Ordinal Logistic Regression to Design an Efficient Mobile Training System from Iranian Experts' Point of View

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Abstract

M-learning offers enterprises the ability to keep their employees engaged in ongoing learning activities that will enhance their productivity and effectiveness, while they work. M-learning can deliver "just in time learning" to enable workers to solve immediate problems and remember the solutions. Because of its portability and low cost, this concept can also be applied to basic education in rural and remote areas. This will greatly expand the educational opportunities and contribute to reducing digital gap in developing countries. The research population included all the extension agents in rural services centers in Phoomanat province (with population size N=78) and a census study was conducted. This study employed the ordinal logistic regression to design an efficient mobile training system in rural areas of Iran. Namely, the results indicated that the factors which affect on designing an efficient mobile training system are self-directed learning skills, Mobile skills, and Equipment factors.

Keywords: *design; mobile training system; efficient system; Iran.*

1. Introduction

Phoomanat is a rural area in North part of Iran, where about 68802 people (18080 householders) living there. *Phoomanat* farmers produce about 72000 tons of rice and 39200 tons of tea leaves pre years. This fact represents the important role of this area from agricultural perspective. There are 4 rural service centers with 78 extension agents in *Phoomanat*. Clearly, such number of extension agents does not enough for such high number of farmers. Therefore, according to the problem of low ratio of extension agents to farmers, an appropriate educational system is required. Such educational system should be: accessible anywhere and anytime; and covered many clients.

Learning while being mobile, and through the use of a mobile device, is considered to be independent from time and location, as it could occur at anytime and in any place. It also provides access-on demand learning content for learners. Mobile learning can be viewed as the focal point, where mobile technologies and web-based learning intersect to offer anywhere, anytime, and instant on-demand educational information. Mobile learning is generally defined as a means of e-learning which occur through a mobile device (Trifanova & Ronchetti, 2003). Generally learners have to find a personal computer with internet access to learn in an e-learning environment. Meisenberger and Nischelwitzer (2004) states however that this can not be considered as fully anytime and anywhere learning, as the learner is fixed

to their location. Today mobile devices have some unique features which make them an efficient device capable of providing, sharing and exchanging of learning content. Some of these features are summarized by Jo et al. (2002) and are presented as follows: Portability and mobility because of the small size and lightweight of mobile devices; Flexibility; Convenience; Remote Accessibility; Ease of use; and Utility.

Mobile telephony offers some unique opportunities, including: providing a direct global communication channel to rural communities, extending the impact of established rural media, such as rural radio, making local content available, making rural services more efficient (logistics, coordination, etc) and cost-effective. These benefits are amplified by the fact that the spread of mobile technology in some rural regions has occurred much faster than with other information and communication technologies. (Yunus, 2009)

The number of rural mobile phone users has been steadily increased in Iran. With the development of rural economy and the farmers' gradually improved income, there will be more and more farmers to use mobile phones in the rural area. Mobile penetration coefficient in *Phoomanat* in recent years has been also dramatically increased. (Phone Company, 2009). So in this research, we will focus on cell phone among the other wireless technologies used in m-learning method.

For mobile users as well in all mobile applications, SMS messaging is found to be the most useful and convenient way of technology. SMS is inexpensive, supported by almost all phones as an unlimited offering, familiar to students, and rapidly gaining worldwide acceptance. SMS is a low-threshold application used widely by students to quickly send concise, text-based messages at any time. Text messaging, also known as the short message service or SMS, is changing the communications landscape (Briggs, 2006).

Virtually no research exists on the applications for m-learning in agriculture in Iran. Thus, there is a need to undertake such a study. Moreover, in Iran, Internet facility is still limited in most of the rural areas. Hence we propose a cost-effective SMS based system, named 'Efficient Mobile Training System', for providing the farmers information about market prices of agricultural commodities and advice about fertilizers to be used for the particular crop being asked.

The main purpose of this study is to Design an efficient Mobile Training System in rural areas. The objectives of this study are as follows: 1) identify factors which affect the efficiency of the system; 2) identify general characteristics of experts.

2. Prior Studies

2.1. Factors Affecting the Efficiency of a Mobile Training System

In considering the implementation of mobile learning, Attewell (2005) suggests five broad categories of technology that should be considered, namely transport, platform, delivery, media technologies, and development languages.

Laouris and Eteokleous (2005) implied to factors which affect on efficiency of a mobile training system as following: First, participating humans, i.e., the learners and their instructors or professors. A learner is a broader concept and could be an elementary school child, a life-long-learner or a worker at the workplace. Of course this list could potentially include peripheral stakeholders such as school technocrats, representatives of the ministry of education. Finally, it could also include resource persons such as technicians from the Internet service (ISP) or mobile service providers as well as librarians interacting with content stored in related databases. Second, all technological elements. One could theoretically consider separately the physical equipment, from virtual systems such as application software, interfaces and drivers, etc. Under physical equipment one may include all types of computers

and of course all types of mobile devices. Optimally, any new mobile learning solution should be capable of blending within existing computer- and mobile technologies without the need for significant changes and adaptations in already developed parts.

Finally, theories of learning and pedagogies, and how these can be modeled effectively in the context of mobile learning. The new pedagogy must also support ambient learning.

Schreurs et al (2009) implied to Technology, human, and environment factors while Sun et al (2008) pointed out to Learners' attitude toward computer, learners' computer anxiety, technology quality, and internet quality. Swatman (2007) pointed out to Students' and teachers' preparedness, infrastructure, management Support, culture, preferences factors while Naismith and Corlett (2006) implied to Curriculum, students' experience, Ownership of technology. Trifonova and Georgieva (2005) imply to parameters seem to be important for mobile learning like availability of devices; the ways of devices usage; attitude to technology; opinion about prices of hardware and telephone and internet services. Sharples et al (2004) imply to *Availability of Technology* which provided *for* or *by* the learner; *Institutional Support* which it is observed that successful projects have good institutional support including staff training and equipment/software maintenance; *Connectivity* which Successful mobile learning projects incorporate wireless network access.

Piskurich (2003) believes an ability to work alone, persistence in learning, and ability to develop a plan to complete a work are such skills which are essential for ICT based learning. Self-directed of learners is a factor which can be used to measure whether or not a leaner can stand alone, whenever an instructor is not available (Haney, 2001).

3. Variables and Research Model

Based on previous studies a questionnaire developed to design an efficient mobile training system in rural areas. The first section of questionnaire consisted some items to gather data about demographic characteristics, such as age, gender, level of education and etc. The second section included factors (self-directed learning skills, Mobile skills, Equipment, Attitude, and opinion about the prices) affecting the efficiency of a mobile training system. The third section included variables which measure the dependent variable. An efficient training system identified by its Affordability, Availability, and Adaptability, also known as triple As. (Aluko, 2004 & Dunmade, 2002). Finally, all three variables summarize into a single variable which is the dependent variable, called efficiency of mobile training system from experts' viewpoint. Eighteen independent variables can be categorized into five factors which are presented alongside with their related hypothesis in Table1.

Table 1: Independent Variables and Research Hypothesis

Factors	Variable and References	Hypothesis
self-directed learning skills	Learn without assistance of instructors? Resist distractions and stay on task while working or studying? Keep up with assignments, and meet deadlines? Manage time appropriately and Complete things on time? Guglielmino & Guglilmino (2002); Kim (2005); Graeve (1987); Straka et al(1994).	There is a significant relationship between an efficient mobile training system (dependent variable) and self-directed learning skills
Mobile skills	Ability to send SMS, ability to receive SMS? Ability to receive and send information via Bluetooth? Koo, 2008; Chapnick, 2000	There is a significant relationship between an efficient mobile training system (dependent variable) and Mobile skills.
Equipment	Having appropriate cell phone? "Having a Mobile with Bluetooth, wireless, camera capabilities". Having laptop? Trifonova & Georgieva, 2005	There is a significant relationship between an efficient mobile training system (dependent variable) and Equipment.
Attitude	Usefulness of m-learning in learning and saving time? Efficiency of m-learning in extension? Efficiency of SMS in education? Interest of educational SMS sending? Karmakar and Wahid, 2005; Sun et al, 2008	There is a significant relationship between an efficient mobile training system (dependent variable) and Attitude.
opinion about the prices	What do you think about monthly bill for cell phone? What do you think about cost of text message communication? What do you think about the prices of mobile phones? Trifonova & Georgieva, 2005	There is a significant relationship between an efficient mobile training system (dependent variable) and opinion about the prices

4. Research Design

The methodology used in this study involved a combination of descriptive and quantitative research. Questionnaire items were developed based on the previous literature. The questionnaire was revised with the help of ICT experts to examine the validity of the research model. A 5–point likert scale ranging from 1 as strongly disagrees to 5 as strongly agree was used for the measurement. A pretest for the reliability of the instrument was conducted with 15 experts randomly chosen from the target population. The factors and designing an efficient mobile training system were summarized into two single variables F, E. Then, the Cronbach's alpha from those variables was computed. The Computed Cronbach's alphas for F, E are 70.2 %, 74.5 % respectively, which indicated the high reliability of the questionnaire. The research population included all the Experts (with population size N=78). Because of small size of AIF experts, the total population was surveyed. This research employed the ordinal logistic regression to drive its results. The binary logistic regression is a well-known technique to set up a generalized linear model for the binary dependent variable. But for multiple ordinal dependent variables, the binary logistic regression does not work properly. Statisticians developed ordinal logistic regressions to handle multiple ordinal dependent variables. Minitab 14 is a statistical software package that can fit an ordinal logistic regression to data. The output of the software includes: 1) Response and Factor Information, which displays the number of observations and the response and factor categories; 2) Logistic Regression Table, which shows the estimated coefficients, p-values (related to a test that the corresponding coefficient is zero) and odds ratio (which shows the effect of variables on the model); 3) Goodness-of-Fit Tests which displays both Pearson goodness-of-fit test of the model to data. The steps in model building for an ordinal logistic model are the same as those for the binary logistic regression model. Unfortunately, the full array of modeling tools is not available in the software packages. So, one has to choose a final and appropriate model by entering variables which their coefficients are significant (p-value<0.05) and ordering effect of variables from their odds ratio (negative coefficient along smallest odds ratio indicates more impact of the variable on the dependent variable, McCullagh & Nelder, 1992). Finally, appropriative of model is evaluated by (i) a G test whose null hypothesis states all the coefficients associated with predictors equal zero versus at least one coefficient is not zero (we prefer to reject their null hypothesis, i.e., p-value <0.05) and (ii) Goodness-of-Fit Tests, (we prefer to accept their null hypothesis, i.e., p-value >0.05), of which more can be found in Hosmer & Lemeshow (2000) and McCullagh & Nelder (1992).

5. Results

5.1. Descriptive Statistics of Experts' Demographic Profile

The results of descriptive statistics indicated that 80% of respondents were male. Majority of experts (63.4%) have bachelor degree and they are 39 years old in average.

5.2. Ordinal Logistic Regression

Since all variables in this research are ordinal, one has to employ the median to summarize a group of variables into one single factor. Firstly, variables in Part 2 (efficiency variables) are summarized into a dependent variable. Meanwhile, independent variables are obtained by summarizing variables into factors which are given in Table1.

Table 2 presents the coefficient, p-value and odds ratio of the ordinal logistic regression analysis.

Table 2: Ordinal Logistic Regression

	Dependent variable, i.e., efficiency of mobile training system			
	Coefficient	P-value	Odds ratio	Rank order
α_1	0.756	0.523	___	___
α_2	1.805	0.084	___	___
α_3	3.788	0.000	___	___
α_4	4.651	0.000	___	___
α_5	6.212	0.000	___	___
self-directed learning skills (SDL)	-0.869	0.000	0.38	1
Mobile skills (MS)	-0.760	0.046	1.27	3
Equipment (E)	-0.649	0.011	0.56	2
Attitude (A)	-0.803	0.735	0.93	
opinion about the prices (OP)	-0.065	0.863	0.91	
P-Value for test that all coefficients are zero= 0.0				
P-Value of the Goodness-of-Fit Tests= 0.882				

One can summarize the results of the above table as follows:

The P-Value indicates that for 0.05 alpha-level, there is sufficient evidence to conclude that self-directed learning skills, Mobile skills, and Equipment factors are significant ones.

Small odds ratio indicates that impact of factors can be ordered as self-directed learning skills, Equipment, and Mobile skills factors.

P-Value=0.00 for test that "all coefficients are zero" along with the P-Value for" the Goodness-of-Fit Tests" >>0.05 (0.882) indicate that the ordinal logistic regression is an appropriate model to analyze the data.

The ordinal logistic regression gives 5 parallel equations (i=1, 2…5) which are

$$\gamma_i = \frac{\exp\{\alpha_i - 0.869\,\mathrm{SDL} - 0.649\mathrm{E} - 0.760\,\mathrm{MS}\}}{\mathbf{1} + \exp\{\alpha_i - 0.869\,\mathrm{SDL} - 0.649\mathrm{E} - 0.760\,\mathrm{MS}\}}$$

Where γ_i is the cumulative probability efficiency of the mobile training system of i^{th} level and $\alpha_1 \ldots \alpha_5$ are given in the above table.

6. Discussion & Conclusion

M-learning can be defined as 'the acquisition of any knowledge and skills through the use of mobile technology, anywhere and anytime' (Geddes, 2004). It is ushering us into a new era of training and education. For companies, mobile learning helps reduce the traditional training infrastructure, facilitates the learning process of employees and improves their productivity and effectiveness whilst on the move (Donnelly, 2009). It adds a new dimension for student–instructor interaction and a positive attitude among the students towards the instructor and learning (Grohmann et al., 2005). In addition, m-learning contributes to improving the accessibility, interoperability and reusability of educational resources, and to enhancing

interactivity and flexibility of learning at convenient times and places (Murphy, 2006). It extends learning opportunities to all social-economic levels, in particular those previously unreachable from traditional education approaches, such as school dropouts (Attewell, 2005). As Naismith et al. (2004) pointed out, m-learning would enable a sort of 'highly situated, personal, collaborative and long-term (learning); in other words, truly learner-centered learning'. In a similar way, Sharma and Kitchens (2004) suggested that the advent and subsequent development of mobile learning indicates a profound evolution from distance learning (d-learning) to electronic learning (e-learning) and then on to m-learning.
From ordinal logistics regression, the following three factors are proven, statistically, to have a critical relationship with efficiency of a mobile training system.

Self- directed learning skills: According to Gibbons (2002), a learner who practices self-directed learning (SDL) initiates challenging activities and develop personal knowledge and skills to pursue these challenges successfully. More specifically, Knowles (1975) described SDL as a process in which individuals take the initiative, with or without help from others, in diagnosing their learning needs; formulating their learning goals; identifying human and material resources for learning; choosing and implementing appropriate learning strategies; and evaluating their learning outcomes. Candy (1991) further discussed SDL and related it to learning strategies. He postulated that learning environments that foster SDL are believed to promote deep-level processing in which learners seek meaning in the subject matter rather than surface-level processing where learners are engaged in rehearsal and memorization. (Biemiller & Meichenbaum, 1992). Generally, SDL entails goal setting and task analysis, implementation of the plan that was constructed and self-evaluation of the learning process (Loyens et al., 2008).

Equipment: the importance of equipment factors pointed out by several authors, such as Barajas & Owen (2006), Surry (2002), Ebadi (2005), Castels (1996) among others, reflects that the responsible organizations might pay more attention to appropriate hardware and software and infrastructure of the system, such as Having appropriate own cell phone with Bluetooth, wireless, and camera capabilities.

Mobile skills: Our findings corroborate those of Sun et al (2007), Guglielmino (2002), Lynch (2001), Samak (2006), Tai (2005) among others, who found skill of learners had a direct impact on the efficiency of the system. Therefore, it would be suggest that the agricultural extension organizations to improve mobile skills of farmers.

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