Utrecht University

**E-learning as a tool to feed the world**

An assessment of conditions under which e-learning contributes to sustainable agriculture in developing countries

Bachelor thesis
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## Preface

This thesis is about the contribution of e-learning to sustainable agriculture in developing countries. More specifically, the influencing conditions of e-learning, in this scope, will be discussed. This thesis is written for the Bachelor *Milieu- en maatschappijwetenschappen (*Environmental Sciences).

With a critical guidance of my teacher, I formulated the research question of this complex subject. The reason I chose this subject is my fascination for agriculture. I grew up on a little farm where year round almost all vegetables came from our own garden. With still a significant number of people starving from hunger in the world, I searched for a subject that can contribute in the eradication of hunger by improving sustainable agriculture.

I want to thank Carel Dieperink for the guidance during the turbulent process of formulating a suitable research question and the search for literature. Both were not easy in this quite unknown subject.
I also want to thank my friends and family, who supported me during this process and by giving me tips, feedback and answering all my questions. I especially want to thank my brother, Karst Schaap, who gave me some very important tips in writing scientific research.

 I hope you enjoy your reading,

Aafke Schaap
Utrecht, 30 July 2016

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# Abstract

Hunger is still an issue in the developing world. The eradication of hunger could be achieved by a combination of education and agriculture. This combination can be fulfilled by implementing e-learning in sustainable agriculture in developing countries. But the conditions of e-learning are not yet distinctly defined. This thesis researches the conditions under which e-learning contributes to sustainable agriculture in developing countries. The conditions are determined through a literature research. An analysis of Food and Agriculture Organization (FAO) documents shows the contribution of e-learning to sustainable agriculture in developing countries. The FAO represents this contribution as it is the key organisation in sustainable agriculture in developing countries. The found conditions for e-learning are: presence of ICT infrastructure, prompt response to problems, interaction among students, fair interaction (regarding women and the poor), the ability to use ICT and the ability to use internet.

The findings are submissive to some weaknesses, such as the high level of interpretation and the limited scientific literature provided. Follow-up research could make a distinction between the important social conditions and the important technical conditions (infrastructure) of e-learning. Social conditions, for example the duration of a course, could have an influence on the effectivity of an e-learning course.

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# 1. Introduction

Hunger is the number one risk for health issues worldwide (WFP, 2016). Even today, around 795 million people are malnourished. This means that 'one in nine people does not get enough food to be healthy and lead an active life' (WFP, 2016). Global action is needed, because it is urgent to fight hunger and malnutrition. Hunger and malnutrition 'continues to be a major health burden in developing countries´ (Müller & Krawinkel, 2005, p. 1).

According to Gartner (2010), many experts see education as great leverage and the 'key missing link' (Gartner, 2010, p. 1) to overcome hunger and poverty. Most education is focussed on primary education, even though educating adults is also of great importance. As the World Declaration on Education for All (1990) states: 'every person—child, youth and adult—shall be able to benefit from educational opportunities designed to meet their basic learning needs' (WorldBank I.-I. , 2010). Educations for adults contributes to technological and social development and thus empower the poor, which makes investments in education indispensable for developing regions in rural Africa (Duveskog, 2013).

Critics say that agriculture may play the same role as education, by creating a safe and equally divided food system (Farming First, 2009). The organization Farming First (2009) tries to reach a 'global coalition for sustainable agricultural development' (FarmingFirst, 2009) and sees agriculture as the key factor to reach sustainable development. Agriculture should be sustainably practised in the next decade 'to sustainably produce more food from less land through more efficient use of natural resources and with minimal impact on the environment in order to meet growing population demands' (Hobbs, Sayre, & Gupta, 2008, p. 1). The Food and Agriculture Organization (FAO), an organ of the United Nations (UN), is a key organization in the eradication of hunger in developing countries, by managing and supporting sustainable use of natural resources (FAO1, 2016).

Agriculture and education are crucial elements of fighting hunger and poverty. These elements could be combined and lead to education about sustainable agricultural development. By providing scientifically sound information and resources, the capacity for innovation and communication of all involved parties could be built in the educational system (Pretty, 1995). Improving education can contribute to the eradication of hunger and malnutrition by raising the productivity and sustainability of food production and agriculture, by the adaptation of new technologies, which largely depend on human knowledge and skills (Behrman, Alderman, & Hoddinott, 2004).

E-learning is a promising education method. E-learning is an example of filling the knowledge gap in order to make an important contribution by establishing a connection between theory and practice (Cooper & Spencer-Dawe, 2006). This education method is suitable for sustainable agricultural development as 'it has the capacity to enhance learning and expand access to education and training in agriculture and natural resource management at the global, regional and local levels' (Atkinson, Beniest, & Rao, 2006, p. 155). E-learning still faces some challenges. Examples of these challenges are lack of technical support, lack of interaction and lacking ICT skills (Sife, Lwoga , & Sanga, 2007). To tackle these challenges, it is important to make the conditions for e-learning clear. These conditions arise from factors. Conditions contribute to successful e-learning, which can be seen as the development of an interactive education system, which serves its goal (Zhang, Zhao, Zhou, & Nunamaker, 2004; Andersson, 2009).

Concluding from previous research as described above, e-learning is a promising way of education. E-learning can be implemented in the eridication of hunger by educating sustainable agriculture in developing countries. However, e-learing faces some challenges. To tackle these challenges it is important to analyse the conditions of e-learning. For this reason the stated problem for this thesis is lack of knowledge about the needed conditions for e-learning contributing to sustainable agriculture in developing countries. In line with the stated problem, the goal of this thesis is to explore conditions regarding e-learning contribution to sustainable agriculture in developing countries. This contributes to the development of better education systems in achieving sustainable agriculture and the eridication of hunger. Conditions for e-learning, are only generally researched. Conditions for e-learning applicated in sustainable agriculture has not been researched before.

The importance and relevance to find a solution for the stated problem is the goal to eradicate hunger in the developing world. Food production and agriculture play an important role in eradicating hunger. Knowledge of the important conditions of e-learning contributing to sustainable agriculture can improve sustainable agriculture projects in the light of sustainable development. The results of this thesis can be used to improve e-learning as an educational method, contributing towards sustainable development policies and the implementation of these policies.

Resulting from the knowledge gap and goal, the stated research question for this thesis is formulated as follows: **under which conditions can e-learning contribute to sustainable agriculture in developing countries?**
First, it is important to distinguish the general e-learning conditions. Second, it is important to determine under which conditions e-learning contributes to sustainable agriculture in developing countries. Given the role of the FAO in this subject, this key organization will be used as guideline. The e-learning conditions distinguished and

recognised by the FAO can be seen as important for the contribution to sustainable agriculture. To determine both political and practical implemented e-learning conditions by the FAO, two documents are analysed.

In short, the sub questions will be:

1. Which general e-learning conditions can be found in the literature?
2. Which conditions are distinguished by the FAO in a policy reflection?
3. Which conditions are distinguished by the FAO, in a project report?

This thesis is structured as follows: concepts which need further definition will be explained in the second section. The used methodology will be discussed in section 3. Section 4. will illustrate the general successful e-learning conditions in sustainable agriculture and developing countries. Section 5. and 6. give the results of the analysis of an FAO policy reflection and an FAO project report. Finally, a discussion (7.) and conclusion (8.) concludes this thesis.

## 2. Defining concepts

In this chapter the different elements, related to the goal, used concepts and definitions of this thesis will be explained.

### 2.1 Developing Sustainable Agriculture

#### 2.1.1 Sustainable development

Sustainable development is seen as the consideration of ecological, economic and social aspects in development. These factors are seen as the 'internal factors': 'social, political, ecological, or economic' (Holling, 2001, p. 390). Critics of sustainable development say that defining sustainability is impossible because it relates strongly to time and place dimensions (Pretty, 1995). A relatively new theory, called the 'Two Tiered Sustainability Equilibria', is a theory which includes and relates economic, environmental and social aspects, but also time and place (Lozano, 2008). There are theories which include all known aspects of sustainability, however to prevent more complexity, this thesis does not take time and place into consideration

#### 2.1.2 Sustainable agriculture

A part of sustainable development is sustainable agriculture where the 'development of sustainable agriculture must accompany advances in the sustainability of energy use, manufacturing, transportation and other economic sectors that also have significant environmental impacts' (Tilman, Cassman, Matson, Naylor, & Polasky, 2002, p. 671). This definition relates to the internal factors of sustainable development described by Holling (2001). The world is in need for sustainable agriculture, by

giving it a new, broad and public order (Ikerd, 1993). Sustainable agriculture should be based on the development of an efficient and productive food and fibre system and 'in addition is ecologically sound, economically viable, and socially acceptable' (Ikerd, 1993, p. 148).

Sustainable agriculture takes several principles in account, which are mentioned by Farming First (2009) and FAO (FAO2, 2016). Both sets of principles can be summarized as: safeguard and efficient use of natural resources, improving knowledge by sharing and research, access to market, protection of harvest and improving resilience of rural livelihoods (Farming First, 2009; FAO2, 2016).

### 2.1.3 Sustainable agriculture development

The development of sustainable agriculture needs to consider the above-mentioned principles.

## 2.2. E-learning

Welsh, Wanberg, Brown and Simmering (2003) describe e-learning as follows: 'E-learning can be defined as the use of computer network technology, primarily over an intranet or through the internet, to deliver information and instruction to individuals' (Welsh et al., 2003). E-learning can be used at schools, classes and at home. For this thesis, multiple applications of e-learning for adults will be viewed. All methods will be discussed since it is not clear which form of e-learning is the most common in developing countries or agriculture. E-learning for adults is designed according to certain characteristics. Learning for adults should focus on problem solving, the benefits of learning the particular subject and seeing the immediate value of the course content (Welsh et al., 2003).

Promising results can already be seen in healthcare education (Cooper & Spencer-Dawe, 2006) and developing countries (Sife et al., 2007). E-learning has multiple advantages: great information access and communication via ICT, increasing teamwork and partnership, and great cost-benefit by teaching great numbers of students. E-learning can also easily adapt pedagogical improvements, in graphic design, simulations and virtual experiences (Sife et al., 2007; Welsh et al., 2003).

## 3. Methodology

The first sub question 'Which general e-learning conditions can be found in the literature?' was answered by a literature review. The used literature was found by

using Scopus and Google Scholar. The used search terms were 'e-learning factors', 'e-learning conditions' and 'e-learning challenges'. Also the terminology of 'e-learning factors developing countries' and 'e-learning factors agriculture' was used. All terms gave sufficient results. The final selection of articles was done by its purpose; the contribution to agriculture in developing countries. This selection means that scientific articles, purely focused on technical aspects, satisfaction in e-learning (excludes the satisfaction of needed conditions), and specific case studies, were excluded from this thesis.

Four articles met the aforementioned selection criteria. These articles formed the base for the overview of e-learning factors. These factors are synthesized in an overview, which led to the related conditions. Knowledge of the influencing e-learning factors is important, to give a general overview of the related subjects of e-learning. However, these e-learning factors did not give a sufficient image of how these factors influence e-learning success. Formulating e-learning conditions can be a guide to successful or effective e-learning implementation. These conditions are inspired by scientific literature, which are found by using the same method as described above. However, these articles were not selected for the overview of factors, because of a lack of clearly defined factors. The overview of e-learning conditions is used as base for the analysis of the FAO documents. This overview provides also the theoretical framework.

The second sub question: 'which conditions are distinguished by the FAO in a policy reflection?' and third sub question: 'which conditions are distinguished by the FAO in a project report?' are answered by determining the conditions in FAO documents. The used documents were selected through searching Google, the website of the United Nations and related organisations. The used terms were 'e-learning policy agriculture' and 'e-learning project agriculture'. The choice for the FAO documents was made, because the scope of this thesis is sustainable agriculture. The FAO commits to sustainable agriculture and sustainable food production development. This commitment should give a sufficient overview of the e-learning conditions mentioned by the FAO and therefore give an impression of the contribution of e-learning in sustainable agriculture in developing countries. Given the limited time and resources, this method is chosen.

The FAO policy reflection is chosen for its broad overview of developments in e-learning in agriculture in 10 years. This should give a sufficient view on important conditions contributing to sustainable agriculture.
The FAO project report was selected because it is one of the few project reports about e-learning. By searching Google for e-learning agriculture projects, the World Bank gave a list of funded projects. However, proper documentation of these projects was

not published. For this reason, a FAO status report of an e-learning project in Asia was chosen.

The analysis of the FAO documents is done by a review of the FAO documents. The FAO documents can confirm the found conditions by an empirical research. By reading the documents, there is determined whether the conditions were distinguished or not. Also in which way the FAO addresses these conditions is differentiated.

This thesis is based on a literature research, because it provides a clear overview of the previously done research regarding e-learning in combination with agriculture and developing countries. Furthermore, due to the lack of e-learning data a survey research is not possible which strengthens the choice of a literature review (Andersson, 2009).

# 4. Theoretical framework

This chapter gives an overview of e-learning conditions retrieved from the literature. The relevant literature will be summarized. The found factors will be synthesized in e-learning conditions. The results will answer the first sub question: 'Which general e-learning conditions can be found in the literature?'.

## 4.1 E-learning factors

### Valsamidis, Petasakis, Kazanidis and Karakos (2011)

The first article defines the application of e-learning in agricultural education and presents related factors of e-learning in a framework. This framework is applied in three different stages: 1) platform development 2) development and delivery of courses and 3) continuous evaluation and revision (Valsamidis, Petasakis, Kazanidis, & Karakos, 2011). For this thesis, the first stage is the most important stage, because it can be seen as the first step to implementing e-learning.

The platform development stage is defined as 'the development of an innovative e-learning platform' (Valsamidis et al., 2011, p. 377). The related factors to the stage 'platform development' are divided in two categories: for both educators as learners' satisfaction of needs, as presented in the figure 1.

| Category: | Satisfy educators needs by: | Satisfy learners' needs by: |
|---|---|---|
| Factors: | Provide integrated authoring tools that let educators to easily develop online courses, | Use simple and familiar language for them, |
| | Let educators upload specific educational documents and publish announcements to their learners, | Have minimalistic design without extra options that reduce learners memory load, |
| | Record user actions and provide useful feedback to educators for both students and their courses. | Provide appropriate documentation and help whenever needed, |
| | | Motivate learners to their study, |
| | | Let learners keep notes on their courses, |
| | | Provide tools for communication between learners and educators such as forums, chat rooms etc. |

**Figure 1. Categorization of factors, addressing e-learning in agriculture in the stage of platform development (Valsamidis et al., 2011).**

The defined factors are clearly defined as stated above. Remarkable is the categorization of factors by Valsamidis et al. (2011). Only educators and learners are included. There is a minimal focus on the technical aspects of e-learning implementation, which could also have an important role in the stage 'platform development'. This could have influence, especially in developing countries, where technical aspects can be an issue.


### Bhuasiri, Xaymoungkhoun, Zo, Rho and Ciganek (2012)

Bhuasiri et al. (2012) identify the success factors of e-learning in developing countries 'that influence the success of e-learning systems' (Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek, 2012, p. 843). These factors are retrieved 'from the literature and compares the relative importance among two stakeholder groups in developing countries, ICT experts and faculty' (Bhuasiri et al., 2012, p. 834). These elements are divided into six dimensions and the related factors. The most important dimension is seen as *learners' characteristics* for ICT developers, where *infrastructure and system quality* were the most important from a faculty perspective (Bhuasiri et al., 2012). The implementation of these success factors should lead to a better learning system in developing countries.

CSF definitions.

| Dimension | Factor | Definition |
| --- | --- | --- |
| Learners' characteristics | Computer self-efficacy | One's perceptions of his or her ability to use computer to complete a specific tasks |
| | Internet self-efficacy | One's perceptions of his or her ability to interact with the Internet |
| | Attitude toward e-learning | Learners' impression of participating in e-learning activities through computer usage |
| Instructors' characteristics | Timely response | Whether students perceive that instructors responded promptly to their problems |
| | Self-efficacy | One's belief about the ability to perform certain tasks successfully |
| | Technology control | The extent to which the learner can control the instructional presentation. Control is a continuum enabling the design of varying degrees of learner control |
| | Focus on interaction | The degree of contact and educational exchange among learners and between learners and instructors |
| | Attitude toward student | Instructors provide various forms of office hours and methods of contacts for the students |
| | Interaction fairness | The extent to which the learner feels having been treated fairly regarding his or her online interaction with the instructor throughout the web-based learning process |
| Institution and Service Quality | Computer training | The amount of specialized instruction and practice that is afforded to the learner to increase the learner's proficiency in utilizing the computer capability that is unavailable |
| | Program flexibility | Ability to arrange the course to serve a student's need to complete the entire degree program |
| Infrastructure and System Quality | Internet quality | The quality of the Internet that can be measured by transmission rate, error rates, and other characteristics |
| | Reliability | Concerned with the degree of accuracy, dependability, and consistency of the information |
| | Ease of use | Refers to the degree to which the prospective user expects the use of the e-learning system to be free of effort |
| | System functionality | The perceived ability of an e-learning system to provide flexible access to instructional and assessment media |
| | System interactivity | The degree a system allows for interaction |
| | System response | The time that elapses from a user action until feedback is received from the system |
| Course and Information Quality | Course quality | The quality of writing, images, video, or flash to meets generally accepted standards of semantics, style, grammar, and knowledge |
| | Relevant content | The degree of congruence between what the learners wants or requires and what is provided by the information, course content, and services |
| | Course flexibility | Learners' perception of the efficiency and effects of adopting e-learning in their working, learning, and commuting hours |
| Extrinsic Motivation | Perceived usefulness | The degree to which a person believes that using e-learning system would enhance his or her learning performance |
| | Clear direction | A direction that free from confusion or ambiguity |

**Figure 2. E-learning success factors and definitions, for developing countries by Bhuasiri et al. (2012)**

Notable is that Bhuasiri et al. (2012) gives a broad variety of clear defined factors. It seems a sufficient overview of success factors in developing countries in e-learning implementation. Both technical as pedagogical aspects are taken into account.

**Andersson & Grönlund (2009)**

The second article, addressing e-learning in developing countries, is written by Andersson and Grönlund (2009). The challenges found by Andersson and Grönlund (2009) are divided in the following categories; individual, course, contextual and technological. Andersson and Grönlund (2009) state that most research about e-learning only focus on two out of four challenges. They provide a framework including all four challenges and additional factors. This research concludes that some of the challenges are not treated with urgency in developing countries (Andersson & Grönlund, 2009). Challenges could possibly decelerate the implementation of e-learning in developing countries, which slows e-learning development regarding the eradication of hunger.

| Individual challenges | Student |
|---|---|
| | • Motivation |
| | • Conflicting priorities |
| | • Economy |
| | • Academic confidence |
| | • Technological confidence |
| | • Social support (support from home and employers) |
| | • Gender |
| | • Age |
| | |
| | Teacher |
| | • Technological confidence |
| | • Motivation and commitment |
| | • Qualification and competence |
| | • Time |
| Course challenges | Course design |
| | • Curriculum |
| | • Pedagogical model |
| | • Subject content |
| | • Teaching and Learning Activities |
| | • Localization |
| | • Flexibility |
| | |
| | Support provided |
| | • Support for students from faculty |
| | Support for faculty |
| Contextual challenges | Organisational |
| | • Knowledge management |
| | • Economy and funding |
| | • Training of teachers and staff |
| | |
| | Societal/Cultural |
| | • Role of teacher and student |
| | • Attitudes on e-learning and IT |
| | • Rules and regulations |
| Technological challenges | • Access |
| | • Cost |
| | • Software and interface design |
| | • Localization |

**Figure 3. E-learning challenges in developing countries according to Andersson and Grönlund (2010)**

The presented factors could help to overcome the challenges. Moreover, these factors of the challenges are reasonable general. The presented factors describe the influencing factors of the challenges, without giving direction to overcome these challenges.

Striking is the focus on pedagogical aspects of e-learning. Again, the technological aspects are minimally represented. Notable thus, is the focus on pedagogical importance of e-learning implementation in developing countries. In addition, the fact that these factors are focused on challenges could lead to a different influence on e-learning.

### Zhang, Wen, Li, Fu and Cui (2010)

The last selected article by Zhang, Wen, Li, Fu, and Cui (2010) explores the key factors of e-learning adoption in China. The 33 factors found are analysed with a quantitative analysis of the relation 'between the perceived innovative attributes and adoption intention of e-learning' (Zhang, Wen, Li, Fu, & Cui, 2010, p. 1428). This article concludes that some of the found factors have more influence on the adoption of e-learning than others.



| First index | Second index | Third index |
|---|---|---|
| E-learning Adoption | Respondents' perception on relative advantage | Pricing (Q1)<br>Flexibility (Q2)<br>Personal control (Q3)<br>Access (time) (Q4)<br>Interaction (Q5)<br>Increase interest (Q6)<br>Increase efficiency (Q7)<br>Avoid intimidation (Q8)<br>Access (place) (Q9)<br>Social prestige (Q10)<br>General advantages perceived (Q11) |
| | Respondents' perception on compatibility | Education quality (Q12)<br>Degree recognition (Q13)<br>Personal needs (Q14)<br>No conflict with the traditional learning (Q15)<br>Chinese government policy (Q16)<br>IT infrastructure in China (Q17)<br>Web security and piracy issue (Q18) |
| | Respondents' perception on complexity | IT equipment (Q19)<br>Level of computer knowledge (Q20)<br>Easiness of use (Q21)<br>Easiness of participation (Q22)<br>Awareness of technology required (Q23)<br>Access to technology (Q24)<br>Self-control ability (Q25) |
| | Respondents' perception on trialability | Trialability of course before taking it (Q26)<br>Trialability of course demos from different suppliers (Q27)<br>Opportunities to talk to e-learners (Q28)<br>Trialability of all (Q29) |
| | Respondents' perception on observability | Opportunities to observe other e-learners experiences (Q30)<br>Opportunities to know e-learning and its benefits (Q31)<br>Benefits are apparent (Q32)<br>Benefits can be demonstrated by e-learners (Q33) |

**Figure 4. Used factors in the quantitative analysis of Zhang et al. (2010)**

Resulting from this research the factors with a relative advantage for e-learning implementation perceived are: pricing, flexibility, personal control, access (time), interaction, increase interest, increase efficiency, avoid intimidation, access (place), social prestige and general advantages (Zhang et al., 2010). These factors are also relevant for this thesis. Notable is that technical aspects are present, where the other used articles mainly focus on the pedagogical background. For instance, pricing concerns both technical aspects and individual aspects. However, this article determines factors for e-learning adaptation and implementation can be seen as part of the adaptation of e-learning.

## 4.2 Results literature research

The found (success) factors of e-learning are presented in the summaries in the previous section. The factors of Valsamidis et al. (2011), Bhuasiri et al. (2012) and Andersson and Grönlund (2009) are divided in categories or dimensions. These categories all contain the category educators and learners according to the categorization of Valsamidis et al. (2011). Zhang et al. (2010) did not present the

found factors in categories. In the integration of the found factors, the factors of educators and learners will be used, because these categories are important in the stage of platform development. The factors found by Zhang et al. (2010) with a relative advantage influencing e-learning adoption will be used.

Above stated summaries of factors per author, are merged in the overview, as can be seen in figure 5. The factors found by the other authors are compared with the factors of Valsamidis et al. (2011).

| Author: | Valsamidis et al. (2011) | Bhuasiri et al. (2012) | Anderson et al. (2009) | Zhang et al. (2010) |
|---|---|---|---|---|
| Category: | **Satisfy educators needs by:** | - | - | - |
| Factors: | 1. Provide integrated authoring tools that let educators to easily develop online courses, | ✓ | ✓ | ✓ |
| | 2. let educators upload specific educational documents and publish announcements to their learners, | ✓ | ✓ | ✓ |
| | 3. Record user actions and provide useful feedback to educators for both students and their courses. | ✓ | ✓ | ✓ |
| Category: | **Satisfy learners' needs by:** | - | - | - |
| Factors: | 1. use simple and familiar language for them, | ✓ | ✓ | ✓ |
| | 2. have minimalistic design without extra options that reduce learners memory load, | ✗ | ✗ | ✗ |
| | 3. provide appropriate documentation and help whenever needed, | ✓ | ✓ | ✓ |
| | 4. motivate learners to their study, | ✗ | ✓ | ✓ |
| | 5.let learners keep notes on their courses, | ✗ | ✓ | ✗ |
| | 6. Provide tools for communication between learners and educators such as forums, chat rooms etc. | ✓ | ✓ | ✓ |

**Figure 5. Overview of found e-learning factors in literature research, categorised according to Valsamidis et al. (2011)**

As can be seen in figure 5., almost all factors are supported by the four selected articles. Though, *have minimalistic design without extra options that reduce learners memory load* (Bhuasiri et al., 2012) and *let learners keep notes on their courses* (Bhuasiri et al., 2012) are not supported by a majority of the selected articles. Remarkable is that Andersson and Grönlund (2009) has the most matching factors. An explanation for this fact can be that Andersson and Grönlund (2009) mentions

mainly pedagogical factors, which fit in the more pedagogical focus of Valsamidis et al. (2011).

The authors of the articles all focus on pedagogical or technological factors. Striking is that most factors are related to education. This can be explained by the focus of Valsamidis et al. (2011) on these aspects of e-learning. Nevertheless, all authors present clear and convincing factors.

It is notable that the e-learning factors found in the literature are vague and broad. These factors need clear defined conditions, to give a direction towards successful e-learning or contribution to, in this case, sustainable agriculture in developing countries. None of the factors refers to agriculture, let alone sustainable agriculture. Also, these factors do not refer to developing countries. However, there are no conflicting factors found. The same applies for conflicting definitions of factors. However, some authors used a specific definition per factor, where others did not. To be consistent, this thesis is in need of clearly defined factors. The definitions by Bhuasiri et al. (2012) will be used because these are the most clearly defined. In addition, these factors match the factors used by Valsamidis et al. (2011). Some of the defined factors by Valsamidis et al. (2011) cover more factors than those used by Bhuasiri et al., (2012). To illustrate the division of factors of Bhuasiri et al. (2012) according to the factors of Valsamidis et al. (2011) figure 6. is designed.

| Author: | Valsamidis et al. (2011) | Bhuasiri et al. (2012) |
|---|---|---|
| Category: | **Satisfy educators' needs by:** | |
| Factor: | 1. Provide integrated authoring tools that let educators to easily develop online courses, | Technology control |
| | 2. let educators upload specific educational documents and publish announcements to their learners, | Attitude toward students; Self-efficacy; Timely Response |
| | 3. Record user actions and provide useful feedback to educators for both students and their courses. | Focus on interaction; Interaction fairness |
| Category: | **Satisfy learners' needs by:** | |
| Factor: | 1. use simple and familiar language for them, | Attitude toward e-learning |
| | 2. provide appropriate documentation and help whenever needed, | Internet self-efficacy |
| | 3. Provide tools for communication between learners and educators such as forums, chat rooms etc. | Computer self-efficacy |

**Figure 6. Specification of found e-learning factors in the literature research**

The following factors are found: *technology control, attitude toward students, self-efficacy, timely response, focus on interaction, interaction fairness, computer self-efficacy, internet self-efficacy* and *attitude toward e-learning* (Bhuasiri et al., 2012). Mainly more pedagogical factors are presented than technical ones. Although the found factors seem to be useful, they are still broad and vague, and in need of direction towards successful implementation of e-learning.

## 4.3 E-learning conditions

To clarify the e-learning factors, it is important to synthesize the found factors in e-learning conditions. According to figure 6. the found factors are: technology control, attitude toward students, self-efficacy, timely response, focus on interaction, interaction fairness, computer self-efficacy, internet self-efficacy and attitude toward e-learning (Bhuasiri et al., 2012).

| Factors: | Related conditions: |
|---|---|
| Technology control | The presence of ICT infrastructure, the ability of schools to use technology and understanding of technology by learners/student (Voogt, Knezek, Cox, Knezek, & Ten Brummelhuis, 2013). |
| Attitude toward students | The instructors (or course) must provide methods to stay in contact with the students/learners. This develops the course/ teacher as a professional learning environment (Voogt et al., 2013). |
| Self-efficacy | A teacher (or course) must perform certain tasks successfully. For teachers it is a technical competence. For a course it is based on the design of a course (Voogt et al., 2013). |
| Timely Response | Timely response is based on promptly responding to problems. These problems could be all kinds of questions; about the course content or set up (Voogt et al., 2013). The respond speed is fast enough to carry out the class (Lim, Sang-Gun, & Nam, 2007). |
| Focus on interaction | Interaction must be present in the course (design) between learners and instructors or among learners. (Voogt et al., 2014; Lim et al., 2007) Interaction is part of natural and effective learning (Johnson, Hornik, & Salas, 2008). |
| Interaction fairness | Learners need to be treated fairly; in communication throughout the learning process and in technological equity, by providing the essential technological aspects of e-learning (Voogt et al., 2013). |
| Computer self-efficacy | The ability of learners to use ICT and complete the tasks needed for e-learning (Voogt et al., 2014; Lim et al., 2007; Johnson et al., 2008). |
| Internet self-efficacy | The ability of learners to use internet and cope with any difficulties (Voogt et al., 2014; Lim et al., 2007). |
| Attitude toward e-learning | The learners needs to be motivated to participate in an e-learning course (Voogt et al., 2013). |

**Figure 7. Results general e-learning conditions found in the literature**

These synthesized conditions are based on successful e-learning implementation or effective course development. These conditions should lead to the most successful e-learning implementation.

To answer the stated first sub question: 'which general e-learning conditions can be found in the literature?' figure 7. presents the results. The same applies for the conditions as for the e-learning factors; the focus is mainly on the pedagogical aspects of e-learning instead of the technical aspects. Notably, the factors cannot be described in one rectilinear condition. For instance, technology control is related to both infrastructure and teachers' and learners' knowledge of technology.

# 5. Results analysis FAO documents

In this chapter two FAO documents will be analysed, based on the found e-learning conditions. This will answer the second sub question 'Which conditions are distinguished by FAO in a policy reflection?' and the third sub question: 'Which conditions are distinguished by FAO in a project report?'.

These sub questions lead to a better insight in the e-learning conditions regarding sustainable agriculture in developing countries and show the important conditions found.

## 5.1 Results FAO policy reflection

The document used for this analysis is 'e-agriculture 10 year review report' (FAO , 2015). The FAO reported several e-learning policies. This report is chosen because it is an overview of the development of e-learning in agriculture. It describes the status of e-learning, where progress is made and where lessons can be learned, from a macro level. In addition, the opportunities and challenges are described (FAO , 2015). Furthermore, the FAO is an important supporter in the eradication of hunger and the development of sustainable agriculture. Important is, to note is that e-learning in agriculture is merged into e-agriculture by the FAO in this document. They see it as one phenomenon: e-agriculture.

The determination of e-learning factors in this report leads to an overview of conditions addressed. This analysis will be done according to the found conditions presented in figure 7. Figure 8. shows which conditions are distinguished by the FAO.

| Conditions: | Distinguished by FAO policy reflection? | |
| --- | --- | --- |
| | Yes | No |
| The presence of ICT infrastructure, the ability of schools to use technology and understanding of technology by learners/student (Voogt, Knezek, Cox, Knezez & Ten Brummelhuis, 2014). | X | |
| The instructors (or course) must provide methods to stay in contact with the students/learners. This develops the course/teacher as a professional learning environment (Voogt et al., 2013). | X | |
| A teacher (or course) must perform certain tasks successfully. For teachers it is a technical competence. For a course it is based on the design of a course (Voogt et al., 2013). | | X |
| Timely response is based on promptly responding to problems. These problems could be all kinds of questions; about the course content or set up (Voogt et al., 2013). The respond speed is fast enough to carry out the class (Lim, Lee & Nam, 2007). | X | |
| Interaction must be present in the course (design) between learners and instructors or among learners (Voogt et al., 2014; Lim et al., 2007). Interaction is part of natural and effective learning (Johnson, Hornik & Salas, 2008) . | X | |
| Learners need to be treated fairly; in communication throughout the learning process and in technological equity, by providing the essential technological aspects of e-learning (Voogt et al., 2013). | X | |
| The ability of learners to use ICT and complete the tasks needed for e-learning (Voogt et al., 2014; Lim et al., 2007; Johnson et al., 2008). | X | |
| The ability of learners to use internet and cope with any difficulties (Voogt et al., 2014; Lim et al., 2007). | X | |
| The learners needs to be motivated to participate in an e-learning course (Voogt et al., 2013). | | X |

**Figure 8. E-learning conditions distinguished in FAO policy reflection document**

In which way these conditions are supported, will be explained below.

- The presence of ICT infrastructure is carried out by the development of technology in rural areas, which meet the conditions of locals and the available conditions.

- The provision of methods to stay in contact with learners is distinguished in the projects of FAO where coaching and monitoring is included, what leads to contact with students.
- Prompt response to problems is carried out by the provision of more than twenty discussion forums. Practices and processes can be documented and supported.
- Interaction among students is facilitated in face-to-face events. Online, social media is an important agent. Social media will be more applicated in the future. Forums contribute to online interaction between students.
- Fair interaction is seen as important and is supported by special designed communication requirements and different information for different gender and age groups. The empowerment of women and the poor is related to this condition. The challenge of this goal is to achieve access for every gender group and create diversity among learners. Women and youth need to be more participating in the future.
- The ability of learners to use ICT is seen by the FAO as digital literacy and is developed by providing opportunities to learn.
- The ability to use internet is carried out by providing training. This training must be developed for, and accessible for all kind of learners.
  (FAO, 2015)

As is shown in figure 8., not all conditions are represented in the policy reflection of the FAO. The condition regarding *students' motivation* is not distinguished by the FAO. Also, the *technical competence of teachers* is not seen as an issue. The target audience of e-agriculture can explain both. Farmers are likely motivated to learn and improve their skills. The technical competence of teachers is not appointed because the course is probably provided online, where classroom meetings with a certain teachers are needless.

It is striking that the focuses of the conditions are on technical aspects of e-learning. The adaption of new technologies and the necessity to meet the needs of the local population are ways of carrying out this condition. It is important to note that, in this policy reflection, the FAO focusses on the availability of ICT and building e-agriculture on existing systems. Also, the focus on equity is worth mentioning. There is a clear focus on equal access to e-learning applications, for all genders, incomes and ethnicity.

Conditions mentioned in this policy reflection which are not represented in the literature, are conditions regarding finances. The FAO tries to develop financially self-sustaining programs. However, this is still a challenge.
Also, a broad knowledge-share network is a focus of the FAO. With the development

of such a network, the goal of an extensive platform for sustainable agriculture will be reached.

To conclude, and answer the stated sub question 'Which conditions are distinguished by FAO in a policy reflection?' the following conditions are distinguished: presence of ICT infrastructure, provision of methods to stay in contact with learners, prompt response to problems, interaction among students, fair interaction (regarding women and the poor), the ability to use ICT and the ability to use internet.

## 5.2 Results FAO project report

The project selected for this analysis is reported in the so-called 'Information and Communication Technologies / Management in Agricultural Research for Development in the Asia-Pacific Region - A Status Report' (APAARI, 2011) . Retrieved from 'Information and communication technologies for sustainable agriculture RAP PUBLICATION 2013/14 Indicators from Asia and the Pacific' (APAARI, 2013). This report explains the development of three main areas: 'telecommunications (especially telephone communications), broadcasting (radio and TV) and the Internet' (APAARI, 2011, p. 49). These technologies are implemented in sustainable agriculture and related research. The main conclusion of this report is that the most progress is made in 'achieving a transition to knowledge-based societies' (APAARI, 2011, p. 49) in these countries. Subsequently, it must be brought into practice. This project report is based on a case study in the region of Asia and the Pacific.

First, it must be clear that the report of this FAO project mainly concentrate on future challenges. However, as explained before, challenges do have a relation with conditions; conditions could help to overcome the challenge. In the figure below is presented which conditions are represented by the FAO.

| Conditions: | Distinguished by FAO project report? | |
| --- | --- | --- |
| | Yes | No |
| The presence of ICT infrastructure, the ability of schools to use technology and understanding of technology by learners/student (Voogt, Knezek, Cox, Knezez & Ten Brummelhuis, 2014). | X | |
| The instructors (or course) must provide methods to stay in contact with the students/learners. This develops the course/ teacher as a professional learning environment (Voogt et al., 2013). | | X |
| A teacher (or course) must perform certain tasks successfully. For teachers it is a technical competence. For a course it is based on the design of a course (Voogt et al., 2013). | X | |
| Timely response is based on promptly responding to problems. These problems could be all kinds of questions; about the course content or set up (Voogt et al., 2013). The respond speed is fast enough to carry out the class (Lim, Lee & Nam, 2007). | X | |
| Interaction must be present in the course (design) between learners and instructors or among learners (Voogt et al., 2014; Lim et al., 2007). Interaction is part of natural and effective learning (Johnson, Hornik & Salas, 2008). | X | |
| Learners need to be treated fairly; in communication throughout the learning process and in technological equity, by providing the essential technological aspects of e-learning (Voogt et al., 2013). | X | |
| The ability of learners to use ICT and complete the tasks needed for e-learning (Voogt et al., 2014; Lim et al., 2007; Johnson et al., 2008). | X | |
| The ability of learners to use internet and cope with any difficulties (Voogt et al., 2014; Lim et al., 2007). | X | |
| The learners needs to be motivated to participate in an e-learning course (Voogt et al., 2013). | X | |

**Figure 9. E-learning conditions distinguished in the FAO project report (APAARI, 2011)**

The distinguished conditions in this project report are carried out as follows:

- The presence of ICT infrastructure and the ability of schools and individuals to use these technologies are recognised by the focus on ICT infrastructure in the implementation of new ICTS. This focus is built on the adoption of a standard infrastructure and existing ICTs. Notable, this infrastructure needs to

be more designed for agriculture application: 'the human capacity that manages and operates the ICT infrastructure is very critical for successful implementation of any ICT initiative in an organization' (APAARI, 2011, p. 44).

- Teachers need to perform certain tasks, this is reached by the development of training programs. These include network platforms, multimedia production and website content management.
- Prompt response to problems is carried out in the possibility for farmers to get response to immediate problems in the e-learning course. However, practice learns that timely response is hardly adequate.
- Present interaction in the course is carried out in virtual community spaces, what facilitates collaboration and discussion. Also offline interaction is supported by global forums on certain topics. Stimulant of social media could improve interaction of learners.
- Fair interaction, or equal interaction and technology is carried out by the improvement made in the equity of access and use of e-learning in the community. Interaction equity is related to access; whenever learners have access, they have access to interaction tools.
- The ability of learners to use ICT, and the ability of learners to use internet is carried out by training for farmers, where local service providers are linked to farmers.
- The motivation of learners is carried out by the provision of suitable information what increases the effectiveness of the course and the motivation of learners to complete the course.
(APAARI, 2011)

One condition is missing in this project report; *the provision of methods to stay in contact with the learners during the course*. An explanation could be that this contact guaranteed in another conditions, like monitoring and evaluation.

To answer the stated sub question 'Which conditions are distinguished by FAO in a project report?', the following conditions are found: presence of ICT infrastructure, the performance of certain ICT tasks of teacher, prompt response to problems, interaction among students, fair interaction (regarding women and the poor), the ability to use ICT, the ability to use internet and the motivation of learners to participate the course. Only the condition related to the *attitude towards students by teachers or e-learning supporters* is not recognised as an important condition by the FAO.

Expected is a more micro focus on e-learning conditions. However, because it is a big extensive project and  for a large region, the found conditions are not that

specific. This report merely shows the general progress made in e-learning in agriculture in this developing region.

Conditions that are mentioned by the FAO which were not mentioned in the literature are the importance of knowledge about existing networks and applications of e-learning in sustainable agriculture. Without this knowledge, it is harder to extent an ICT application successfully.

## 7. Discussion

The findings of this thesis are comparable with the findings of related studies (Bhuasiri et al., 2012; Valsamidis et al., 2011). However, this thesis does show some weaknesses. The first point of weakness is the high level of (personal) interpretation. This is because of the method used in selecting the e-learning factors of matter. Every researcher or student would possibly connect these factors and conditions in a different manner. Another weak part is the analysis of the found conditions in the FAO documents. This analysis is based on empirical research. Which makes the results of this thesis questionable; authors of the used articles composed their findings in more or less the same way. For stronger evidence, another research method needs to be used or designed. Thereby only four articles met the selection criteria for the theoretical research. This makes the theoretical research less reliable than a literature review with more articles.

Another weakness of this thesis is that there remain other possibly influencing factors or conditions. It could be that other factors have an impact on e-learning, which are not included in this thesis. Especially conditions focussed on the application of e-learning conditions in agriculture, for instance the presence of tools in a certain area could have an effect. This means that implementation of all critical e-learning conditions is not a guarantee for an effective e-learning course and achieving sustainable agriculture. However, this research can be seen as introduction to e-learning conditions and their application in sustainable agriculture in developing countries. The analysis of the FAO documents indicates simply the most named conditions for this purpose.

It is remarkable that e-learning conditions do not refer to agriculture or rural areas. This has an influence on the results of this research; they stay general. However, it does not exclude e-learning as suitable application in e-learning. Though focussed is on the general system to implement e-learning, this system needs to be sufficient. Moreover, the conditions are not explicit enough to determine the precise conditions for e-learning implementation in sustainable agriculture. More precise defined conditions are necessary in the technical aspects of e-learning. As seen in the

results of the FAO, technical conditions are seen as important. As stated before, this thesis is still a great contribution to the overall imaging of e-learning.

The last weak point is that the found conditions do not always express the effect  or success of a project. Even without all conditions present, an e-learning course can contribute to sustainable agriculture. However, the found conditions give the direction under which conditions e-learning contribute in sustainable agriculture in developing countries.

The lack of both time and tools for this thesis has restricted the choice of methodology, which influences the findings. Especially, for the analysis of the FAO documents, only two documents are assessed. With an assessment of more documents, the findings of this thesis would give stronger evidence to the addressed e-learning conditions by the FAO.

# 8. Conclusion

The eradication of hunger is still an issue in developing countries. Education and agriculture are seen as key missing links in combating hunger. A relatively new, but potential education method is e-learning. Moreover, e-learning is easy to apply in developing countries. Sustainable agriculture is seen as the best method to support sustainable development and eradicate hunger. The stated question for this thesis is: 'under which conditions can e-learning contribute to sustainable agriculture in developing countries?'. To answer this question a literature research is done, which formed the theoretical framework. This gave an overview of e-learning conditions. To research under which conditions e-learning contributes to sustainable agriculture in developing countries, two documents of the FAO, which can be seen as a key organisation in the eradication of hunger, are analysed.

Concluding this research and answering the research question, all conditions found in the literature are recognized in FAO documents. All conditions have a link to the conditions distinguished by the FAO. Both documents distinguish the following e-learning conditions: presence of ICT infrastructure, prompt response to problems, interaction among students, fair interaction (regarding women and the poor), the ability to use ICT and the ability to use internet. These conditions are most accented in  the FAO documents, which mean that these conditions most likely play the biggest role in e-learning contribution to sustainable agriculture in developing countries. According to the results of the analysis, technical aspects and equity in e-learning are the main focus of the FAO.  Conditions seen as important by the FAO in e-learning, which are not mentioned in the used literature are: financially self-

sustaining programs and the importance of knowledge about existing information and learning system.

Thus, for the greatest contribution of e-learning to sustainable agriculture in developing countries, e-learning implementation needs to take into account the found e-learning conditions. Resulting from the analysis of the FAO documents, assumed can be that technical aspects are the most important and possibly restricting in the contribution of e-learning in sustainable agriculture in developing countries.

This thesis showed some weaknesses as: a high level of interpretation and possible other influencing conditions. Research need to be done in the exploration of conditions focused on technical aspects of e-learning or purely focused on the social aspects. The FAO could focus more on the social result of e-learning. It would be an interesting topic to deepen the social implementation of e-learning and the effective change needed for the eradication of hunger.

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