A Hybrid Course for Probability and Statistics for Engineers: A Readiness Study at Shahid Beheshti University

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Abstract—**Probability and Statistics for Engineers covers verities of subjects in the set theory, the combinatory analysis, probability, statistics, and (in some universities) the stochastic processes. Since, course receives only 3 credits it has to be thought 3 hours/week. This overloading content along with time limitation make course as a challenging and difficult one for students. Also, many instructors, including the first author, found the course very challenging to teach. Two popular on-site and e-learning training systems do not provide any appropriate solution. This article suggests a hybrid training system, which combines some elements of both training systems to reduce the disadvantages of both systems. Readiness of such hybrid course is measured by preparedness of students for online activities. The readiness study at Shahid Beheshti University shows that *Internet skills, self-directed learning, learner attitude toward e-learning, e-mail skills,* and *software ability* of students are factors which are significantly affect *readiness* of students.**

Index Terms—**Readiness, Hybrid course, Probability and Statistics for Engineers, E-learning.**

I. INTRODUCTION

Probability and Statistics for Engineers is one of the challenging courses for both instructors and students in engineering. Overloading of the course content, time limitation, and simultaneous offering the course with several difficult courses (such as fundamental of physics, multivariate calculus, differential equations) transform an interesting course to a difficult one. Some instructors suggest dropping some less important materials of the course, and teaching the rest with more care. But, the majority of them believe that the course contents have been chosen based upon students' needs in other courses and their research. Therefore, it is reasonable to employ a training system which have no time limitation and can be adapted based upon learners' abilities.

An e-learning training system can provide an interactive, individualized, and repeatable environment to teach a subject. Universities are witnessing many benefits of e-learning, such as cost saving, increasing flexibility, productivity, rapidly developing, deploy and update a course, providing an effective training system, availability anytime and anywhere, providing broadly training opportunities, staying competitive, improving motivation and morale, and implementing strategic initiatives more effectively (Bonk, 2002; So and Swatman, 2007; Minton, 2000). On the other hand, there are situations where an e-learning training system is not an appropriate one. Many instructors believe that mathematics and statistics need the traditional face-to-face training system and they cannot teach using an online training system (Broadbent, 2001 and Chapnick, 2000).

To overcome such barriers and limitations, several authors suggest using a hybrid course; see Garnham and Kaleta (2002) and Sands (2002), among others for more detail. Many universities have sought to develop their own hybrid learning courses as another option for students and instructors who prefer to replace some portion of traditional face-to-face meeting time with online instruction (Olapiriyakul & Scher, 2006). In a hybrid training system, similar to the traditional training system, students participate in a classroom and learn significant portion of the course on-site. But, some complimentary activities such as advanced topics, assignments, quizzes, more examples, and etc are moved to an online part. The goal of hybrid courses is to join the best features of in-class teaching with the best features of online learning to promote active independent learning and reduce class seat time (Garnham and Kaleta, 2002). Moreover, Arbaugh (2000) pointed out that hybrid courses may be accompanied benefits of both on-site and e-learning techniques to reduce disadvantages of both techniques. To have a successful hybrid course an instructor must invest significant time and effort in redesigning a traditional course. Since, online activities require special abilities, equipments, and etc. of learners. Garnham and Kaleta (2002) pointed out that readiness of a hybrid course measured by preparedness, mentally or physically, of learners in online activities.

Sands (2002) described how one may integrate online activities with classroom work to obtain a successful hybrid course. Based upon Sands' suggestions, our experience, and several in-deep interview with some experts and instructors, we decide to design a hybrid course, which (**i**) the course contents teach in the On-site part; (**ii**) Class materials companies with some new examples and more advanced materials as well as quizzes and assignments are moved to the On-line part.

This article reports the readiness of Shahid Beheshti university (say SBU) students, who registered the course in 2009 winter semester. This article develops as the following. Section 2 reviews some relevant literature regarding readiness. Research's hypothesizes as well as statistical methods are given in Section 3. Research's design is given in Section 4. While Section 5 represents results of the research. Finally, Section 6 provides a conclusion regarding our findings.

II. Literature Review

Webster's New Collegiate Dictionary defines readiness as bei ng prepa red, m entally or phy sically, for som e ex-perience or act ions. B orotis and p oulymenakou (2004) defined e-learning readiness of an or ganization as pre par-edness, m entally or phy sically, for s ome e-l earning ex -perience or actions.

Kaur and Abas (2004), Anderson (2002), Bean (2003), Chapnick (2000), Clark and Mayer (2003), and Gold et al. (2001) are aut hors, am ong o thers, who di scussed the ne-cessity of a re adiness study in an e-learning training sys-tem. Th ey war ned th at with out a careful pl anning m ost likely an e-l earning system wi ll be ended wi th cost over-runs, unappealing t raining p roducts, and failure. M ore-over, they stated that (sim ilar to any other major i nnova-tions) e-l earning st rategies r equire co nsiderable up -front analysis, developm ent tim e, money, technological i nfra-structure, and leadership su pport to be successful . There-fore, managers must assess their companies' readiness for an e-l earning system, before im plementing t his i nnova-tion. Several authors st udied fact ors w hich m ay affect readiness of learners. Table 1 summarizes some of their results.

III. Variables and Hypothesizes of Research

A two -section su rvey en titled, *"e-Learning Readiness Survey"* has been developed to assess e-learning readiness of st udents at SB U, wh o re gistered t he course i n 2009 winter sem ester. The fi rst sect ion consi sted of 5 i tems to gather dat a about dem ographic charact eristics, such as gender, schola stic success (which is measured by Gra d Point Average, GPA), major, computer usage, and Internet usage in the week who takes the survey. The second sec -tion included 41 item s to asse ss respon dents' self-report perceptions of their readines s for an e-learning training system. No w observe that: (i) th e On-line part o f the h y-brid training system is a new part, which added to the tra-ditional part. Therefore, it is reasonable to measure readi-ness of l earners for t he hy brid t raining syst em t hrough their readiness for an online training syste m; (ii) R eadi-ness defi nes b ased upo n m entally and phy sically prepar-edness of studen ts who will p articipate th e course. Fro m these observations one can conc lude that, readiness of the hybrid t raining sy stem (dependent variable) can be meas-ured, only, by students' online preparedness, mentally and physically, using q uestions 1 to 9. It is worth t o mention that q uestions 1 to 5 assesses th e m ental read iness wh ile

questions 6 t o 9 assess t he phy sical readi ness of st udents in the survey.

DeVellis (20 03) ind icated that th e first step in d evel-oping an instrument is, clearly, d etermining what it is th e researcher wants to measure. The variables, or factors, of this research identified afte r d etailed an alyses o f th e available e-le arning readi ness assessm ent instrum ents, and au thors' personal ex perience. As a result, 12 m ajor factors t hat ca n be helped o rganizations t o measure how ready they are for an e -learning training sy stem are iden-tified.

Based upon previous researches, partly given in Section 2, a questionnaire devel oped t o m easure readi ness of a learner for the online course . Ap pendix A r epresents t he questionnaire items as well as their sources. Now, the fol-lowings present the hypotheses of this research.

Hypothesis 1. Skills of users influence **on learners' readiness for an online course.**

Learners with h igh sk ills h ave more co nfident to ac-complish e-lea rning activ ities an d i mprove their satisfac-tion. Many studies explore influences of self-efficiency on users' recognition effects. Wang and Ne wlin (2002) from a research, on 122 st udents, concl uded that students wi th higher skills are more inclined to adopt a network-base d learning sy stem and earned, si gnificantly, bet ter fi nal grades. Users' Sk ills wh ich considered in this stu dy are learners' ab ility to ev aluate their ab ility to use th e so ft-ware, har dware, e- mail and Internet to perform an e-Learning activity.

Hypothesis 2. **Self-directed ability of learners influ-ences learners' readiness for an online course.**

In an online course, a learner goes through instructional material, delivered via the We b, at his/her own pace with no (m ore preci sely, wi th minimal) interaction fr om an instructor. Self-directed of l earners is a factor which can be used to measure whether or not a leaner can stand alone, whe never an instructor is not avai lable (Haney, 2001). Piskurich (2003) believes an ab ility to work alone, persistence i n learning, and ability to devel op a pl an t o complete a wo rk are su ch sk ills wh ich may affect read i-ness of e-learners.

Hypothesis 3. **Learners' attitude toward an online course influences on their readiness for the course.**

Arbaugh (2002), Hong (2002), and Piccoli et al. (2001) are such authors, among others, who believe that learner's

TABLE I.
FACTORS AFFECTING LEARNERS' READINESS

Author	Factors
Schreurs et al (2009)	Resources (technological and human readiness), education, environment
Koo (2008)	Individuals' language, discipline, experience in using e-mail, skill levels
So and Swatman (2007)	Students' preparedness, teachers' pre paredness, infrastructure, management Support, school culture, preference to meet face-to-face.
Sun et al (2007)	Learner attitude toward computer, learner computer anxiety, technology quality, Internet quality.
Liu (2005)	Trainee characteristics, training content, system design, working environment.
Gunawardana (2005)	Instructional material, tutorial support, communication, collaboration
Haney (2002)	Employee co mpetency, develop ment needs, career paths and r ecords, cour se tr acking tec hnology, infrastructure, supporting finance, vendor offerings.
Chapnick (2000)	Psychological, sociological, hu man-resource, financial, technological skill (aptitude), e quipment, content readiness.
Gastaldo et al (2005)	User characteristics, accessibility to computer equipment, knowledge, attitudes toward ICT

attitude, towards e-learning, are an important factor in e-learning readiness. Learner's attitude can be defined as learner's impression to participate in an e-learning activity. Instructors post their materials on the platform and learners participate through computer networks. A more positive attitude toward e-learning, for example, when students are not afraid of the complexity of using computers, will result in more satisfaction and effectiveness of learners in a n e-learning environment (Piccoli et al., 2001). Furthermore, positive attitudes toward e-learning increase the chances of success of an e-learning system, while negative attitudes reduce it. Therefore, this research considers learners' attitude towards computers as an important factor in e-learning readiness.

Hypothesis 4. **Learners' computer anxiety influences on their readiness for an online course.**

Piccoli et al. (2001) believe computer anxiety, significantly, affects an e-learning environment. Computers are communication tools in e-learning environments. Therefore, any fear in computer usage would certainly hamper learning (Piccoli et al., 2001). Computer anxiety is an emotional fear which comes up some potential negative outcomes, such as damaging to equipments or looking foolish (Barbeite and Weiss, 2004). The higher computer anxiety causes the lower level of e-learning readiness. The definition of computer anxiety in this research is the level of learners' anxiety, when they apply computers.

Hypothesis 5. **Equipments influence on learners' readiness for an online course.**

Other factors contributing to an increase in e-learning readiness are the infrastructure of technology and technical support of an e-learning system. It is important to bring into account the reliability and quality of the system, because they play important roles in e-learning readiness. To build an acceptable e-learning environment, one has to maintain and up-to-date technology and material represented by the environment (Folorunso et al., 2006; Poon et al., 2004; Selim, 2005).

Hypothesis 6. **Scholastic success of learners, influence on learners' readiness for an online course.**

Carmel and Gold (2007) pointed out those learners who reported higher readiness tended to be more successful, scholastically.

Hypothesis 7. **Gender of learners influences on learners' readiness for an online course.**

Summer (1990) and McMahon and Gardner (1995) found out that male students experience less anxiety about ICT than female students. Moreover, Oliver (1993) and Van Braak (2001) discovered that female students have lower confidence or knowledge ability than males regarding computer usage. However, many other authors (such as Koohang, 1989; Kay, 1989; Hunt and Bohlin, 1993; Marshall and Bannon, 1986; Woodrow, 1991 among others) are agree with the claim that "*there are no significant different between attitude of male and female students regarding ICT usage*".

Hypothesis 8. **Major of learners influences on their readiness for an online course.**

Summers and Easdown (1996) mentioned that student's major and specialization are such factors which influence on e-learning's readiness.

IV. RESEARCH DESIGN

A series of in-depth interviews, with various experienced e-learning and instructors of the course, have been conducted to examine the validity of our research model. After that, questionnaire items developed based upon previous literature and comments gathered from the interviews. Questionnaires were revised with help from experts (including academics and practitioners) with significant experience in e-learning and Probability and Statistics. A 5-point Likert scale ranging from 1, as strongly disagrees, to 5, as strongly agrees, is used for the measurement.

A pretest, to measure validity and reliability of study, was conducted with 3 instructors and 2 e-learning's experts. Followed by pretest to verify reliability of questionnaire, a pilot test has been conducted using 20 randomly chosen students from the target population. Questions regarding skills of users, online audio/video, self-directed leaning, learner attitude toward learning, leaner computer anxiety, equipments, and e-learning readiness can be summarized into 7 single factors $F_1, ..., F_7$. The Cronbach's alpha from those factors are 80.2%, 75.34%, 95.01%, 89.32%, 73.02%, 89.54%, and 78.93% respectively, which indicate an acceptable reliability of the questionnaire.

The research population included all undergraduate students in computer and electronic majors, who registered in the Probability and Statistics course in 2009 winter semester at SBU (with population size N=130). After a pilot test, a census study was conducted by distributing the questionnaire among all students. This survey generated 109 useable responses from students resulting in a response rate of 83.8%, which is indicated that the respondents found the topic interesting and relevant.

This research used two statistical packages, Minitab 13, SPSS 16, to analyze the data. Data was analyzed using the following two techniques.

A. Ordinal Logistic Regression

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 an ordinal logistic regression to handle multiple ordinal dependent variables. Minitab 13 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 effect of each 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 similar to 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 with significant coefficients (p-value<0.05) and ordering effect of variables from their Odds ratio (negative coefficient along smallest odds ratio indicate more impact of the variable on the dependent variable, McCullagh and Nelder, 1992). Finally, appropriative of model is evaluated by (**i**) a

TABLE II.
DEMOGRAPHIC PROFILE AND DESCRIPTIVE STATISTICS OF STUDENTS

Sex	Female (42.20%)	Male (57.80%)
Province	Tehran (77.78%)	Other (22.22)
Major	Computer (33.03%)	Electronic (66.97%)
Computer usage (daily)/hour	Mean=3.058 S.D=1.811	
Internet usage (daily)/hour	Mean=2.159 S.D=1.519	

TABLE III.
PERSONAL AND UNIVERSITY FACILITIES

Having Laptop	Yes (55.05)	No (44.95)
Having an appropriate personal computer	Yes (94.50)	No (5.50)
Internet connection at home✲	Dial-up (60.55)	ADSL (9.17)
Internet connection at university✲	Wireless (62.38)	Wire (27.72)
Having a cell-phone	Yes (100%)	No (0%)
Having an appropriate memory stick	Yes (88.07)	No (11.93)

*Contained some missing observations

G test wh ose its n ull h ypothesis states a ll the co efficients associa ted with pre dictors equal zero vers us at least one coefficient is not ze ro (we prefer to reject its null hypothesis, i.e., p-value <0.05) and (**ii**) Goodness-of-Fit Tests, (we prefe r to a ccept its null hypothesis, i.e., p-val ue >0.1), more can be foun d i n Hosm er and Lemeshow (20 00) an d M cCullagh and Nel der (19 92), among others.

B. Contingency table

A co ntingency t able (or cr oss t abulation) describes the di stribution o f t wo or more vari ables sim ultaneously. Each cell shows the number of respondents, who gave a specific combination of responses. Since contingency table is easy to understand, can be used with any kind of dat a, (the co ntingency t ables t reat no minal, or dinal, interval, and ratio scales as a nom inal scale), provides g reater i nsight t han si ngle st atistics, and ca n be used as a tool to measure association among variables is one of most popular techniques in statistics. I n a two-ways contingency table, there are several statistical tests can be used to test hypothesis:

H_o : **Row's Variable influences on variable in column**, vs. H_1 : **Rejection of H_o.**

Which t he chi -square t est is t he most pop ular one. The sm all enoug h p -value o f t he t est (l ess than 0. 05) indicates that there is no evidence for association between these variables.

V. RESULTS AND DISCUSSION

Demographic profile and descri ptive statistics of t ar get population are summarized in Table 2.

Table 3 summarizes personal facilities and attitude of students about university facilities.

A. Ordinal Logistic Regression

As mentioned the above, sev eral 5-point Likert scale variables have been used to measure readiness of a learner (see Appendix A). To summarize such variables into a single one, say the dependent variable, one has to

use t he m edian, w hich i s an appropriate central tendency for Like rt scale variables, see Agresti, 2003 a nd Johnson at al, 1999, among others. Therefore, readiness of each learner has 9 levels, b ecause median of those 5-point Li kert scal e vari ables generat es 1, 1. 5, 2, 2. 5, 3, 3.5, 4, 4.5, and 5.

To di scover a ffect of i ndependent vari ables t he dependent vari able an ordi nal l ogistic regressi on can be employed. The fol lowing t able represents coefficients, p-values and odds ratios of such ordinal logistic regression.

Results of Table 4 (bel ow) can be summarized as the following:

1. There is significant evidence to conclude that skills of u sers (e-m ail sk ills), sk ills o f u sers (software ability), sk ills o f u sers (In ternet sk ills), self-directed learn ing, and learn er attitu de to ward e-learning are s uch variables whose a ffect learning readiness, the dependent variable (their p-values is smaller than 0.05).

2. Small odds ratio i ndicates t hat im pact of si gnificant fact ors can be or dered a s (**1**) sk ills o f u sers (Internet sk ills), (**2**) self-di rected learning, (**3**) learner attitude toward e-learning, (**4**) sk ills o f us ers (e-mail skills), and (**5**) skills of users (software ability).

3. P-value= 0.00 fo r test th at "all coefficie nts are zero" al ong with t he p-va lue= 0.89 9 fo r "t he Goodness-of-Fit Test s" i ndicate t hat the ordi nal logistic regression i s an appr opriate model to analyze the data.

4. The ordi nal l ogistic regressi on gi ves 8 p arallel equations $(i = 1, 2, ..., 8)$

$$\gamma_i = \frac{\exp\{\alpha_i - 3.212X_1 - 3.321X_2 - 0.232X_3 - 1.232X_4 - 2.330X_5\}}{1 + \exp\{\alpha_i - 3.212X_1 - 3.321X_2 - 0.232X_3 - 1.232X_4 - 2.330X_5\}},$$

where γ_i is th e cu mulative p robability o f i^{th} level o f the depen dent variable and $\alpha_1, \alpha_2, ..., \alpha_8$ are constant values, which given in Table 5.

TABLE IV.
ORDINAL LOGISTIC REGRESSION

	Dependent variable, i.e., efficiency of the model.			
	Coefficient	P-value	Odds ratio	Rank order
α_1	0.842 0.	042	___	___
α_2	1.805 0.	000	___	___
α_3	0.345 0.	001	___	___
α_4	0.352 0.	000	___	___
α_5	0.452 0.	000	___	___
α_6	2.452 0.	005	___	___
α_7	3.452 0.	021	___	___
α_8	4.320 0.	000	___	___
Skills of users (e-mail skills), say X_5	-2.330 0.	040	1.3335	5
Skills of users (hardware ability)	-0.321	0.091	0.211	-
Skills of users (software ability) , say X_4	-1.232 0.	000	1.321	4
Skills of users (Internet skills) , say X_1	-3.212 0.	003	0.210	1
Self-directed learning, say X_2	-3.321 0.	000	0.321	2
Learner attitude toward e-learning, say X_3	-0.232 0.	001	0.983	3
Learner computer anxiety	-0.302	0.230	0.442	-
Equipments (hardware)	-2.123	0.410	0.662	-
Equipments (software)	-0.091	0.621	0.421	-
Equipments (Internet)	-0.001	0.832	0.321	-
Online audio video	-0.129	0.785	3.211	-
p-value of goodness-of-fit test= 0.899				
p-value of test that "all coefficients are zero"= 0.002				

TABLE V.
HYPOTHESIS'S RESULT

Hypothesis number	Chi-square statistic	Degree of free-dom	p-value	Result on H_o at significant level $\alpha = 0.05$
1 13.114		8	0.892	Accepted
2 4.893		8	0.231	Accepted
3 9.817		16	0.124	Accepted
4 3.	942	16	0.001	Rejected
5 0.	464	8	0.000	Rejected
6 3.515		8	0.102	Accepted
7 1.	596	8	0.009	Rejected
8 17.435		16	0.642	Accepted

B. Hypothesis tests:

As pointed out the above, readiness of each learners is a 9 level variable to test the given hypothesizes, one has to categorize the second variable in each hypothesizes into some levels. Population can be categorized into some groups regarding skills (low and high), self-directed ability (low and high), learners' attitude to-

ward the online course (negative, neutral, and positive), learners' computer anxiety (negative, neutral, and positive), ICT's equipments (enough and lack), gender (male and female), major (computer sciences and Electronic), and scholastic success, according to their GPA (week, GPA< 12, average, $12 \leq GPA < 17$, and strong, $GPA \geq 17$). The contingency analysis has been con
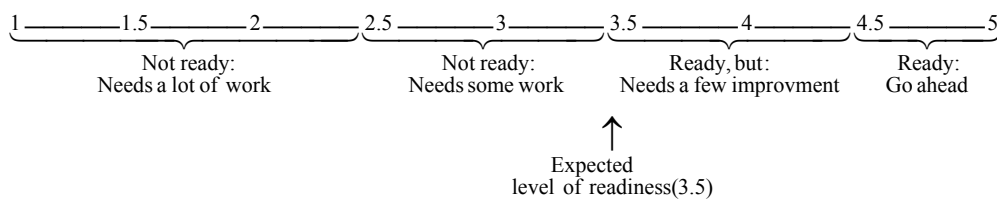
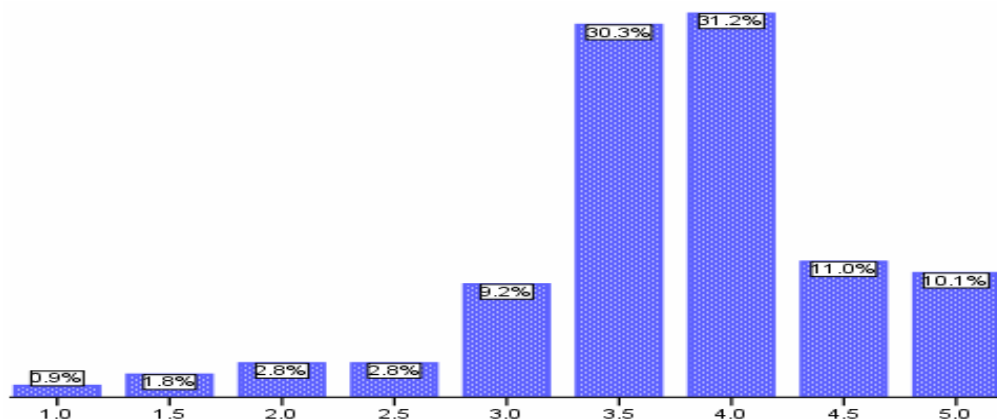Figure 1. Discriminative index to identify level of readiness of each individual

Figure 2. Distribution of the target population regarding level of readiness.

ducted t o see t est the gi ven 8 hy pothesizes. R esults summarized in Table 4.

From Table 4, one can observe that:

1. Computer anxi ety, equi pment, and gen der o f st u-dents do not affect their readiness reading the online training system.
2. Skills, self-d irected ab ility, attitude to ward th e online t raining sy stem, schol astic, and m ajor of students affect their readin ess reading the training system.

In order to h elp m anagers o f u niversities, we in tro-duce a d iscriminative in dex to id entify lev el o f read i-ness of each individual. Figure 2 duplicates such index.

The bar chart above d uplicates l evel of readi ness of the t arget pop ulation, regar ding t he ab ove discrimina-tive index.

Using the discriminative index, provided by Figure 2, one can observe that, more than 80% of the target popu-lation i s ready for t he onl ine course and co nsequently for t he hy brid course. B ut, they need so me im prove-ments, which vary from an individual to another one.

VI. CONCLUSION AND SUGGESTION

This st udy made t heoretical and p ractical cont ribu-tions to the literature of the hybrid course readiness and more specifically on students' perceptions of the hybrid course im plementation at SBU. The em pirical results showed that the most of factors that were extracted from the d ata were g enuinely sig nificant in p redicting th e criterion vari able. Our fi ndings co uld hav e pract ical importance for any uni versity as whose p lanning t o implement su ch h ybrid cou rse. Un iversities, in th eir rush to im plement the hybr id courses often place too much emphasis o n th e equi pment an d to o litt le o n th e human part. So, this research comes up with authorizes must take a h ard look at sk ills of users (Internet skills),

self-directed learn ing, learner attitu de t oward e-learning, skills of users (e-mail skills), and skills of us-ers (soft ware abi lity) even t hought other n on-significant, sta tistically, fact ors sh ould b e tak en in to account to have efficient a nd successful hybrid training system.

This st udy wa s t he fi rst part of a l ong t erm project, which desi gnation and im plementation of t he hy brid course a nd st udy sat isfaction and follow-up st udy are the last part of such project. Already, the second part of the project has been started. Th e On-lin e p art o f th e hybrid course available at: http://faculties.sbu.ac.ir/ ~payandeh/efront/www/index.php?logout=true, w here students i n summer sem ester, in 20 09, used i t to wri te quizzes, download and upload assignments, and review the course materials.

To desi gn t he website, we us e an ope n so urce W eb designer nam ed *Efront*. Efron t p rovides abili ty to th e Web ad ministrator to o rient e-learn ers' activi ties b y (**i**) defining some rules for e-learners; (**ii**) providing a com-plete database about activities of e-l earners on the web-page; (**iii**) ability to ass ign, randomly, a quizzes to learners. Oth er Efro nt's ab ilities may b e fo und in Za-haria (20 07) and i ts offi cial websi te avai lable at http://www.epignosis.com.gr/.

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APPENDIX A. QUESTIONNAIRE ITEMS AND SOURCES

Independent variables	Items	Sources
Skills of users Email skills	How confident do you feel about: 1. Logging in and out of your account? 2. Sending and receiving mail? 3. Attaching and downloading files? (Likert's scale 1, strongly disagree; 5, strongly agree)	Nakhoda et al (2006), SORT website
Hard ware ability	How confident do you feel about: 1. Using a keyboard and mouse? 2. Basic troubleshooting skills, such as rebooting the computer in case of a crash and resolving printer errors? 3. Changing printer ink cartridges? (Likert's scale 1, strongly disagree; 5, strongly agree)	Nakhoda et al (2006), SORT website
Soft ware ability	How confident do you feel about: 1. Working with fi les, such as creating, saving , a nd printing documents? 2. Installing software? (Likert's scale 1, strongly disagree; 5, strongly agree)	Nakhoda et al (2006), SORT website
Internet ability	How confident do you feel about : 1. Logging on to your Internet ser vice provid er an d navigating to different Web addresses? 2. The advanced Internet skills, such as using a search engine, identifying and downloading appropriate files, or updating software via Internet? (Likert's scale 1, strongly disagree; 5, strongly agree)	Nakhoda et al (2006); Joo et al (2000) SORT website
Online Audio/Video	I think that I would be able to: 1. Relate the content of short v ideo clips (1 -3 minutes ty pically) to the information I have read online or in books. 2. Take notes while watching a video on the computer. 3. Understand cour se related info rmation when it's pres ented in video formats.	Watkins et al (2004)

Self-directed learning	Are you able to: 1. Learn without assistance of instructors? 2. Resist distractions and stay on task while working or studying? 3. Keep up with your assignments, and meet deadlines? 4. Manage your time appropriately? 5. Complete things on time?	Guglielmino and Guglilmino (2002) Kim (2005); Graeve (1987); Straka et al (1994)
Learner attitude toward e-learning	I believe that e-learning : 1. is very difficult (R) 2. is very complicated (R) 3. requires technical ability (R) 4. let me feel psychological stress very greatly (R) 5. can be done only if one knows a programming language such as Basic (R) 6. is only advisable for people with a lot of patience (R) 7. makes a person more productive at his/her job 8. is for young people only (R) (Likert's scale 1, strongly disagree; 5, strongly agree)	Gattiker and Hlavka (1992)
Learner computer anxiety	I think: 1. Working with a computer would make me very nervous 2. I get a sinking feeling when I think of trying to use a computer 3. Computers make me feel uncomfortable 4. Computers make me feel uneasy and confused (Likert's scale 1, strongly disagree; 5, strongly agree)	Barbeite and Weiss (2004)
Equipments Hard ware	Do you have: 1. A consistent and convenient access to a computer? 2. A sound phones or speakers and microphone? 3. A working printer? 4. A CD-ROM drive? 5. A flash-stick memory? 6. A laptop?	SORT website Watkins et al (2004)
Software	Do you have: 1. A Web browser, such as safari, fire-fox, Internet explorer, on your computer? 2. A virus protection software on your computer? 3. The Microsoft package on your computer?	SORT website Watkins et al (2004)
Internet	Do you have: 1. A reliable Internet connection? 2. A high-speed Internet connection?	SORT website Watkins et al (2004)
Dependent variables	**Items**	**Sources**
readiness	1. I have enough IT skills to use e-learning technologies. 2. My parents are ready to support the use of e-learning at home. 3. I think I am ready for e-learning 7. I think I am ready to take my quizzes, assignments, extra examples from the web. 8. I think I am ready to communicate with instructors and students via the web. 4. I think it is the right time to promote e-learning in universities 5. Taking this class in this manner allow me to arrange my work for the class more effectively. 6. The advantages of taking this class in this manner outweigh any disadvantages 7. Taking this class in this manner allow me to see course lectures which I was absent in that lessons (Likert's scale 1, strongly disagree; 5, strongly agree)	Arbaugh(2000) Thurmond et al (2002) So and Swatman (2007) And self-development