs comprise six components: 1) purpose, 2) participants, 3) perspective, 4) processes, 5) platforms, and 6) products.

- The results of the synthesis of components of Virtual Learning Environments (VLEs) as shown in Table II [19-26]:

TABLE II. RESULTS OF THE SYNTHESIS OF COMPONENTS OF VLEs

Components of VLEs	Reference							
	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]
1. Learning aims and objectives	✓	✓	✓	✓	✓	✓	✓	✓
2. Learning contracts			✓	✓	✓	✓		
3. Learning issues/ Topic / Agenda	✓	✓	✓	✓	✓	✓	✓	✓
4. Learning activities/ Task	✓	✓	✓	✓	✓	✓	✓	✓
5. Learning technologies	✓	✓	✓	✓	✓	✓	✓	✓
6. Learning assessments	✓	✓	✓	✓	✓	✓	✓	✓

According to the result of the synthesis indicated in Table II, it can be summarized that the VLEs comprises six components: 1) learning aims, 2) learning contracts, 3) learning issues, 4) learning activities, 5) learning technology and 6) learning assessments.

- The results of the synthesis of components of Digital Learning Resources (DLRs) as shown in Table III [5, 7, 27-29]:

TABLE III. RESULTS OF THE SYNTHESIS OF COMPONENTS OF DLRs

Components of DLRs	Reference				
	[5]	[7]	[27]	[28]	[29]
1. Search engine and translation tools	✓	✓	✓	✓	✓
2. Data and storage management tools	✓	✓	✓	✓	✓
3. Content creation, presentation, and publishing tools	✓	✓	✓	✓	✓
4. Distance learning tools	✓		✓	✓	✓
5. Social networking tools	✓	✓	✓	✓	✓

According to the result of the synthesis indicated in Table III, it can be summarized that the DLRs, comprise five components: 1) search engine and translation tools, 2) data and storage management tools, 3) content creation, presentation, and publishing tools 4) distance learning tools, and 5) social networking tools.

- The results of the synthesis of components of the critical inquiry method as shown in Table IV [30-32]:

TABLE IV. RESULTS OF THE SYNTHESIS OF COMPONENTS OF CRITICAL INQUIRY METHOD

Components of critical inquiry method	Reference		
	[30]	[31]	[32]
1. Observing/ Exploring and questioning	✓	✓	✓
2. Information seeking/ Information searching/ Problem-posing	✓		✓
3. Knowledge building/ Knowledge gathering/ Knowledge construction/Taking action	✓	✓	✓
4. Creative communicating	✓	✓	✓
5. Knowledge sharing/ Knowledge exchange	✓	✓	✓

According to the result of the synthesis indicated in Table IV, it can be summarized that the critical inquiry method comprises five components: 1) exploring and questioning, 2) information searching, 3) knowledge building, 4) creative communicating and 5) knowledge sharing.

- The results of the synthesis of components of the digital agriculturists' learning competencies as shown in Table V [33-38].

According to the result of the synthesis indicated in Table V, it can be summarized that the digital agriculturists' learning competencies comprise six components: 1) seeking lifelong learning opportunities, 2) self-concept of being an effective digital learner, 3) initiative, creativity, and independent learning concerning digital agriculture learning issues, 4) self-responsibility in digital agriculture occupations, 5) optimistic about agriculture's evolution in the digital era, 6) problem-solving and decision-making concerning agriculture practices in the digital era.

TABLE V. RESULTS OF THE SYNTHESIS OF COMPONENTS OF DIGITAL AGRICULTURISTS' LEARNING COMPETENCIES

Components of Digital agriculturists' learning competencies	Reference
1. Seeking lifelong learning opportunities	[33], [34], [35], [36], [37]
2. Self-concept of being an effective digital learner	[33], [34], [36]
3. Initiative, creativity and independent learning concerning digital agriculture learning issues	[33], [34], [35], [38]
4. Self-responsibility in digital agriculture occupations	[33], [34], [35], [36], [37], [38]
5. Optimistic about agriculture evolution in the digital era	[33], [34], [35], [36], [37], [38]
6. Problem solving and decision-making concerning agriculture practices in the digital era.	[33], [34], [35], [36], [37]

- The results of the synthesis of components of the learning engagement as shown in Table VI [39-41]:

TABLE VI. RESULTS OF THE SYNTHESIS OF COMPONENTS OF LEARNING ENGAGEMENT

Components of learning engagement	Reference		
	[39]	[40]	[41]
1. Behavioral engagement	✓	✓	✓
2. Emotional engagement	✓	✓	✓
3. Cognitive engagement	✓	✓	✓

According to the result of the synthesis indicated in Table VI, it can be summarized that learning engagement comprises three components: 1) behavioral engagement, 2) emotional engagement, 3) cognitive engagement.

*B. The Second Stage*

- The results of the construction of the conceptual framework for the development of the Virtual Communities of Practice through Digital Inquiry (VCoPs-DI Model) to promote digital agriculturists' learning competencies and learning engagement are in Fig. 1.

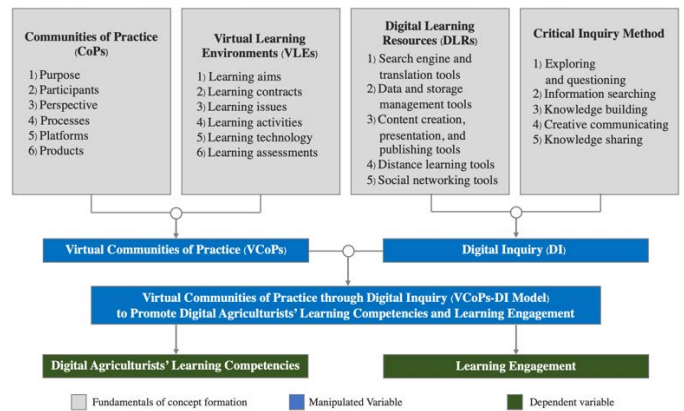


Fig. 1. Conceptual Framework.

From Fig. 1, this conceptual framework consists of the following three parts: (1) The fundamentals of concept formation were divided into four concept bases: a) Communities of Practice (CoPs), b) Virtual Learning Environments (VLEs), c) Digital Learning Resources (DLRs), and d) Critical Inquiry Method. (2) The identification of the manipulated variable was divided into two compositions: a) Virtual Communities of Practice (VCoPs), which has six elements: i) desire and passion for learning, ii) digital learning platforms, iii) decentralized learning contracts, iv) deep learning issues of practice, v) dynamic learning processes, vi) developmental learning assessments and b) Digital Inquiry (DI), which has five elements: i) exploring and questioning, ii) information searching, iii) knowledge building, iv) creative communicating, v) knowledge sharing. (3) The identification of the dependent variable was divided into two compositions: a) Digital agriculturists' learning competencies, and b) Learning engagement.

C. The Third Stage

The results of the validation of the conceptual framework for the development of the VCoPs-DI Model to promote digital agriculturists' learning competencies.

TABLE VII. RESULTS OF THE VALIDATION OF THE CONCEPTUAL FRAMEWORK FOR THE DEVELOPMENT OF THE VCoPs-DI MODEL TO PROMOTE DIGITAL AGRICULTURISTS' LEARNING COMPETENCIES

Evaluation Items	Experts					Number in Agreement	I-CVI	Meaning
	1	2	3	4	5			
<b>Part I: Fundamentals of concept formation</b>								
1. Communities of Practice (CoPs)	4	4	4	4	4	5	1.00	Valid
2. Virtual Learning Environments (VLEs)	4	4	4	4	4	5	1.00	Valid
3. Digital Learning Resources (DLRs)	4	4	4	4	4	5	1.00	Valid
4. Critical Inquiry Method	2	4	4	4	4	4	0.80	Valid
<b>Part II: Identification of manipulated variable</b>								
<b>1. Virtual Communities of Practice (VCoPs)</b>								
1) Desire and passion for learning	4	4	4	4	2	4	0.80	Valid
2) Digital learning platforms	3	4	4	4	4	5	1.00	Valid
3) Decentralized learning contracts	3	3	4	3	4	5	1.00	Valid
4) Deep learning issues of practice	3	3	4	3	4	5	1.00	Valid
5) Dynamic learning processes	3	3	3	3	4	5	1.00	Valid
6) Developmental learning assessments	2	3	4	3	4	4	0.80	Valid
<b>2. Digital Inquiry (DI)</b>								
1) Exploring and	4	4	4	4	4	5	1.00	Valid

questioning									
2) Information searching	4	4	4	4	4	5	1.00	Valid	
3) Knowledge building	3	4	4	4	4	5	1.00	Valid	
4) Creative communicating	3	4	4	4	4	5	1.00	Valid	
5) Knowledge sharing	4	4	4	4	4	5	1.00	Valid	
<b>Part III: Identification of dependent variable</b>									
<b>1. Digital agriculturists' learning competencies</b>									
1) Seeking lifelong learning opportunities	4	4	4	4	4	5	1.00	Valid	
2) Self-concept of being an effective digital learner	4	4	4	4	4	5	1.00	Valid	
3) Initiative, creativity and independent learning concerning digital agriculture learning issue	3	2	4	4	4	4	0.80	Valid	
4) Self-responsibility in digital agriculture occupations	4	4	4	4	4	5	1.00	Valid	
5) Optimistic about agriculture evolution in the digital era	4	4	4	4	4	5	1.00	Valid	
6) Problem-solving and decision-making concerning agriculture practices in the digital era	3	4	3	4	3	5	1.00	Valid	
<b>2. Learning engagement</b>									
1) Behavioral engagement	4	4	4	4	4	5	1.00	Valid	
2) Emotional engagement	4	4	4	4	4	5	1.00	Valid	
3) Cognitive engagement	4	4	4	4	4	5	1.00	Valid	
<b>S-CVI/Ave</b>							0.958	Excellent content validity	

From Table VII, based on the experts' review, the results of the validation of the conceptual framework for the development of the VCoPs-DI Model to promote digital agriculturists' learning competencies found that the item levels of the content validity index (I-CVI) were in the range of 0.80–1.00.

In addition, the scale levels of the content validity index (SCVI) also showed excellent content validity (S-CVI/Ave ≥ 0.90).

## V. CONCLUSION AND DISCUSSION

The proposed conceptual framework for developing the Virtual Communities of Practice through Digital Inquiry (VCoPs-DI Model) to promote digital agriculturists' learning competencies and learning engagement has three parts as follows:

1. The fundamentals of concept formation are divided into four concept bases: *a*) Communities of Practice (CoPs), *b*) Virtual Learning Environments (VLEs), *c*) Digital Learning Resources (DLRs), and *d*) Critical Inquiry Method.

2. The identification of the manipulated variable was divided into two compositions: *a*) Virtual Communities of Practice (VCoPs), which has six elements: *i*) desire and passion for learning, *ii*) digital learning platforms, *iii*) decentralized learning contracts, *iv*) deep learning issues of practice, *v*) dynamic learning processes, *vi*) developmental learning assessments and *b*) Digital Inquiry (DI), which has five elements: *i*) exploring and questioning, *ii*) information searching, *iii*) knowledge building, *iv*) creative communicating, *v*) knowledge sharing.

3. The identification of the dependent variable was divided into two compositions: *a*) digital agriculturists' learning competencies and *b*) learning engagement. The five educational technology experts evaluated the validity of the conceptual framework for developing the VCoPs-DI Model to promote digital agriculturists' learning competencies and found that the validity of the proposed conceptual framework has excellent content validity.

From the findings, we anticipate that our conceptual framework could be used for reference in the design and development of the VCoPs model to promote learning in the agricultural sector. We expect that our framework will lead to practical ways to incorporate agricultural communication to increase participation in VCoPs among the agricultural workforce, including for all ages in the digital transmedia era, towards the Digital Agriculturists' learning competencies, which include six expected learning outcomes: 1) Seeking lifelong learning opportunities, 2) Self-concept of being an effective digital learner, 3) Initiative, creativity and independent learning concerning digital agriculture learning issues, 4) Self-responsibility in digital agriculture occupations, 5) Optimistic about agriculture's evolution in the digital era, 6) Problem-solving and decision-making concerning agriculture practices in the digital era.

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