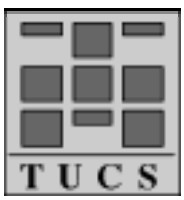
Factors Affecting End-User Computing Skills

Timo Auer
LABORIS
University of Turku, Department of Computer Science,
Lemminkäisenkatu 14, FIN-20520 Turku, Finland



Turku Centre for Computer Science
TUCS Technical Report No 159
January 1998
ISBN 952-12-0145-2
ISSN 1239-1891

Abstract

This paper reports on the results of a study examining factors having an impact on the skills in end-user computing. Based on existing literature a research model is presented and empirically tested. The analysis suggest, that IS usage (intensity and variety of use) and self-motivation have a direct impact on current skill level of end users, and self-motivation and favorable IS attitudes on IS usage. Organizational support was found to have a direct impact on IS attitudes and only a very limited impact on usage. Training activity instead did not have any impact either on usage or skills.

Keywords: end-user skills, end-user training, IS usage, end-user attitudes

TUCS Research Group
Information Systems Research Group

1 Introduction

Nowadays, Information Systems (IS) use is a daily issue in modern business organizations and in almost every work task and at every organizational level. Further, IS use has become so widespread that additional benefits cannot be achieved purely by increasing the intensity of IS use. Implementation policies purely encouraging use may lead to an unproductive situation (Pentland, 1989), since putting a sophisticated system into use with low skills it may cause active use, but the output may be ineffective. We should be more and more interested in the quality of microcomputers' use i.e. how they can be used and how we can improve skills in end-user computing. In this study we concentrate on the impact of IS usage, user characteristics and organizational support on IS skills.

Nelson (1991) relates skills to an ability to work concretely and Nass (1994) argues that skills reflect to information processing capabilities. Whereas Nelson argues that training provides skills (education provides knowledge) Nass states that skills are gained from learning by doing. Altogether, skill has been seen as "an ability to do something" as Oxford dictionary (Hawkins, 1991) implies it. Here, we relate end user computing skills to the the ability to use a software package. It is a "technical" ability rather than an ability to conceptualize information processing problems.

The research in end-user computing assumes generally, that higher IS knowledge and skills should lead to more active use (Igbaria, 1995; Suh et. al, 1994), since capable individuals are assumed to be able to find more use for information systems. IS assimilation research has similar viewpoint, where a potential adopter's prior related knowledge determines an individual's ability to recognize the value of an innovation and assimilate it effectively (see for example Boyton et. al, 1994; Cohen & Levinthal, 1990).

Here, we hold an opposite viewpoint. We adopt the view that it is experience which has an impact on skills (Harrison & Rainer, 1991; Pentland, 1989) rather than skills on usage. This notification gives the starting point for this research. First of all, we have to make a distinction between skills and knowledge. Whereas skill is an ability to do something knowledge is an ability to reason abstractly (Nelson, 1991) and "know about things" (Hawkins, 1991). We agree that an individual's prior related knowledge is an important precondition for adoption, since an adopter's ability to recognize the value of an innovation depends on his/her ability to understand and recognize the possibilities to use the innovation in work context. Instead of skills are seen here as a cause of IS usage. Here, it is seen that IS utilization as a daily activity results in cumulative learning, where learning is seen as a continuous process grounded in experience (Kolb, 1984). But, it is not just the more active use which should lead to improved skills, since skills are developing in a circular form. Previously achieved skills make it possible to gain new more demanding skills (Davis, 1987; Huff et. al, 1988).

The objective of the research can be expressed with the following research question: What is the impact of user characteristics, organizational support and IS usage on IS skills? Of course, other variables may also explain the variance in IS skills.

This paper is organized as follows. First, the research model and hypothesis are introduced. Secondly, the research methodology is presented. Thirdly, the

measurements being used are described. Fourthly, the results based on the data analysis are presented. Finally, the implications of the results of the study are discussed.

2 Research Model and Hypothesis

This section goes to describe the developed research model and hypothesis to be tested. In the developed research model (see Figure 1) IS skills is the dependent and usage mediating variable. User characteristics and organizational support have been treated as independent variables.

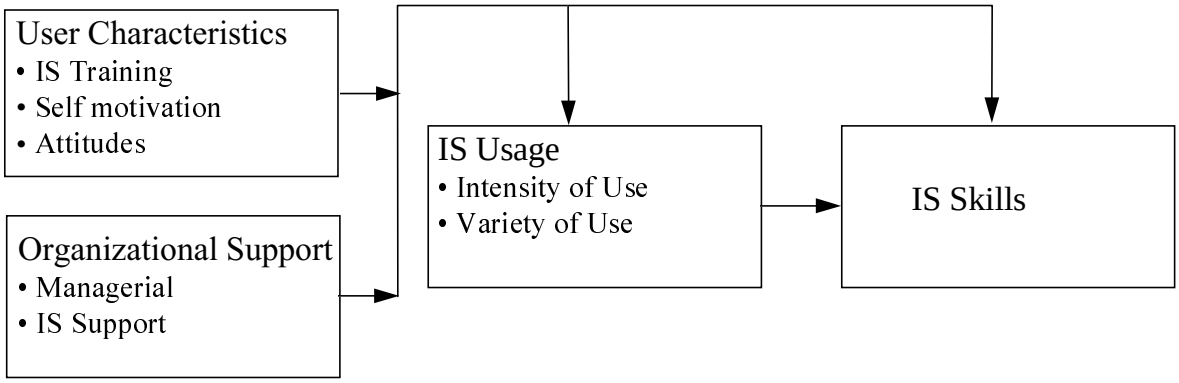


Figure 1: Research model on Factors Affecting IS Usage Skills

Here, user characteristics include three variables - IS training, self-training and attitudes. Training has been seen to be an important method to increase IS usage and to improve abilities to use IS (Compeau & Higgins, 1995; Igbaria 1990; Igbaria 1992; Igbaria 1993; Pentland 1989; Schiffman et al. 1992). The impact of training on the usage skills has been assumed to be so direct, that it has been used even as a surrogate for skills (Igbaria, 1995). In addition to training we emphasize the importance of informal learning. The approximate percentage of time and money spent on informal and incidental learning is 83 %, and on formal learning only 17% (Carnevale 1984, cited in Marsick & Watkins, 1990).

Attitudes towards IS have been found to be important with respect to the way individuals utilize IT (Adams et al. 1992; Amoroso & Cheney, 1991; Davis et al. 1989; Ein-Dor & Segev, 1991; Igbaria, 1990; Igbaria, 1993; Schiffman et al. 1992) and skills (Harrison & Rainer, 1991). Therefore, favorable attitudes are assumed to increase both IS usage and skills. For example, Technology Acceptance Model (TAM) developed by Davis et al. (1989) has been used to predict users behavior based on their attitudes towards IS and intentions to use the system. Attitudes have also an important role in diffusion process. For example, in the diffusion model (see Rogers, 1983) the process which leads towards decision to accept or reject an innovation is a phase where a potential adopter forms a favorable or unfavorable attitude towards an innovation.

Three hypothesis related to the impact of user characteristics on IS usage and IS skills have been formulated:

1a: Training activity (number of courses) will have a positive relation to IS usage and skills

1b: Self-motivation has positive relation to IS usage and skills

1c: IS attitudes will have a positive relationship with IS usage and skills

Organizational support is an integral part of the organizational environment where information systems are utilized. Organizational support has been found to have a positive impact on IS utilization (Amoroso & Cheney, 1991; Boyton et. al, 1994; Igbaria 1990; Igbaria 1992; Schiffman et al. 1992; Thompson et al. 1991). We can identify two forms of organizational support (Igbaria, 1990 & 1995). First, the support provided by the IS function. Secondly, the support provided by the management. The IS support may improve the quality of IS utilization by lowering or removing the barriers to adoption (Attewell, 1992). Further, according to diffusion theory the closer an agent is the more likely an adopter will form a favorable attitude towards an innovation and make a decision to adopt it (Rogers, 1983). Thus, a quality IS support may bring an innovation closer to its potential adopters.

Similarly management support should have a positive impact on IS utilization. As organizational decision makers management is responsible for IS issues. They have to identify the role IS should play in their organization, to make decisions as to whether (and when) an innovation is worth adopting into the organization (i.e. to make a prior innovation decision) and to control diffusion processes after the prior innovation-decision (Ruohonen, 1991). Thus, the management's IS knowledge and abilities to create favorable conditions for IS should increase IS use (see Boynton et al. 1994). Especially people with low adoption characteristics seem to wait until management give a directive to adopt (Leonard-Barton & Deschamps, 1988), but also active people need a prior decision before they are able to make their own decisions about adopting an innovation. The hypothesis to be tested are:

2a: Managerial support will have a positive relation to IS usage and skills

2b: IS support will have a positive relation to IS usage and skills

And finally, as stated in the introduction IS usage is assumed to have an impact on IS skills. Previous research has found that intensity of use and variety of use represent different dimensions of IS usage (Suh et. al, 1994). Therefore, we have to separate them. Intensity of use is assumed to have a positive relationship with usage skills. The more the users operate with software packages or applications, the more familiar they will be with computers. Similarly, the variety of use (i.e. number of tasks supported with IS) should improve usage skills, because many-sided use should give the a user a wider perspective to the tool. The hypothesis to be tested are:

3a: Intensity of use is positively related to skills

3b: Variety of use will have a positive relation to skills

3 Research Design

The objective of this study is to develop and test a research model to understand the impact of user characteristics, organizational support and IS usage on IS skills. A single-case study project was selected as a research approach (Yin, 1984). Here, the case study process has been supported by quantitative and qualitative means to make triangulation possible and to improve the quality of observations and conclusions (Benbasat et al., 1987; Yin, 1984).

The data collection methods were experimental simulation (see Jenkins, 1985), questionnaire and semi-structured interviews. The assessment process included multiple phases in order to make the simulations in the experimentation more realistic (see George, 1989). First, pre-measurement interviews gave a general view of the object organization and an insight into computer-supported work. Secondly, preliminary tests had been made to be certain that the exercises in the experimentation were neither too difficult nor too simple, and simulations reflected the reality. Thirdly, skills in end-user computing were measured by experimental simulation. To collect background information to be used in the data analysis each participant in the experimentation filled out a questionnaire. Finally, post-measurement interviews were used to connect the research findings to organizational reality.

The research object is a Finnish conglomerate operating in the foodstuffs, animal feed and chemical fields. In 1993, the company employed in an average of 1900 people and the total turnover was US$ 614m. The population of the study included the active users of spreadsheet programs. Thus, to exclude non-users a preliminary questionnaire was used. The participants for the experimental simulation were selected based on systematic sampling (Babbie, 1973) from the population of active users. Systematic sampling was based on lists of users with a sampling interval of four. The first person to be invited was selected at random.

The experimental simulations were executed in the object organization's PC classroom. The classroom was equipped with seven microcomputers. An experimentation comprised several exercises, with a different set time allocated to each exercise. The participants had to execute commands that are generally needed in different work tasks. In other words, the simulations were not connected to any specific work task. The researcher controlled the test situation carefully. All participants did the same exercise at the same time.

4 Measures

4.1 IS Skills

The skills to use a spreadsheet program was measured by testing. The exercises were planned to measure "everyday" operations. For example, macros were excluded from the tests because in the pre-tests it became obvious that users were totally unfamiliar with them.

The eight tasks being included were 1) enter numbers and texts into a table, 2) save and open files, 3) make a formula using functions, 4) make a formula using add, sum, multiply and divide operations, 5) copy a formula and a table inside a sheet, 6) format cells, 7) print a table and 8) make and modify a graph. In this study the exercises were appraised with an integer (e.g. 1 = unknown task, 2 = major problems, 3 = minor problems, 4 = successful execution), which indicated the successfulness of execution. This scale does not fulfill strict scale requirements. Therefore, the ordinal data has been transformed into binary form, which indicates the presence or absence of characteristics. Here, the binary data implies whether an exercise has been successfully executed or not. Finally, we used hierarchical cluster analysis to form groups based on participants' skills. The internal consistency reliability coefficient for the items was 0.86.

4.2 IS Usage

IS usage was measured with two items. The participants estimated with a five-point ordinal scale, how frequently they are using a spreadsheet program. The intensity was measured with a five-point ordinal scale, from (0) not using to (4) using daily. The second item measured the variety of use. The participants were asked to indicate based on a list in which business tasks they are using computers. These two items represent different dimensions of IS use. Therefore, they were not combined.

4.3 User Characteristics

IS training activity was measured with one variable. The participants were asked to indicate with a five-point scale, how many times they have participated in in-house training (none, 1 course, Very little, 2 - 3 courses, 4 - 6 courses, Over 6 courses). Finally, they evaluated with a five-point Likert-type scale the extend they have studied the use of microcomputers by their own (self-motivation). These variables were treated as separate items and they were not combined, since they were assumed to present different dimensions.

Respondents expressed their attitudes on ten statements using five-point Likert-type scale, from (1) strongly disagree to (5) strongly agree. The ten items ranged from the efficiency of a spreadsheet program to IT's impact on the competitiveness of the company. The statements were as follows: 1) Spreadsheet program increases my job efficiency, 2) Budgeting is effective with IS, 3) Reporting is effective with computers, 4) IT increases my job efficiency, 5) IT increases my department's efficiency, 6) IS have enabled accurate control of the company, 7) Due to IS we can serve our customers better, 8) Microcomputers have a positive impact on the competitiveness of our company, 9) IT has increased our department's productivity and 10) IT has increased our company's productivity. The internal consistency reliability coefficient for the items was 0.86.

4.4 Organizational Support

The support offered by the Information Center (IC) was measure with six statements using five-point Likert-type scales, from (1) strongly disagree to (5) strongly agree. The statements were: 1) IC masters PC technology, 2) The service quality of IC is good, 3) IC understands the requirements jobs have for IS, 4) IC personnel is capable of cooperation with users, 5) I can get help to IS problems rapidly, and 6) The service provided by the IC is cost-efficiency. The internal consistency reliability coefficient for the items was 0.84.

Managerial support was measure with six statements using five-point Likert-type scales, from (1) strongly disagree to (5) strongly agree. The statements were: 1) S/he knows what benefits can be achieved with information technology, 2) S/he understands IS related problems, 3) S/he can guide and manage IS use, 4) S/he encourages us to use IS in the performance of jobs, 5) S/he has given us enough IS resources, and 6) S/he is keen to see that IS are easy to use. The internal consistency reliability coefficient for the items was 0.79.

5 Analysis

Altogether 45 spreadsheet users were invited to the experimentation and 31 (69%) participated in the tests. The profile of the participants and descriptive statistics of the independent variables can be seen from the Appendix.

5.1 Preparation of the Analysis

Prior to the analysis we made some preparations. First, the variables formed were tested for reliability using the Chronbach's alpha test applied to inter-item scores. The values of alpha ranged from 0.79 to 0.86, which is generally within typical 0.80 criterion value for inter-item reliability. The measures and their inter-item scores are in the previous section. Secondly, we formed homogenous groups of the participants based on the skill profiles. Thirdly, we had to re-code some of the variables because the number of observations was relatively low.

Hierarchical cluster analysis was used to form groups based on participants' skills. The clustering technique used is Ward's method, which combines clusters based on the smallest increase in the overall sum of the squared within-cluster distance, requiring interval or binary data (Norušis, 1993). Here, a visual hierarchical tree (dendrogram) has been used to produce a suggestion how many clusters should be formed. Each cluster has been named on the basis of a skill profile of its members, and the values referring to cluster membership have been saved to a variable.

In this study the exercises were appraised with an integer (eg. 1 = unknown task, 2 = major problems, 3 = minor problems, 4 = successful execution). This scale does not fulfill strict scale requirements. Therefore, the ordinal data has been transformed into binary form, which indicates the presence or absence of characteristics. Here, the binary data implies whether an exercise has been successfully executed or not (See Table 1).

Table 1: Homogenous groups of users

	Novice (1)		Routine (2)		Expertise (3)	
Tasks	OK	Fail	OK	Fail	OK	Fail
Spreadsheet						
Enter numbers and text		5		11	15	
Save and open files	2	3	10	1	15	
Make formula (functions)		5	10	1	15	
Make formula (+, -, /, *)		5	11		15	
Copy formula and table		5	8	3	14	1
Format cells	1	4	7	4	12	3
Print a table		5	2	9	15	
Make and modify graphs		5	1	10	15	
Cases (N = 31)	*5*		*11*		*15*	

Scale: OK = Successful execution, Fail = Problems or unknown task

The attitude, managerial support and IS support -variables were re-coded as follows. First, a new summary variable was formed. The new variable indicated the total sum of the items. Missing values for each item were replaced with the mean value of that item. Secondly, the cases were divided into three - approximately - equal-sized groups. These

groups were used in the analysis. Finally, we had to re-scale the variety of use -variable as follows: (1) less than 4 tasks, (2) 4 to 8 tasks, and (3) more than 8 tasks.

Table 2: Correlation between variables. (Kendall correlation coefficients, 1-tailed)

	1.	2.	3.	4.	5.	6.	7.	8.
1. Skills	1.00							
2. Intensity of use	0.54 ** *	1.00						
3. Variety of use	0.43 ** *	0.39 ** *	1.00					
4. IS training	-0.81	0.05	-0.09	1.00				
5. Self-motivation	0.36 **	0.41 ** *	0.30 **	-0.21 *	1.00			
6. Attitudes	0.10	0.42 ** *	0.38 ** *	0.02	0.20 *	1.00		
7. Managerial support	0.06	0.21 *	0.00	0.09	0.05	0.24 *	1.00	
8. IS support	0.09	0.11	0.13	-0.06	0.14	0.46 ** *	0.34 **	1.00

* p< 0.10; ** p< 0.05; *** p< 0.01

5.2 Testing the Hypothesis

Correlation between usage skills and independent variables were examined with nonparametrical correlation analysis. Skill profiles (i.e. expertise, routine, novice) were capable of ranking, but it proved impossible to measure distances between values. Thus, the skill profile data was ordinal which limited the number of possible analyses. These facts led to the selection of a nonparametric correlation analysis (tau-b) developed by Kendall, which is suitable for ordinal data. In this study, the test of significance was one-tailed, because the directions of the relationships were possible to determine in advance.

The results indicate that there is a positive relationship between IS usage and IS skills. Both the intensity (0.54) and variety of use (0.43) have clear impact on the skills in end-user computing. Among the variables representing user characteristics and organizational support only the self-training intensity (0.36) correlates positively with IS skills. Further, IS training activity (no of courses) and self-training intensity had a negative relationship (-0.21), indicating that these items represent different dimensions of learning.

Favorable attitudes towards IS (0.41; 0.30) and self-motivation (0.48; 0.38) seemed to have a positive relationship with both intensity and variety of use. Of the organizational support variables only managerial support (0.21) had a definite but small positive relationship with the intensity of use. Neither of the organizational support variables did correlate with the variety of use variable.

Table 3: Hypothesis being supported and rejected

Hypothesis	Usage Intensity	Variety	Skills
User Characteristics			
1a: Training activity (number of courses) will have a positive relation to IS usage and skills	Rejected	Rejected	Rejected
1b: Self-motivation has positive relation to IS usage and skills	*Supported*	*Supported*	*Supported*
1c: IS attitudes will have a positive relationship with IS usage and skills	*Supported*	*Supported*	*(via usage)*
Organizational Support			
2a: Managerial support will have a positive relation to IS usage and skills	*Supported*	*(via attitudes)*	Rejected
2b: IS support will have a positive relation to IS usage and skills	*(via attitudes)*	*(via attitudes)*	Rejected
IS Usage			
4a: Intensity of use is positively related to skills			*Supported*
4b: Variety of use will have a positive relation to skills			*Supported*

The results support H1 only partially. User characteristics seemed to be an important precondition for active IS usage, although training activity did not hold any relationship with IS usage or IS skills. Both attitudes and self-motivation have clear impact on IS usage. Whereas attitudes seemed to have only an indirect impact on IS skills, self-motivation had also a direct and clear impact on IS skills.

H2 was supported marginally, since managerial support did not have direct relationship with IS usage or IS skills, and IS support had a positive relationship only with IS usage. Although the organizational support variables had only a very limited relationship with IS usage and no relationship with IS skills, their importance seemed to be high. Both the managerial (0.24) and IS support (0.46) variables correlated positively with attitudes. Thus, we can assume that organizational support variables have a positive but indirect impact at least on IS usage (through attitudes) but also on IS skills (through attitudes and IS usage).

H3 was supported. Both the intensity and variety of use variables had a clear positive relationship with IS skills. Apparently, experience in the form of IS usage results in better abilities to use IS.

5.3 Understanding "Training Paradox"

Self-training, i.e. motivation to learn by oneself, had a direct positive impact both on IS usage and skills to use a spreadsheet program. Training activity had impact neither on usage nor skills. The results indicate the importance of self-motivation to gain skills in using spreadsheet programs. This finding underlines the importance of informal training. Parallel to Cheney and Nelson's (1991) finding in-house training intensity is not necessarily related to skills. In addition, Beer et al. stated that training is a poor method by which to achieve changes in an organization (Beer et. al, 1990). Also, from a training effectiveness perspective, the gradual nature of the organizational changes can

be recognized from the model developed by Hamblin (1974)[1]. The process itself is long and requires a lot of support until the ultimate value effects can be realized.

On the other hand this research finding raises a huge concern. Are we wasting our money on training? We decided to investigate the nature of training in more detail in our object organization.

The interviews revealed that the object organization had invested in IS training remarkably. In 1994, for example, more than half of the users had participated in IS training. The training concentrated mainly on microcomputer software packages, but also a considerable amount of training was related to mainframe based applications. Further, the management had a favorable attitude towards training. If someone wanted to participate in a course, s/he was allowed to. The favorable attitude towards training might even be the cause of the "training paradox." The object organization had probably reached a state where active people had adopted spreadsheet programs before the increased training investments took place. Thus, only the less motivated people had participated in training. This reasoning is supported by Leonard-Barton and Deschamps' (1988). They stated that people with low adoption characteristics seem to wait until management give a directive to adopt. Unfortunately, we were not able to confirm that finding, since the object organization had invested in training for years - not only recently.

Some interviewees stated that "wrong" people are participating in courses. According to their observations the less motivated people resisted to participate in courses and learn to use computers in general. On the other hand this argument was not supported by the statistical analysis, since the problem was that training did not have any impact on the skills. In this paper we did not go to evaluate the ability to utilize microcomputers, but the factors having an impact on skills in end-user computing.

Another possible explanation for the "training paradox" emerged from the interviews. According to a number of interviewees the courses concentrated on the functions of the software packages rather than the deployment of the tool. For example, the trainers were stated to explain in detail how to construct a formula rather than to clarify why and when to use them. Thus, the participants did not learn how to support work with the tool (i.e. spreadsheet program). In order to confirm the interviewees' opinions we browsed through several course materials. Further, we had an opportunity to participate in a course. The interviewees arguments were supported. It seemed that the work itself and the tool were separated due to standardization. Separation might be cost-effective, but forms a barrier to effective utilization of information systems in the work context (see Nurminen & Forsman, 1994).

We can conclude that a better integration of the training situations and organizational processes might lead to a better motivation to use information systems actively. We do not believe that training per se could improve remarkable organizational actors' skills to use microcomputer software packages. Training courses are a necessity, but their role and nature should be considered. Although we recognize that information technology is

---

[1] According to the model, organizational changes through training happen in the following order: First come *reaction effects* that suggest changes in individuals' interests. Secondly, there might exist *learning effects* and individuals are able, for example, to use new concepts and "language". Thirdly, *job behavior effects* may be realized from the use of the new concepts in a working situation at an individual level. Fourthly, cumulative individual changes may result as *organizational effects*, and finally these changes may result in *ultimate value effects* to benefit the object organization.

under-used owing to lack of skills in computing, we have to do something other than merely establish training programs which concentrate on the functions of a software package. Training activities should concentrate more on motivational aspects. A course should generate ideas how to utilize microcomputers in a work context.

6 Conclusions

This study has its limitations. The most serious one is related to the possibilities to generalize the results. As a case study, the research findings might be valid only in the object organization. Another concern is the number of observations. Due to low number of observations we were not able to make detailed and more sophisticated data analysis.
On the other hand this study has its strengths, too. We were able to analyze and interpret the findings in its context. Another strength is related to direct evaluation of the skills to use microcomputers. In the IS field we have a tendency to use surrogates instead of evaluating the phenomenon itself. Further, measurement of skills needed laboratory environment because users' own opinions might be misleading. For example, Pentland (1989) found that users greatly over-estimate their actual use of IT in their work. Experimental simulation yield more objective results.
Our research findings indicate that IS usage (intensity and variety of use) and self-motivation have a direct impact on current skill level of end users, and self-motivation and favorable IS attitudes on IS usage. Organizational support was found to have a direct impact only on IS attitudes. Training activity instead did not have any impact either on usage or skills. Further, we had an opportunity to go beyond the hypothesis testing.
We do not conclude that companies should not arrange training courses for its personnel. However, the "training paradox" is a crucial and real phenomenon. It is not reasonable to invest in training, if the outcome of the investments is questionable. We suggest that the role of training should be reconsidered. We believe that training courses have and also should have a crucial role in a learning process. The main reason for the "training paradox" seemed to be the separation of the work itself and training. Training should be connected to real situations and a training course should give the participants practical ideas and examples how to support work with a software package.
Further, we do emphasize the importance of informal training. Methods to support effective informal learning should be developed and tested. The main challenge is to combine the cost-efficiency (per capita) of formal training and the effectiveness of informal training. Companies should also allocate a considerable portion of their training budget to support informal training.

7 References

Adams, D.A., Nelson, R.R. & Todd, A.T. (1992) Perceived Usefulnes, Ease of Use, and Usage of Information Technology: A Replication, *MIS Quarterly*, Vol 16., No. 2, pp. 227-247

Amoroso, D.L. & Cheney, P.H. (1991) Testing a Causal Model of End-User Application Effectiveness, *Journal of Management Information Systems*, Summer, Vol. 8, No. 1, pp. 63-89

Attewell, P. (1992) Technology Diffusion and Organizational Learning: The Case of Business Computing, *Organization Science*, Vol. 3, No. 1, 1-19.

Babbie, E.R. (1973) *Survey Research Methods*, Wadsworth Publishing Company, Belmont California.

Beer, M., Eisenstat, R.A. & Spector, B. (1990) Why Change Programs don't Produce Change, *Harvard Business Review*, November-December, Vol. 68, No. 6, pp. 158 - 166

Benbasat, I., Goldstein, D.K. & Mead, M. (1987) The Case Research Strategy in Studies of Information Systems, *MIS Quarterly*, Vol. 11, September, pp. 369-386.

Boynton, A.C., Zmud, R.W. & Jacobs, G.C. (1994) The Influence of IT Management Practice on IT Use in Large Organizations, *MIS Quarterly*, Vol. 18, September.

Carnevale, A. (1984) *Jobs for the Nation: Challenge for a Society Based on Work*, Alexandria, VA, American Society for Training and Development.

Cohen, W.M. & Levinthal, D.A. (1990) Absorptive Capacity: A New Perspective on Learning and Innovation, *Administrative Science Quarterly*, Vol. 35, pp. 128-152.

Compeau, D.R. & Higgins, C.A.(1995) Computer Self-Efficacy: Development of a Measure and Initial Test, *MIS Quarterly*, Vol. 19, June

Cheney, P.H. & Nelson, R.R. (1988) A Tool for Measuring and Analyzing End User Computing Abilities, *Information Processing & Management*, No. 2, 1988, pp. 199 - 203.

Davis, F.D., Bagozzi, R.P. & Warshaw, P.R. (1989) User Acceptance of Computer Technology: A Comparision of Two Theoretical Models, *Management Science*, Vol. 35, No. 8, pp. 982-1003

Davis, G.B. (1987) *Strategies for Information Requirements Determination, in: Information Analysis*, Selected Readings, ed. Galliers, R, Addison-Wesley, Great Britain.

Ein-Dor, P. & Segev, E. (1991) Intensity of End User Computing, *Data Base*, Vol. 22, Winter/Spring, pp. 30-37

George, J.F. (1989) An Alternative View of Small Group Research in MIS, in: *The Information Systems Research Challenge: Experimental Research Methods*, ed. Benbasat, I., Harvard Business School Research Colloquium, Vol. 2.

Hamblin, A.C. (1974) *Evaluation and Control of Training*, McGraw-Hill, London.

Harrison, A.W. & Rainer, R.K. Jr. (1991) The Influence of Individual Differences on Skill in End-User Computing, *Journal of Management Information Systems*, Summer, Vol. 9, No. 1, pp. 93-111.

Hawkins, J. (1991) *Oxford Minidictionary*, Third edition, Clarendon Press, Oxford.

Huff, S.L., Munro, M.C. & Martin, B.H. (1988) Growth Stages of End User Computing, *Communications of the ACM*, May 1988, Vol. 31, No. 5, pp. 542 - 550.

Igbaria, M. (1990) End-User Computing Effectiveness: A Structural Equation Model, *Omega International Journal of Management Science*, Vol. 18, No. 6, pp. 637-652.

Igbaria, M. (1992) A Examination of Microcomputer Usage in Taiwan, *Information & Management*, Vol. 22, pp. 19-28

Igbaria, M. (1993) User Acceptance of Microcomputer Technology: An Empirical Test, *Omega International Journal of Management Science*, Vol. 21, No. 1, pp. 73-90

Igbaria, M. (1995) An Examination of the Factors Contributing to Microcomputer Technology Acceptance, *Accting. Mgmt & Info. Tech*., Vol. 4, pp. 205-224

Jenkins, A.M. (1985) Research Methodologies and MIS Research, in: *Research Methods in Information Systems*, eds. Munford, E., Hirschheim, R., Fitzgerald, G. & Wood-Harper, A.T., North-Holland, Amsterdam.

Kolb, D.A. (1984) *Experiential Learning - Experience as a Source of Learning and Developmen,* Prentice-Hall, Englewood Cliffs.

Leonard-Barton, D. & Deschamps, I. (1988) Managerial Influence in the Implementation of New Technology, *Management Science*, Vol. 34, No. 10, pp. 1252-1265.

Marsick, V.J. & Watkins, K.E. (1990) *Informal and Incidental Learning in the Workplace*, Routledge, London.

Nass, C. (1994) Knowledge or Skills: Which do Administrators Learn from Experience?, *Organizational Science*, Vol. 5, No. 1, 1994, pp. 38 - 50.

Nelson, R.R. (1991) Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements, *MIS Quarterly*, Vol. 15, No. 4, 1991, pp. 503 - 525.

Norušis, M.J. (1993) *SPSS® for WindowsTM: Professional StatisticsTM Rel. 6.0*, New York, McGraw-Hill.

Nurminen, M.I. & Forsman, U. (1994) Reversed Quality Life Cycle, in: *Human Factors in Organizational Design and Management -IV*, eds. Bradley, G.E. & Hendrick, H.W., Elsvier Science B.V., Amsterdam

Pentland, B.T. (1989) Use and Productivity in Personal Computing: An Empirical Test, *Proceedings of the Tenth International Conference on Information Systems*, December, pp. 211-222.

Rogers, E.M. (1983) *Diffusion of Innovations*, New York, Free Press

Ruohonen, M. (1991) *Strategic Information Systems Planning -Analyzing Organizational Stakeholders and Planning Support Activities*. Publications of the Turku School of Economics and Business Administration A-2:1991.

Schiffman, S.J., Meile, L.C. & Igbaria, M. (1992) An Examination of End-User Types, *Information & Management*, Vol. 22, pp. 207-215

Suh, K., Kim, S. & Lee, J. (1994) End-User Computing Abilities and the Use of Information Systems, *Computer Personnel*, April 1994, pp. 3 - 14.

Thompson, R.L., Higgins, C.A. & Howell, J.M. (1991) Personal Computing: Toward a Conceptual Model of Utilization, *MIS Quarterly*, Vol 15, March, pp. 125-143

Yin, R.K. (1984) *Case Study Research: Design and Methods*, SAGE Publications, California

Appendix A: Profile of the participants and independent variables

	Mean	Median	Std dev.	Skew-ness	N
Attitudes					
- Spreadsheet program increases my job efficiency	4.81	5.00	0.40	-1.63	31
- Budgeting is effective with IS	4.42	5.00	0.72	-0.85	31
- Reporting is effective with computers	4.74	5.00	0.45	-1.16	31
- IT increases my job efficiency	4.55	5.00	0.93	-2.18	31
- IT increases my department's efficiency	4.61	5.00	0.80	-2.46	31
- Due to IS we can serve our customers better	4.39	4.00	0.72	-1.33	31
- Microcomputer systems have a positive impact on the competitiveness of our company	4.10	4.00	0.83	-0.93	31
- IT has increased our department's productivity	3.16	4.00	1.24	-0.35	31
- IT has increased our company's productivity	4.07	4.00	0.81	-0.52	31
Managerial support					
- S/he knows what benefits can be achieved with information technology	4.25	4.00	0.73	-2.35	31
- S/he understands IS-related problems	3.13	4.00	1.26	-0.37	31
- S/he can guide and manage IS use	2.48	2.00	1.15	0.74	31
- S/he encourages the use of IS in the performance of jobs	3.87	4.00	1.06	-1.18	31
- S/he has gave us enough IS resources	3.94	4.00	0.96	-1.06	31
- S/he is keen that our IS are easy to use	3.00	3.00	1.13	0.00	31
IS support					
- IC masters PC technology					
- The service quality of IC is good	3.45	4.00	0.89	-1.06	31
- IC understands the requirements jobs have for IS	3.48	4.00	1.06	-0.94	31
- IC personnel is capable of cooperation with users	3.32	4.00	1.14	-0.84	31
- The IC enables effective use of microcomputers	3.16	4.00	1.24	-0.44	31
- I can get help to IS problems rapidly	2.83	2.00	1.23	0.34	30
- The service provided by the IC is cost-efficiency	3.13	3.00	0.89	-0.27	31

Scale: 1 = Strongly disagree, 2 = Disagree to some extent,
3 = Agree to some extent, 4 = Strongly agree

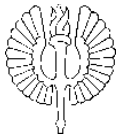
Age	%	**Education**	%	**Position**	%
Less than 30 years	13%	Upper comprehensive or high school	13%	Specialists	20%
30 - 39 years	52%	Upper secondary	3%	Middle mgmt	80%
40 - 49 years	23%	Bachelor's degree	19%		
Over 60 years	13%	Master's degree	65%		
N	31	N	31	N	30

Training activity	%	**Self-training**	%
None	0%	None	3%
1 course	19%	Very little	13%
2 - 3 courses	48%	Little	29%
4 - 6 courses	19%	Much	26%
Over 6 courses	13%	Very much	29%
N	31	N	31

Usage frequency	%	Variety of use	%
Daily	21%	Less than 4 tasks	29%
Weekly	45%	4 - 8 tasks	32%
Less freq.	35%	Over 8 tasks	39%
Not at all	0%		
N	29	N	30

Turku Centre for Computer Science
Lemminkäisenkatu 14
FIN-20520 Turku
Finland

http://www.tucs.abo.fi/



University of Turku
• Department of Mathematical Sciences

Åbo Akademi University
• Department of Computer Science
• Institute for Advanced Management Systems Research

Turku School of Economics and Business Administration
• Institute of Information Systems Science