

Agric Extension Experts' Usability of a Developed Agro-Mobile App for Learning in Nigeria

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Abstract: The use of wireless technologies and the development of its applications for learning has been impressive. Therefore, there was a need to develop an application for agricultural extension; hence, the study designed and developed an Agro-Mobile app for agricultural extension experts. The study employed a design and development type. The population of the study was all educational technology experts, mobile app experts, crop science experts, and Agricultural extension experts in South-west, Nigeria. Four instruments which consisted of three experts' ratings and one (1) usability evaluation questionnaire. The instruments were validated and reliability values of 0.87, 0.93, 0.78, and 0.90 was obtained. The data gathered was analyzed statistically using frequency counts, percentages, mean and t-test. The findings revealed among others that; the design and development of the Agro-mobile app for agricultural extension experts was rated excellent by mobile app experts, crop science experts, and educational technology experts with 83.3%, 88.8% and 87% respectively. Also, the Agro-Mobile app for agricultural extension had a positive evaluation for usability by extension experts with a grand mean of 3.67. Based on the findings, it was recommended among others that, the Agro-Mobile is an important app for professional development.

Keywords: Agriculture Extension, Mobile App, Educational Technology

Introduction: Agricultural extension plays a critical role in development in the sub-Saharan by bringing the farmers information on new agricultural information and advanced technologies, which they can adopt to increase production, incomes and improvement to their livelihood. Therefore, extension experts are key in the development process. However, the world is widely information-driven where Information and Communication Technologies (ICT) are becoming the underlying drivers of development including agriculture, not only in developed countries but across the world [1]. Hence, the use of Information and Communication Technology (ICT) in Nigeria for use by extension experts will tend to provide appropriate information to rural farmers. Also, the Food and Agriculture Organization [2] stated that Information and Communications Technology (ICT) has contributed significantly to the growth and socio-economic in countries where they are deployed. ICT encompasses mobile learning, which is a methodology that involves the use of mobile devices to carry out learning process. Additionally, the growth of mobile technologies has created new platforms for learning. Smartphone and tablet penetration reached 66% and 20% in 2018, respectively. Mainwhile, tablets and smartphones which are the primary means of accessing the internet, and mobile internet penetration rate will reach 71% of the world population by 2025 [3]. In light of these advancements, digital technologies are highly productive despite their low cost, and they can greatly support agricultural extension in developing countries. Therefore, the use of mobile devices to learning and information gathering in agriculture processes would require the development of accompanying mobile applications. These mobile apps are solutions developed for particular platform like iOS or Android and supports all the features that the operating system provides and also allows us to utilize the maximum potential of a mobile device [4]. In the development of the Agro-Mobile app, ADDIE (analysis, design, development, implementation, and evaluation) model and the usability evaluation model proposed by the International Organization for Standardization ISO 9126 was employed. As a development framework, the ADDIE model has been used by researchers concerning digital learning in various areas of study. Also, adopted a usability evaluation model proposed by the International Organization for Standardization, for usability based on six main constructs of Functionality, Reliability, Usability, Efficiency, Maintainability, and Portability. In line with this development framework, [6] developed an android-based mobile application that can support in the teaching-learning process of civic education in senior high schools, where ADDIE model was employed. Hence, this study sought to determine the Usability of a developed Agro-Mobile App for extension experts.

Agricultural information and knowledge acquisition in Nigeria and indeed in Sub-Saharan Africa has not been efficient in areas of new agricultural technologies, early warning systems (drought, pests, diseases), improved seedlings, fertilizer, good agronomic practices and harvest and post-harvest practices [7]. Additionally, with the rapid integration of ICTs into our daily lives, there has been limitations in access to agricultural information from traditional print, libraries, magazines, websites, journals, books, government information and research institutes, by extension agents and extension officers [8]. Also, extension agents have over the years been restricted to accessing information through these traditional modes. Although with the intent of integration of technology, in 2016 the Ministry of Agriculture and Rural Development in Nigeria through their extension department developed a web-portal as an information dissemination channel. Further, one of the problems of agricultural

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extension work is the lack of clarity and knowledge. And lack of knowledge of the role of agricultural extension in helping farmers in the adoption of modern agricultural techniques [9]. Agricultural Extension is an expansive work, which deals with all areas of agricultural value chain, and offers a variety of services and assistance to farmers, with a role in increasing agricultural production in quantity and quality.

This study was supported by the Constructivist theory of learning. Constructivist theory focuses on the active engagement of the learner in the learning process. It is believed that when learners are engaged in learning activities, they unconsciously learn through the reconstruction of knowledge [10] and [11]. Learning from the constructivist perspective involves both the perception of experiences through constructed reality and the encouragement to develop new knowledge through experiences. This knowledge is interpreted and received, constructing the ideas of reality [12], [13]. Also, individuals use these mental structures to organize current knowledge and provide a framework for future understanding [14].

The basic premise of constructivist theory is that people are said to learn when they have gained experience from what they learn. That is, individuals create their own meaning through experiences. Also, for this study two instructional design models were adapted to develop and evaluate a mobile app for professional development in agricultural research and extension. Hence, the use of the combination of ADDIE model and Usability Evaluation Model was proposed in developing the mobile app.

ADDIE Model: The ADDIE model is an instructional model which is a popular and generally accepted model that can be used in the design and development of electronic learning platforms [15] Analysis: In the analysis phase the researcher clarified the instructional problems on varieties, yield, quality, objectives, and identifies the institutional environment and researchers' existing knowledge and skills. Hence, analysis and inquiries about extension experts' perceived performance gaps, their main problems during work, and their use of mobile app for professional development.

Design phase: The design phase dealt with learning objectives, assessment instruments, content, subject matter analysis, and mobile app prototyping. The design was systematic and specific. Systematic means a logical, orderly method of identifying, developing and evaluating a set of planned strategies targeted for attaining the project's goals.

Development Phase: In the development phase, the researcher created content assets blueprinted in the design phase. In this phase, the designer created User experience (UX), User Interface (UI) and HTML frameworks. The purpose and objective of the App development, is to aid the professional development process of Agricultural research and extension. A sketch to lay a foundation for future interface was developed. The design was visually conceptualized with main features, layouts and structure of application. A prototype was created to help build a roadmap that helped connection between screens and navigation.

Evaluation:(Using International Standardized Model ISO 9126): Usability evaluation was based on six metrics of International Standardized Model (ISO 9126). These six metrics are:

1. **Functionality:** This will measure capability of the Agro-Mobile app to provide functions which meet stated and implied needs when the app is used under specified conditions.
2. **Reliability:** The capability of the Agro-Mobile app to maintain a specified level of performance when used under specified conditions by extension experts.
3. **Usability:** The metrics in usability compliance measured the Agro-Mobile Apps' ability to comply with guidelines for software usability. This metrics in usability compliance measured if the Agro-Mobile App does not violate the rules of Agricultural Extension about software usability.
4. **Efficiency:** This measured the capability of the Agromobile to provide appropriate performance, relative to the amount of resources used, under certain conditions.
5. **Maintainability:** This is capability of the Agro-Mobile to be modified. These modifications included corrections, improvements or adaptation of the app to changes in environment, and in requirements specifications.
6. **Portability:** This measured the capability of the software product to be adapted for different specified environments without applying actions or means other than those provided for this purpose for the app considered. Specifically, this will include the scalability of internal capacity.

Hence the study conceptualized ADDISO model, which was formed from three levels of ADDIE model which include (Analysis, Design, and Development), and six levels of ISO which include (Functionality, Reliability, Usability, Efficiency, Maintainability, and Portability).

Research Questions and Hypothesis

The following questions were raised for the study and answered

1. How do Mobile App experts' rate the Agro-mobile app for agricultural extension experts?
2. How did educational technology experts' rate the Agro-mobile app for agricultural extension experts?
3. How did crop scientists rate the Agro-mobile app for agricultural extension experts?
4. How did Agricultural extension experts evaluate the usability of the Agro-mobile app?

Based on the research questions raised and answered the following hypotheses were formulated and tested in the study:

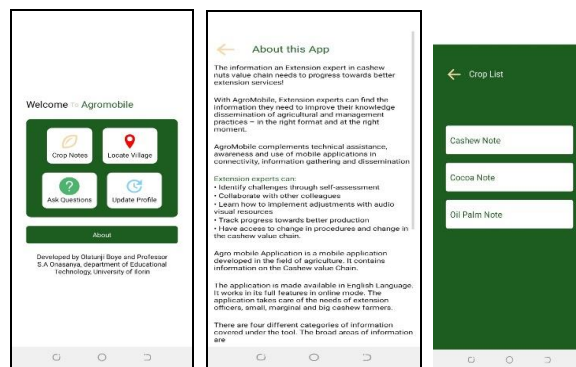
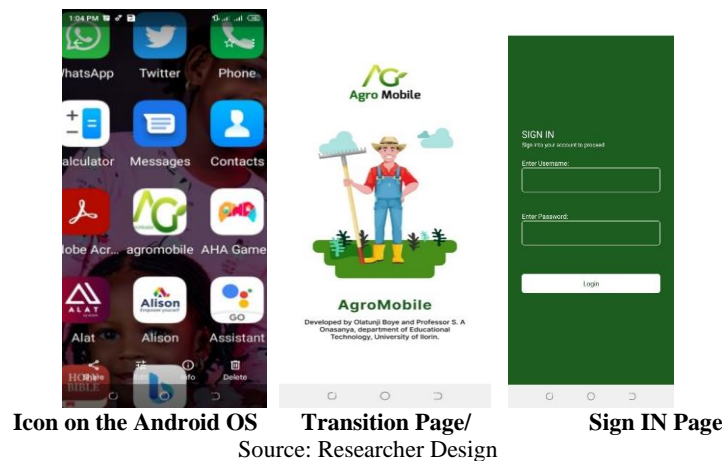
H_{01} There is no significant difference in the usability evaluation of the Agro-mobile app by extension officers and extension agents.

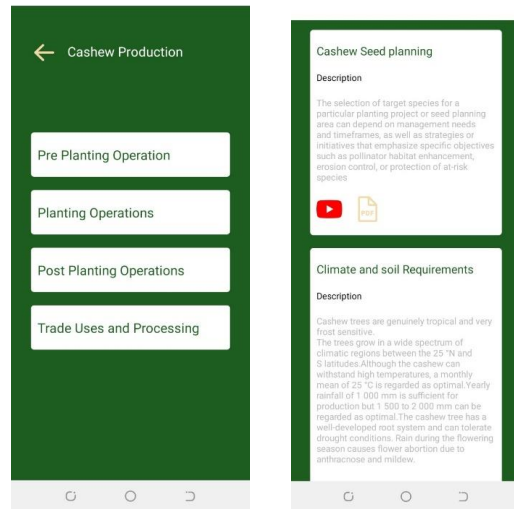
Materials and Methods: This study employed a Design and Development type. This research type deals with the design, development, evaluation and use of models. The study adopted the first three levels of ADDIE model and six levels of the International Standardized Model (ISO 9126) for its usability Evaluation.

The population for the study were educational technology experts, mobile app experts, crop science experts, and Agricultural extension experts in South-west, Nigeria. The sample comprised of two categories; the sample of experts who rated the Agro-mobile app and agricultural extension experts who determined the usability of the Agro-Mobile app. Further, the study adopted multistage sampling. Hence, the first stage consisted of five educational technology experts, five mobile app experts and five crop science experts purposively selected. The second stage consisted of 30 extension experts purposively selected from the ministries. The instrument used for data collection were Experts' Rating and Usability Evaluation Questionnaires. In order to ensure content and construct validity, the instruments were validated by involving 9 experts in the area of mobile application development, educational technology and crop science from a selected higher institution in Ilorin for analysis and expertise judgment. To test the reliability of the instruments, Cronbach Alpha was used to analyze the Mobile Application Development Experts' Assessment, Educational Technology Experts' Assessment, Crop Science Experts Assessment, and Agricultural Extension Experts' Usability Evaluation which were found to have reliability values of 0.87, 0.93, 0.78, and 0.90 respectively, which means the research instruments are consistent and fit for use.

The study lasted for a period of five weeks during which the questionnaire was administered on the Agriculture extension experts. Descriptive and inferential statistics were used to answer the research questions and test the research hypotheses respectively.

The diagrams below show how users can interact with the Agro-mobile Application:

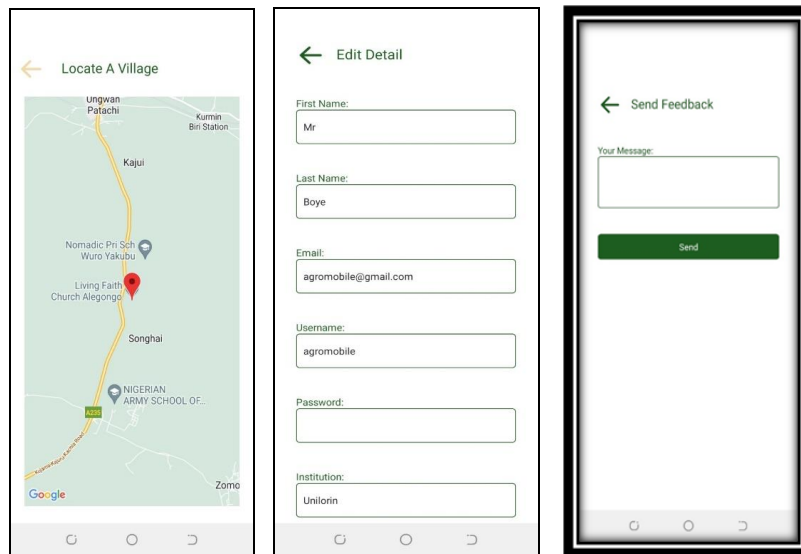




Notes Selection Page

Content Selection Page

Source: Researcher Design



Google Search Page

Profile Update Page

Feedback Page

Source: Researcher Design

Results: The demographic information revealed that most of the Mobile app experts were male, with Male 4 representing (80.00%) and Female 1 (20.00%). A total number of 5 Mobile app experts were selected for the study. Crop Science experts were five (5) males, representing (100.00%) of Crop Science experts selected for the study, while the extension experts were Male 21 representing (70.00%) and Female 9 (30.00%). A total number of 30 extension experts were selected. Also, the Educational Technology experts were male, with Male 3 representing (60.00%) and Female 2 (40.00%). A total number of 5 Educational Technology experts were selected.

Research Question 1: How do Mobile App experts' rate the Agro-mobile app for agricultural extension experts?

To answer research question one, the data was collected using the Mobile App Experts' Questionnaire (MAEQ) and analyzed with simple and cumulative average, while range was used to determine the overall rating of the developed mobile app. A benchmark of 0-18.9, 19-37.9, 38-56.9 and 57-70 to represent poor, good, very good, and excellent were employed respectively. Based on the range benchmark the cumulative score of **66.2 (88.3%)** indicated the developed Agro-mobile App was rated excellent by Mobile App experts.

Table 1: Mobile App experts' Rating of the Agro-Mobile App

S/N	Assessment of the Technicality of mobile app	Average Score
1.	Home key for returning to the main page	4.40
2.	Back key to get back to the previous page	4.40
3.	Next key to move back to forward to the next page	4.60
4.	Exit key for exiting the programme	4.20
5.	Screen designed to in a clear and understandable manner	4.60
6.	Balanced presentation of information	5.00
7.	Key for moving forward or backward	3.60
8.	The mobile app considers the individual differences of the learner	4.20
9.	The mobile app considers different learning styles and experiences	4.60
10.	Faults can be easily diagnosed on the mobile app	4.20
11.	Images are purposeful, adding impact to the usability experience	4.20
12.	The mobile app has durability over time	4.40
13.	The software complies with portability standards	4.80
14.	The app is presented in logical order	4.60
15.	The mobile app can easily be tested	4.40
	Cumulative Score	66.2

Research Question 2: How do Educational Technology experts' rate the Agro-mobile app for agricultural extension experts?

To answer research question three, the data was collected using Educational Technology Experts' Questionnaire (ETEQ) and analyzed with simple and cumulative average, while range was used to determine the overall rating of the developed mobile app. A benchmark of 0-25.9, 26-51.9, 52-77.9, 78-100 to represent poor, good, very good, and excellent were employed respectively. Based on this benchmark, the cumulative score of **87 (87%)** indicated the developed Agro-mobile App was rated excellent by Educational Technology experts.

Table 2: Educational Technology experts' Rating of the Agro-Mobile App

S/N	Screen Design	Average Score
1.	The Presentation of information can captivate attention	4.00
2.	The design does not cause information overload	4.60
3.	The color of the text follows readability principles	4.60
4.	There is consistency in the use of color	4.00
5.	Presented pictures are relevant to text content	4.80
6.	Relative contrast exists between graphics and background	4.20
7.	The quality of images and graphics is good	4.20
8.	Presentation of content is well coordinated	4.20
9.	The quality of text is good	4.60
	Design Factor Interactivity	
10.	The app allows users apply what have been learnt in their work	4.20
11.	The mobile app allows users access new information	4.20
	Structure	
12.	The structure of the app allows users advance, review, and access other relevant pages on the app	4.60
13.	The content is structured in a clear and understandable manner	4.80
	Adaptivity	
14.	The mobile app encourages collaboration among researchers	4.40
15.	The app facilitates professional development	4.20
	Assessment of the content of the mobile app	
16.	The content is reliable	4.00
17.	Balanced presentation of information	4.20
18.	Correct use of grammar	4.40
19.	Information relevant to researchers	4.40
20.	Current and error free information	4.00
	Cumulative Score	87

Research Question 3: How do Crop Science experts' rate the Agro-mobile app for agricultural extension experts?

To answer research question four, the data was collected using Crop Science Experts' Questionnaire (CSEQ) and analyzed with simple and cumulative average, while range was used to determine the overall rating of the developed mobile app. A benchmark

of 0-25.9, 26-51.9, 52-77.9, 78-100 to represent poor, good, very good, and excellent were employed respectively. Based on this benchmark, the cumulative score of **88.8 (88.8%)** indicated the developed Agro-mobile App was rated excellent by Crop Science experts.

Table 3: Crop Science experts' Rating of the Agro-Mobile App

S/N	Assessment of the content of mobile app	Average Score
1.	Objectives are clearly stated and relevant to the concept	4.40
2.	Contents of the mobile app match the objectives	4.20
3.	Presentation leads to acquisition of knowledge sought for	4.40
4.	Relevant to research and extension needs	4.60
5.	Design of the mobile app is based on instructional theories and related with the content	4.60
6.	The application of mobile app is possible in various topics in research	3.80
7.	The application of mobile app is possible on issues related with research	4.20
8.	The mobile app can be used independently by without any support	4.40
9.	There is balanced presentation of information	4.60
10.	Concepts and vocabulary are relevant to the user	4.40
	Assessment on the Technicality of mobile app	
11.	The content of the mobile app caters for the three domains of instruction	4.60
12.	The text quality is good	4.80
13.	The mobile app allows researchers assess themselves.	4.20
14.	The mobile app affords opportunity for collaboration	4.60
15.	Screens are designed in a clear and understandable manner	4.20
16.	The images in the mobile app are clear enough	4.20
	Assessment on the Design of the mobile app	
17.	The app allows individual researchers learn at their own pace	4.20
18.	The app is self-explanatory to achieve the stated objectives	4.40
19.	The organization of images and graphics are well presented	4.40
	Cumulative Score	88.8

Research Question 4: How do Agricultural extension experts evaluate the usability of the Agro-mobile app?

To answer research question five, the data was collected using Agro-Mobile App Usability Questionnaire (AAUQ) and was analyzed with mean. A benchmark of 2.50 was employed, indicating that a value less than 2.50 was regarded as negative, while a mean value higher than 2.50 was regarded as positive. This finding indicated that the 30 extension experts that participated in the study were able to successfully complete all tasks on the Agro-Mobile and evaluated it with a **Grand Mean of 3.67**. In summary, the grand mean of $3.67 > 2.50$ indicated that the extension experts evaluated the mobile app positively.

Table 4: Agricultural extension experts' usability evaluation of the Agro-Mobile App

S/N	Functionality	Mean
1.	The Agro mobile app is appropriate for use for my work	3.63
2.	Using the Agro-mobile app at work gives me the result for my research needs	3.77
3.	Next key to move back to forward to the next page	3.60
4.	The Agro-mobile app helps me access the information I need easily.	3.73
	Reliability	
5.	When I make mistakes using the Agro-mobile, I recover easily	3.50
6.	The Agro-Mobile App does not hang or crash while I use it	2.77
7.	Using the Agro-mobile app I encountered some failed commands	3.63
8.	The Agro-Mobile App is easy for me to comprehend	3.77
9.	The Agro-Mobile App is easy for me to use	3.70
10.	The Agro-Mobile App is easy for me to operate	3.80
11.	The interface of the Agro-Mobile App looks good to me	3.73
12.	The Agro-Mobile App responds quickly when I use it	3.63
13.	I believe I became productive using the Agro-Mobile App	3.80
14.	I am able to efficiently complete my work using the Agro-Mobile App	3.73
15.	When I use the Agro mobile App, there is little time between my action and its response	3.77
	Grand Mean	3.67

Hypothesis one

H₀₁ There is no significant difference in the usability evaluation of the Agro-mobile app by extension officers and extension agents.

To test for this hypothesis, the extension officers and extension agents' respondent's data was collected using Agro-Mobile Application Usability Questionnaire (AAUQ) and was analyzed for Mean, Standard Deviation and P value. It can be deduced that there was no significant difference in the usability evaluation of extension officers and extension agents on the Agro-mobile application. This is reflected in the findings of the hypothesis tested $df (28)$, $t = -0.82$, $p > 0.05$. Thus, the hypothesis which state that 'there is no significant difference in the usability evaluation of the Agro-mobile application by extension officers and extension agents' is accepted.

Table 5: Independent Sample t-test Analysis of Employment level in the Usability Evaluation of extension experts use of Agro-Mobile Application

Employment Level	N	X	SD	df	t	Sig.(2-tailed)	Remarks
Extension Officer	12	3,61	.15				
				28	-0.82	0.41	Accepted
Extension Agent	18	3.66	.14				

Conclusion: The study designed, developed and evaluated an Agro-Mobile application for learning Pre-planting operations, Planting operations and Post Planting operations for Cashew, Cocoa and oil Palm for agricultural extension experts using both the ADDIE and ISO 9126 models. The results established that mobile application are effective means of learning. Hence, the areas of analysis of learners, objectives, contents, design, and development and usability were assessed and found suitable for by educational technologists, crop scientists and mobile application experts. The mobile application is an area of mobile learning that allows for self-paced learning at ones' convenience. There was no significant difference in the usability of the Agro-mobile application by extension officers and extension agents.

Recommendation: Based on the findings and conclusions of this study, the following recommendations were made:

1. In order to ensure product quality of Agriculture based applications, the ADDIOS (the first 3 levels of ADDIE, and six levels International Standardized Model -ISO 9126) is recommended for the design development and evaluation of mobile app.
2. The Agro-Mobile is an important app for professional development. Hence, it should be deployed to ministries and agencies actively involved in agricultural extension.

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