



Development and Evaluation of an e-Learning Module for Aquaculture Development through ICT Projects: ADDIE Model

P. Mahalakshmi* and M. Krishnan

Central Institute of Brackishwater Aquaculture, 75, Santhome High Road, Chennai - 600 028, India

Abstract

The aim of this study was to produce an e-Learning module to assist the users of Village Knowledge Centres (VKCs), Puducherry, which is one of the information centres in coastal areas and to evaluate its suitability as an alternative learning material. The centre was initiated by Information Village Research Project of M.S. Swaminathan Research Foundation, Chennai, India for aquaculture development in coastal areas. The module development and evaluation followed the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model of Instructional System Design. Based on the overall assessment of the VKCs, the asynchronous e-Learning module in Tamil on mud crab fattening, which has been identified as one of the species for diversification in brackishwater aquaculture, was developed by Central Institute of Brackishwater Aquaculture (CIBA). The results revealed that the items related to contents produced, visual design, accessibility and presentation style had good responses. The findings indicated that majority of the respondents had intention to use the module in future (85.3%) and to recommend the module to other learners (100%) who are interested in mud crab fattening. The results also revealed that 84% of the respondents felt that this module could be used as an alternative learning material in mud crab fattening though it still needed improvements in various aspects such as presentation of information with animation effects, user friendliness and interactivity.

Key words: e-Learning, ICT projects, ADDIE model, knowledge centres, aquaculture

Received 16 October 2009; Revised 14 September 2011; Accepted 13 December 2011

* E-mail: maha@ciba.res.in

Introduction

Today, e-Learning techniques have drastically changed the way of information dissemination especially in the field of agriculture and aquaculture through Information and Communication Technology (ICT) interventions. In e-Choupal and Information Village Research Project of M. S. Swaminathan Research Foundation (MSSRF), Chennai, India, e-Learning is enabled via synchronous (online) and asynchronous (offline) delivery system in respect of information on coastal aquaculture. In both the ICT projects, synchronous e-Learning takes place via web based video conferencing, net meeting, audio conferencing with presentation material and on-line chat. In e-Choupal project, users elicit the aquaculture information through synchronous and asynchronous mode of e-Learning system (Mahalakshmi et al., 2008). MSSRF Information Village Knowledge Centre (VKC) is in possession of asynchronous e-Learning modules in the form of CD-ROMs in agriculture, horticulture, animal husbandry and value added products (Mahalakshmi et al., 2009). To date, however, there is no asynchronous mode of e-Learning for aquaculture.

This study was aimed at producing an e-Learning module prototype to assist the users of VKCs for aquaculture development in coastal areas and to evaluate its suitability as an alternative learning material.

Materials and Methods

The module development and evaluation followed the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model of Instructional System Design (ISD) (Strickland, 2006). Model structure and explanation of each phase is depicted in Fig. 1.

Analysis

The study was conducted in Village Resource Centre, Union Territory of Pudhucherry, which is one of the information centres in coastal areas, initiated by Information Village Research Project of MSSRF. This centre has a number of VKCs which are disseminating need based information and technologies among the local communities. Four such VKCs *viz.*, Veerampattnam, Pannithitu, Periyakalapet and Ganapathychettikulam, which are located in coastal areas, were selected for this study. A total of 160 users, 40 each from each centre were identified in the study area that fulfilled the assessment of needs of users. From this group, a sub sample of 103 users were selected based on their education and knowledge in ICT from the four centres *viz.*, Veerampattnam (31), Pannithitu (30), Periyakalapet (25) and Ganapathychettikulam (17) for the present study. Data were collected from the targeted groups by employing a well-structured and pre-tested interview schedule.

After discussion with experts, knowledge centre workers and volunteers of VKCs, five categories of needs assessment in aquaculture and its allied activities were selected for this study. They were: culture practices, e-Learning module in aquaculture, extension activities, fisheries and allied information and base information. A number of parameters were identified under each of these five categories and the respondents were asked to indicate their perceived extent of needs along a three point scale namely mostly needed, somewhat needed and not at all needed, with the scoring pattern of 2, 1 and 0 respectively (Sailaja & Reddy, 1999).

The users' responses were recorded by putting a tick mark in the appropriate column against each parameter. The overall needs assessment score for each parameter was determined as follows:

$$T_{ij} = a_{1ij} + a_{2ij} + a_{3ij} \dots + a_{Nij} \quad \text{for } i = 1 \text{ to } k; \quad \text{for } j = 1 \text{ to } l \quad (1)$$

where k = number of parameters.

l = number of scales used, such as, mostly needed, somewhat needed and not at all needed.

N = number of VKCs.

$A = \{a_{1ij}, a_{2ij}, a_{3ij}, \dots, a_{Nij}\}$ a set of frequency (number of users' responses) matrices of VKCs.

T_{ij} = Total assessment score of j^{th} scale in i^{th} parameter.

The overall needs assessment score for i^{th} parameter was determined by summing up of multiplication of total assessment score of j^{th} scale in i^{th} parameter with the weight of j^{th} scale

$$O_i = \sum_{j=1}^l T_{ij} w_j \quad \text{for } i = 1, 2, \dots, k \quad (2)$$

where, O_i = Overall assessment score of i^{th} parameter.

w_j = weight of j^{th} scale

We rank the parameter in the descending order of O_i , the parameter with the highest value of O_i is the first rank, next highest value of O_i is the second rank and so on.

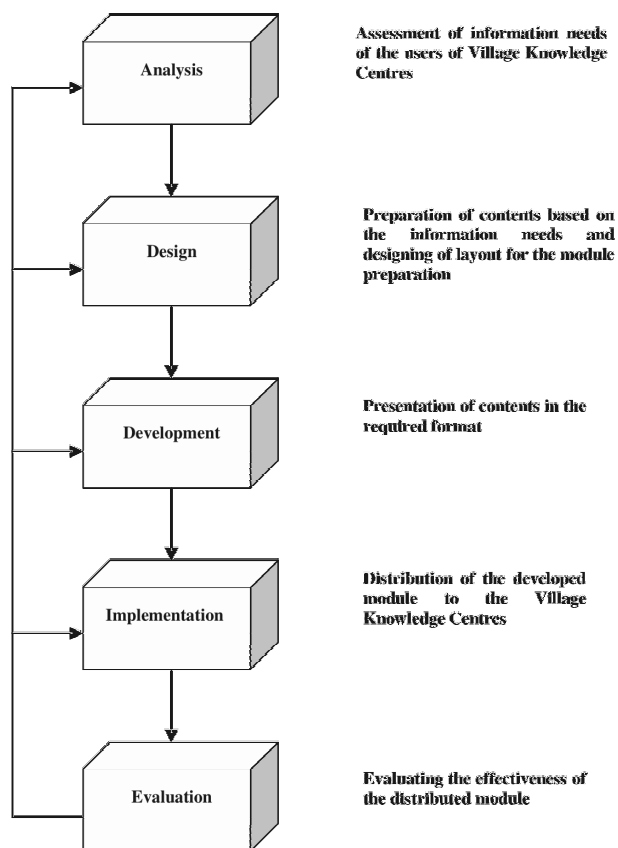


Fig. 1. ADDIE model structure and the explanation of each phase (Modified from Strickland, 2006)

Design and Development

The module structure was designed as simple as possible to deliver the required information to the end users including the extension educators about the significance of the mud crabs, their benefits and the different types of fattening systems (Mahalakshmi et al., 2007). For optimization of communication, very careful consideration was taken by the experts and designers to draft the messages to be conveyed to the target groups. Experts reviewed the materials prior to development of an information base for this module. The information base was converted to an asynchronous e-Learning module via electronic format using variety of media like audio, text, images and animation. During discussions, it was noted that the selection of communication channels including media and language, would depend on their availability and accessibility to the different target groups and the preferences of the users of the knowledge centres.

Implementation and Evaluation

After the development of the modules, these were delivered or distributed to the users of VKCs, Puducherry. After implementation of the module, the effectiveness of the learning module was evaluated using a structured questionnaire. The questionnaire was divided into two sections. The first section (section A) aimed at obtaining demographic profile of the respondents while the second section (section B) consisted of six categories related to the module. Items presented to the respondents were related to contents, presentation of modules, interactivity, visual design, accessibility, user friendliness, module applicability and general assessment of the module.

A pilot study was conducted with this questionnaire for testing the design of the questionnaire. For the pilot study, the second section of the questionnaire was distributed to thirty five users of VKCs, Puducherry, based on their education level, and their responses were entered into SPSS 17.0 for conducting reliability analysis based on the Alpha-Cronbach score (Cronbach, 1951). If the Alpha-Cronbach score was greater than 0.7, the design of the questionnaire would be considered as good (Chong et al., 2005). Otherwise, the questionnaire was updated accordingly until the score exceeded 0.7. After the pilot study was successfully carried out, this tested evaluation questionnaire was used for recording the responses of 75 sample VKC users

of Puducherry. The Likert scale on a five point continuum (strongly disagree 1; disagree 2; neutral 3; agree 4; strongly agree 5) was used as options for section B. In the analysis, the number of respondents in each group who had exercised their option as 1 and 2 were grouped under the category 'disagree' while those who had opted for 4 and 5 were grouped under the category 'agree'. Those who opted for 3 were categorised as 'neutral'.

Results and Discussion

Analysis

Identifying information needs of users of knowledge centre and aqua farmers at regular intervals followed by development of an appropriate e-Learning module could be a viable strategy for the improvement of knowledge and skills. The information needs of users of knowledge centre in the order of ranking are presented in Table 1. On the basis of data presented in Table 1(B), it could be inferred that the mud crab fattening e-Learning module with an overall assessment score of 135 ranked first, followed by seabass e-Learning module (107), and shrimp e-Learning module (103). Table 1 also shows the overall assessment score and their corresponding rank for the parameters under different categories of needs assessment such as awareness programme in culture aspects, e-Learning module in aquaculture extension activities, fisheries and allied information and base information. Out of these parameters, awareness programme on mud crab fattening, training on value added products, market information and addresses of fisheries and aquaculture offices ranked first in their corresponding categories.

The users showed keen interest to know different types of mud crab fattening systems in brackishwater area, economics, contact addresses for training centres, hatcheries, exporters details and banks which are providing the loan facilities for mud crab fattening. The respondents at all centres suggested Tamil as the preferred language. The knowledge centre workers expressed that the text attached with audio was suitable for illiterates. Media suggested for users of centres were asynchronous e-Learning module with auto-run facilities.

e-Learning Module

Based on the overall assessment of the VKCs, the asynchronous e-Learning module in Tamil was

Table 1. Information needs assessment of the respondents in the study area

Parameters	Overall assessment score	Rank
(A) Awareness programme in culture aspects		
Shrimp	103	III
Seabass	109	II
Mud crab fattening	138	I
(B) e-Learning module in aquaculture		
Shrimp	103	III
Seabass	107	II
Mud crab fattening	135	I
(C) Extension activities		
Publications	119	II
Fact sheet	103	V
Training (Value)	135	I
Training (Mud crab fattening)	110	III
Posters	108	IV
(D) Fisheries and allied information		
Ornamental fishing	120	V
Mangroves	131	IV
Dry fish preparation	137	III
Market information	200	I
Coastal zone laws, acts	173	II
(E) Base information		
Address - education	223	III
Address - offices	256	I
Subsidies	226	II

developed on mud crab fattening which was identified as one of the species for diversification in brackishwater aquaculture. The module was named Mud Crab Fattening (*Scylla tranquebarica*) (Mahalakshmi et al., 2007). This module offers the main topics on mud crab fattening viz., introduction, fattening systems and contact addresses. In order to narrow down the topics, the main topics were subdivided into additional topics (Fig. 2).

The 'introduction' topic provides information about salient features, basic details of mud crabs and its availability. Users can look for information regarding three different types of fattening systems in brackishwater area, such as fenced earthen ponds, fibreglass cages and pens in open backwaters. Each fattening system is subdivided into areas covering layout preparation, stocking of water crabs, feed & feed management, water management, details of weight gain, harvesting practices, packing methods, marketing and economics. 'Layout preparation'

provides information about the requirements and designing structure for the fattening systems. 'Feed & feed management' highlights the types of feed, feed rate and timings. 'Harvesting methods' provide information about gears used for harvest, harvesting by hand picking and methods of handling crabs. Containers used for packing the fattened crabs for transportation across the country and for exports were highlighted in the topic 'packaging methods'. Detailed economics were given for each fattening system. In addition to this, the module highlights water management and weight gain information. The page on 'contact addresses', lists the addresses like training centres, the sources of availability of extension materials, hatcheries, list of exporters and banks. This is used as a ready reference volume for users.

After the development of e-Learning module, it was sent to content experts prior to implementation. The verification of the module was successfully com-

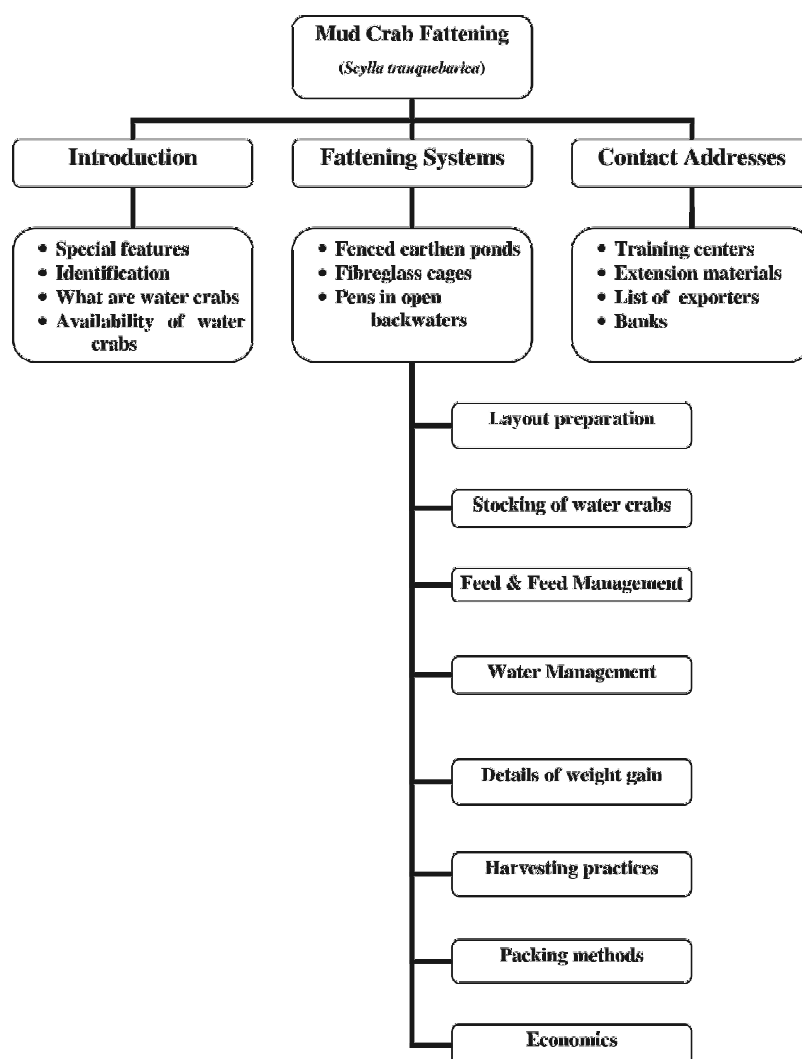


Fig. 2. Structure of Mud crab fattening (*Scylla tranquebarica*) e-Learning module (Mahalakshmi et al., 2007)

pleted with all the experts agreeing that the module was well designed and well suited to the learning of users of VKCs.

Implementation and Evaluation

This verified module was distributed to VRC and VKCs of Puducherry. Besides, the implementation of the module results from the pilot study also showed that the questionnaire was reliable since the Alpha-Cronbach score produced was over 0.7 for each category in the section B of the questionnaire (Table 2). The actual evaluation study was conducted after the reliability test for the questionnaire.

The analysis of data showed that there were 39 female respondents. More than half of the

respondents (62%) had working knowledge in computers. Sixty seven percent of the respondents had knowledge in e-Learning module.

Table 2. Reliability analysis score for each category

Categories	Alpha value (α)
Contents of the module	0.85
Presentation and interactivity of the module	0.74
Visual design and accessibility of the module	0.81
User friendliness and motivation of the module	0.73
Module applicability	0.82
General assessment	0.84

The results of the effectiveness of evaluation of the module are depicted in Table 3. The results regarding contents are presented in category I. The findings indicated that majority of the respondents

agreed to the contents and exactly suited their needs (92%), easy to understand (77.3%) and were scientific (86.7%). In terms of topics given in the module, 86.7% of the respondents opined that the

Table 3. Effectiveness of an e-learning module on mud crab fattening

Categories (I to VI)	Sub - categories	Agree	Neutral	Disagree
I. Contents of the module	Contents that exactly fits your needs	92.0	8.0	0.0
	Contents are easily understood	77.3	13.3	9.3
	Contents are scientific	86.7	13.3	0.0
	Good and simple language usage in content presentation	86.7	13.3	0.0
	Contents are free of errors	88.0	12.0	0.0
	Module provides up-to-date content	72.0	14.7	13.3
II. Presentation and interactivity of the module	Systematic presentation	84.0	16.0	0.0
	The method of presentation fits the audience	86.7	13.3	0.0
	Information is presented in a logical order	84.0	6.7	9.3
	Navigational aspects of interactivity exist between module and learner	36.0	17.3	46.7
III. Visual design and accessibility of the module	The design of module is appropriate for the subject matter	89.3	10.7	0.0
	Text and audio materials suitable in the contents	88.0	12.0	0.0
	Color usage is suitable in the contents	92.0	8.0	0.0
	Contents are appealing to the eye / ear	85.3	14.7	0.0
	The module is free from technical problems	100.0	0.0	0.0
	Interface is well designed	77.3	13.3	9.3
IV. User friendliness and motivation of the module	The module is user-friendly	70.7	14.7	14.7
	The module allows the learner to leave whenever desired, but easily return to the closest logical point in the module	24.0	20.0	56.0
	Module stimulates the interest or curiosity of learners	66.7	18.7	14.7
	Module is enjoyable	65.3	14.7	20.0
V. Module applicability	This module helps you in your learning of mud crab fattening	90.7	9.3	0.0
	The module is able to assist farmers/extension personnel in learning of mud crab fattening	92.0	8.0	0.0
	The module can be distributed to departments/ICT centres/other stake holders who are involved in aquaculture development programmes	100.0	0.0	0.0
VI. General assessment	Intention to use it in the future	85.3	14.7	0.0
	Intention to recommend it to other learners	100.0	0.0	0.0
	The e-Learning can be used as an alternative learning material in mud crab fattening	84.0	16.0	0.0

language used for explanations was simple and easy to understand, 88% of them agreeing that the contents were free from spelling errors and 72% of the respondents found that the module provided up-to-date information. They also felt that the dynamic learning module provides current information which would be useful for updating the knowledge and skills. Gerard et al. (2006) discussed about the dynamic content and content reusability in e-Learning for effective updation of knowledge and skills on users.

The category II included the presentation of the module contents as well as navigational aspects of the interactive module. As shown in Table 3, 84% of the respondents perceived that the contents were systematically arranged. Nearly 87% of the respondents agreed that the method used for presentation was good and easy to understand and 84% found that the information was presented in a logical order. Overall, 36% of them agreed that some degree of interactivity existed between the module and the learner. In terms of navigation aspects of interactivity, all of them felt that they required the control over the presentation flow of the module, with the ability to move forward, backward or out of the contents and module. In addition, they felt that the inclusion of interactive quizzes or tutorial sections would enhance the interaction between the module and learner. Percy et al. (2007) discussed the importance of quiz, which are relevant to the content, in the e-Learning module for testing the utilization of module among the users.

The items related to visual design and accessibility of the module is presented in category III, in Table 3. Of all the respondents, 89.3% agreed that the design of the module was appropriate for the users who were interested in the mud crab fattening. They also agreed on the suitability of the text and audio (88%) and colour usage (92%) in the module. Nearly 85% of the respondents agreed that the contents were appealing to the eye and ear. Nearly three-fourth of them (77.3%) expressed that the module had a good interface design. All the respondents (100%) agreed that the module was free from technical problems. They felt that the module was stable and would not easily crash or hang.

The items related to user friendliness and motivation of the module is presented in category IV in Table 3. Nearly 71% of the respondents agreed that the module was user-friendly. It could be found that

only 24% of the respondents felt that the module allowed them to leave whenever desired, and again easily return to the closest logical point in the module. In terms of motivation of the module, 66.7% of the respondents opined that the module stimulated the interest or curiosity of learners, with nearly 65% of them agreeing that the module was enjoyable and interesting. They felt that the inclusion of multimedia with animation effects would increase the motivation of the learners. Chong et al. (2005) highlighted the importance of animation in e-Learning module towards the visibility of increasing the motivation factors among the learners.

Overall, 90.7% of the respondents expressed that the module had assisted them in understanding mud crab fattening. More than 90% of them felt that the module was suitable to assist farmers and extension personnel in imparting knowledge on mud crab fattening. The results on module applicability are shown in category V (Table 3). All the respondents (100%) felt that the module could be distributed to departments / ICT centres / other stakeholders who are involved in aquaculture development programmes.

The results on general assessment indicated that majority of the respondents had the intention to use the module in future (85.3%) and to recommend to other learners (100%) who are interested in mud crab fattening (Table 3). The results also revealed that 84% of the respondents felt that this module could be used as an alternative learning material in mud crab fattening though it still needed improvements in various aspects such as presentation of information with animation effects, user friendliness and interactivity.

Overall, the perception of the respondents towards e-Learning module developed was encouraging. The findings revealed that the items related to contents produced, visual design and accessibility had good responses. Respondents also had good impressions about the presentation style, with the exception of the interactive elements.

The module was found to be suitable to serve as an alternative learning material that would assist learning mud crab fattening in the subject of aquaculture development. The respondents felt that the module would be suitable in assisting the users of VKCs to gain knowledge about mud crab fattening. Respondents also commented that the

animation features could be included for better presentation and motivation of the learners. Overall, the module was successfully produced with all the features intended and the evaluation of the module was carried out using ADDIE model of Instructional System Design.

Acknowledgements

The authors are thankful to Dr. A.G. Ponniah, Director, Central Institute of Brackishwater Aquaculture, Chennai, for his guidance and encouragement. The authors are also thankful to M.S. Swaminathan Research Foundation, Chennai and Village Knowledge Centres, Puducherry, for their cooperation and coordination during the study.

References

- Chong, J.L.S., Yunus, J.M. and Spahat, G. (2005) The development and evaluation of an e-module for pneumatics technology. *Malaysian Online J. Instr. Tech.* 2: 25-33
- Cronbach, L.J. (1951) Coefficient alpha and the internal structure of tests. *Psychometrika*. 16: 297-334
- Gerard, S.A., Sreenath. D., Diwakar, B., Kumar, S.R. and Balaji, V. (2006) Content reusability in e-Learning - ICRISAT's experiments with LMS. In: Third International Conference on e-Learning for Knowledge Based Society, pp 12.1-12.5, August 3-4, Bangkok, Thailand
- Mahalakshmi, P., Vimala, D.D. and Krishnan, M. (2007) Mud Crab Fattening -*Scylla tranquebarica*. e-Learning module (Compact Disk), Central Institute of Brackishwater Aquaculture, Chennai, India
- Mahalakshmi, P., Vimala, D.D. and Krishnan, M. (2008) Web kiosks in aquaculture: A study of aquachoupal model in Prakasam district of Andhra Pradesh. In: Extension Strategies for Fostering Knowledge Centric Agricultural Growth (Vasanthakumar, J., Bhaskaran, C. and Philip, H., Eds), pp 66-72, Society of Extension Education, Tamil Nadu Agricultural University Campus, Coimbatore, India
- Mahalakshmi, P., Vimala, D.D., Krishnan, M. and Ravisankar, T. (2009) Needs assessment of ICT users for implementation of aquacultural development projects in coastal areas. *Fish. Technol.* 46: 73-78
- Percy, A., Yanamandram, V. and Humphrey, S. (2007) Using evidence and avoiding plagiarism in e-learning module: scaffolding academic integrity. In: Annual Conference of the Australasian Society of Computers in Learning in Tertiary Education (Atkinson, R., McBeath, C., Kit, A.S.S. and Cheers, C., Eds), pp 839-843, Nanyang Technological University, Singapore
- Sailaja, A. and Reddy, M.N. (1999) Training needs of farm women in paddy and additional activities. *J. Extn. Educ.* 10: 2419-2424
- Strickland, A.W. (2006) ADDIE. Available at: <http://ed.isu.edu/addie/index.html> (Accessed 16 August 2011)