Understanding and measuring user competence

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Abstract

End User Computing (EUC) is experiencing a resurgence of importance as managers realize it is tied to the new knowledge economy through knowledge-worker productivity. Assessing individual's capabilities with respect to end user technologies is central to both research on EUC and management of EUC in organizations. For this reason, we advance a new construct, User Competence, which is multi-faceted. It is composed of an individual's breadth and depth of knowledge of end user technologies, and his or her ability to creatively apply these technologies (finesse). Several issues are explored, including what User Competence means, how users differ in their capability, and how these differences relate to other individual characteristics. The experimental study of 100 subjects shows that the dimensions of competence relate differently to individual factors, such as gender, education, self-efficacy, and specific software-syntax skills. Reasons for and implications of these observed relationships are discussed. © 1997 Elsevier Science B.V.

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1. Introduction

In the 1980s, several surveys of IS managers across North America identified End User Computing (EUC) as one of their top ten most important issues. Many IS managers had to adjust quickly, coping with a rapidly accelerating demand by users for hands-on access to computers and software. This shift toward 'computer democratization' triggered a great deal of anxiety about how best to manage the process. The two big issues of the day were 'How fast should EUC be allowed to grow in our organization?,' and 'What controls are needed to discipline and direct the growth of EUC?'

By the beginning of the 1990s, management of EUC dropped off the 'Top Ten' list [20]. Managers today are confident in their ability to handle the challenge and generally no longer regard managing EUC as a critical issue.

Recent studies show, however, that a substantial proportion of the potential return on the investment in end user information technology is never realized [12]. So, why are managers confident that they are managing this area well? Unfortunately, many organizations have simply assumed that the mere presence of end user tools would spur productive activity: a
give them the tools and let them finish the job' perspective. That approach has not worked [13, 21]. In fact, this laissez-faire approach to EUC is perhaps one of the reasons for the ‘productivity paradox’ – the discovery that despite billions of dollars of investment in information technologies, knowledge worker productivity during the 1980s barely improved at all [9]. This raises two questions. Does knowledge-worker productivity actually exist, but is not detected? And/or could it be that knowledge-worker productivity is not actually being achieved? There is evidence that the first statement is true. Brynjolfsson [4, 5] has found that past measurements of IT related productivity improvements have not been appropriate and, in fact, companies are achieving three times the initial costs back in value. Interestingly, he goes on to suggest that the latter statement could also be true. He posits that "the discrepancy between the large consumers' surplus implied by [his] methodology... and the minimal productivity impact found in some other studies may be due not only to mismeasurement of output, but also to systematic over-consumption of IT by managers.” Managers are perhaps not purchasing the right technology for their firms and compensating by buying too much. Others agree that organizations are not getting much of technology. Several authors posit that personal productivity gains vary greatly among organizations [11] and between individuals [16]; hence, much can still be done. End users are not extracting the maximum benefit from the technology and many simply do not develop the competence that is required for their jobs [2].

Fitting technology to people, organizations and tasks is critical if managers want to improve the impact that this technology can have on their staff. In this situation, managers will need to have a much better grasp of the important elements that affect users’ competence, with the most likely factors being organizational, task, individual and technological. Furthermore, to capture evidence of individual performance improvement, managers must have a means of benchmarking performance, a way to measure staff computing ability. Repeated benchmarking with an effective measurement tool could permit an assessment of the overall payoff from EUC investment. Better understanding of the EUC process will also enable managers to develop effective strategies for improving individual skill and usage levels. All in all, this holds the promise of a more rational and focused basis for the allocation of scarce EUC resources.

Our purpose is to explain the User Competence concept which addresses users’ EUC activities as it relates to productivity, and to discuss some findings from an empirical examination of the construct, and its relationship with other predictor variables. The results of our study of 100 end users provide initial evidence as to the validity and appropriateness of the User Competence construct and approach.

2. User competence

2.1. Breadth, depth and finesse

Our earlier research [15] on EUC led us to conceptualize User Competence as consisting of three independent dimensions: breadth, depth, and finesse. Breadth refers to the extent, or variety, of different EUC tools, skills, and knowledge that an individual possesses and can bring to bear on his or her job. This includes EUC software, hardware, and concepts and practices. For example, many user support staff have a especially broad grasp of EUC technologies, techniques, concepts and issues, because they are constantly fielding questions from many different end users. Certain individual users, in contrast, may have a very narrow breadth of EUC capability, even to the extent of knowing how to do only one thing (for example, using a spreadsheet package to perform budget analyses).

The second dimension concerns the depth of the person’s EUC capability. Depth represents the completeness of the user’s current knowledge of a particular EUC sub-domain. In any sub-domain (for example, using a spreadsheet), individuals will differ in the extent of their use of its capabilities. This includes the degree to which they have mastered the full capabilities of a particular software package and the degree to which they are able to apply the package’s toolset in the full range of problem tasks for which it was designed. Depth has much to do with the mastery of features and functions of particular types of application systems, practices, techniques, etc., and it is usually developed over time, through a combination of study and hands-on use. User support consultants,
interestingly, are often found to have surprisingly limited depth of skill or knowledge within most sub-domains, even though their breadth of knowledge may be substantial. In practice, they rarely have enough time or opportunity to become deeply skilled or knowledgable in the use of a particular aspect of EUC. Rather, they know just enough to be able to handle most common user questions efficiently. The consultants themselves frequently turn to their own end users for assistance on difficult questions or problems requiring greater depth; these end users, while likely to possess much less breadth of knowledge than the consultant, will often possess much deeper knowledge in the specific area under consideration.

Previous end user studies have suggested that different end users could also differ in terms of their innovativeness, or creativity, in the use of EUC. In numerous organizations, certain end users would be known to be power users with respect to certain EUC technologies (for example, spreadsheets). When this was probed, it became clear that a power user had more than an encyclopaedic grasp of the commands and capabilities of certain application packages or technologies. It also included the ability to exercise innovativeness and creativity in the practical use of the technology – the ability to find new or unusual, especially effective ways of using a technology that were seen as innovative in the organization; in effect, ‘pushing the edge of the EUC envelope.’

This suggests that there is a third dimension to UC, separate and distinct from that of breadth or depth of capability. We term this third dimension finesse, and define it as “the ability to creatively apply EUC.” Our model of UC, then, embodies these three fundamental aspects of EUC capability.

2.2. EUC knowledge domains

Previous EUC research provides guidance in determining and partitioning the areas of EUC knowledge. Earlier studies (for example, [22]) had observed that end users could range in their capabilities from complete novices, up to individuals who could properly be considered IS professionals. Also, some end users have been found to ‘consume’ information only, while others ‘produce’ it for consumption by others [8]. However, whether they only use or also produce information, end users essentially need to know about, and be able to use, three things: EUC software, hardware, and concepts and practices. These, then, are the three major EUC ‘domains.’

The EUC hardware domain includes sub-domains such as personal computing hardware, shared (mini or mainframe) computing hardware, and telecommunications hardware. The EUC software domain is dominated by the generic application packages, such as spreadsheets, word processors, data base managers, and graphics packages. It also includes operating systems, programming languages and other development tools, and company-specific applications, such as accounting and specific decision support systems. The third domain, EUC concepts and practices, includes sub-domains such as designing a data base, performing basic systems analysis, common computing and data communications concepts, backup and recovery procedures, etc. [10, 17].

Fig. 1 illustrates the important components. The three dimensions are shown along the left side of the matrix, and the three knowledge domains across the top. The horizontal arrow communicates breadth of knowledge across (and within) the knowledge domains; the vertical arrows indicate depth of knowledge within domains; and the light bulbs suggest ability to apply end user technologies creatively.

3. Previous empirical studies

Two previous studies of end user training and skill development, conducted by the authors, helped frame
this basic model. For completeness, these studies are now summarized.

3.1. Study 1 – field interviews

This was an exploratory field study of 31 end users in eight organizations, using on-site, semi-structured interviews that lasted between 60 and 90 min each. The primary purpose was to uncover the nature of the EUC performed by the individual, the breadth and depth of the individual’s EUC knowledge and ability, the ways in which the person thought EUC provided value to the organization, the person’s background and development with respect to EUC, the degree of innovation they had brought to these activities, etc. The objective was to develop a general impression of how competent the individual was in his or her EUC skills, how and why this happened, and where they expected to go with EUC in the future.

The results of the field interviews confirmed the basic conceptualization of User Competence and also suggested a set of general research questions about the factors underlying User Competence for later research. This study, in combination with previous EUC research literature, led to the formulation of a macro research model, displayed in Fig. 2.

This macro model proposes that User Competence is an important determinant of individual performance. User Competence has three dimensions, breadth, depth, and finesse. Any individual end user’s degree of User Competence is, in turn, influenced by various organizational, task, individual, and technological factors.

3.2. Study 2 – measurement construction and preliminary validation

Based on the findings, a preliminary instrument for measuring User Competence was developed. In the second study, the instrument was pilot tested in a series of three phases, with 74 users in groups of 14, 30, and 30. Initially, faculty and doctoral students reviewed the questions and provided suggestions for clarity and topic coverage. Then 14 university clerical and managerial administrative staff completed the instrument and provided feedback for improvement. The last two phases involved administering the instrument to sets of 30 administrative staff in two different organizations. Analyses were conducted to evaluate alternative measurement approaches and methods, and these resulted in an improved version of the User Competence instrument.

The purpose of this study is to provide the next step towards testing the research model. It involves further validation of the User Competence concept and measures through empirical comparison with related individual concepts.

4. Methodology

4.1. Overview

The purpose of the new study was to examine the User Competence construct itself, and its relationship with certain individual factors, as illustrated by the specific research model (Fig. 3). Only the

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**Fig. 2. Overall research model.**

**Fig. 3. Specific research model.**
most salient factors of our earlier model were studied, since questionnaire space was limited. The important model factors were identified and chosen from prior research and the literature review. In particular, the field interviews suggested that demographic factors, such as gender, age, and duration in the company, might play a role in determining competence. Also, the interviews suggested that the extent of an individual's computing usage, as well as his or her confidence in using EUC technology, would play a role as well.

An experiment was devised to compare the survey instruments to commercial software testing procedures, since our prime concern was how our competence measure related to self-efficacy and software testing. Survey instruments were, therefore, compared under experimental treatment conditions to assess different traits, packages, data collection methods, testing order, and specificity. We modified the previous questionnaire instrument, and added demographic and other related variables. We also created a pencil- and paper test of WordPerfect and Lotus 1-2-3 skills, drawing questions from a commercial skills assessment tool, which we used in verifying the competence measuring instruments.

To examine the relationship between the confidence of end users toward IT and UC, a variable called computer self-efficacy was also measured. This is an individual's perception of his or her ability to use a computer successfully in the performance of a job task [7]. Computer self-efficacy represents an important point of comparison to UC, for two reasons. First, confidence and ability may be easily confused in the process of managing EUC in organizations. Second, individuals who are confident end users would be expected, over time, to develop their skills more completely than those who lack this confidence. Thus, a causal relationship is expected to exist between self-efficacy and competence. By showing that they are separate (though related) constructs, this study could help to clarify how they differ.

4.2. Sample

The intended population is all organizational personnel who use EUC technology in the conduct of job tasks but who are not considered to hold IS support positions. The specific sample was chosen from end users who were familiar with the two popular computing application packages: WordPerfect and Lotus 1-2-3. The 100 end users who participated in this study were, on average, 29 years old (std. dev. = 7.4). Forty-eight percent were women. They were divided between students (60%) and current members of the labour force (40%). Of those currently employed, 18% held managerial positions; 21% held professional positions; 30% occupied technical positions; 21% occupied clerical positions, and 10% held 'other' positions, which most often were self-employed. Seventy-eight percent had at least an undergraduate university degree or college diploma. The remainder had some college or university (12%) or high school (10%). Of the students, the majority had several years work experience.

Basic knowledge of word processing and spreadsheet software was a prerequisite for people to participate, and they had to know Word Perfect and Lotus 1-2-3 best. Seventy-five percent of the participants used computers on a daily basis; 17% used computers on a weekly basis. On average the subjects in this study used computers for 3 h per day (std. dev. = 99 min).

4.3. Measurement of study variables

4.3.1. Breadth, depth and finesse

The measures of breadth and depth were taken for different specific knowledge areas across each of the different knowledge domains (EUC hardware, software, and concepts and practices). For example, within EUC software, breadth and depth were measured for 10 different software packages. For each knowledge area of interest, the instrument recorded five pieces of information. First, each individual was asked about the extent to which he or she had received formal or informal training in the domain. The person was then asked how many specific packages he or she knew best. Finally, each person was asked to rate (on a scale of 0 to 7 where 0 = No Knowledge, 1 = Very Little Knowledge and 7 = Complete Knowledge) the thoroughness of his or her current knowledge within the domain. This information was used in the calculation of indices for breadth and depth. Measurements of breadth and depth for the other two domains were created in a
similar fashion. See Appendix A for samples of the scale. A complete copy of the research instrument and details regarding construction of indices are available from the authors.

The variable *finesse* was somewhat more challenging to characterize precisely. Drawing upon interviews with users in the first field study and discussions with an IS academic panel, finesse was characterized in terms of three things:

- **creativity** with EUC,
- **self-sufficiency** with respect to EUC, and
- **ability to learn** new (EUC-related) things.

Creativity encompasses finding new ways to apply existing EUC tools, as well as finding new ways to solve problems or deal with job tasks using the tools. Self-sufficiency involves being able to function well without the need for extensive backup support, and also knowing enough to be able, when problems or barriers are encountered, to uncover the probable causes and possible solutions to those problems quickly. Similarly, a person who is creative in applying EUC would probably be able to learn new features and capabilities of the technology rather easily. Based on the above, a five-item scale to measure finesse was developed.

### 4.3.2. Software tests

In order to improve our assessment of the validity and reliability of the user competence measures, a multitrait–multimethod analysis was conducted. This required a comparable but different measure of UC. To this end, it was decided to measure certain basic software skills directly, since this was the common business practice. Subjects’ skills with the application packages WordPerfect and Lotus 1-2-3 were assessed using 10 items each from the Skills Evaluation System (SES) [6], a standardized test that has been administered to thousands of end users in several countries over several years. These multiple choice items test an individual’s ability to recall various commands in the software, or the steps required to execute specific functions. Wordperfect and Lotus 1-2-3 were chosen for comparison rather than other packages (the SES contains tests for over 60 packages) since they were expected to be most prominent in the end user community at the time.

### 4.3.3. Self-efficacy

Self-efficacy was measured by the eight-item scale, developed and tested by Compeau and Higgins. Respondents were asked to imagine that they had been provided with an unfamiliar software package to assist in some (hypothetical) job task. They were then asked to consider whether they believed they could complete the task using the software under each of eight different conditions (for example, ‘if there was no one around to assist me’ or ‘if I had a lot of time to complete the task’). For each item the respondent was asked to indicate both whether they believed they could complete the task, and if so, their confidence in that judgment. Previous studies using the self-efficacy measure have shown it to possess high construct validity.

In order to complete the multitrait–multimethod assessment, a second measure of self-efficacy was also completed to parallel the software tests. Each question in the software test was shown to the subjects on a card, and they were asked to indicate whether they believed they could answer the question (Yes/No) and if ‘yes,’ how confident they were that they could do so (on a scale of 1–10).

### 4.3.4. Demographic variables

Demographic variables were included to allow examination of potential systematic differences between individuals who were more and less knowledgeable in their use of computers. Age, gender, education, and employment status (students versus non-students) were measured in order to assess these differences.

### 4.3.5. Usage

While it has not been proved that its use necessarily results in increased competence, some degree of relationship can be expected to exist. For example, Bostrom, Olfman and Sein [3] argued that users’ mental models regarding software packages are formed partly by direct usage. To test the relationship between competence and usage, both frequency and average duration of computer use were measured through direct questions.

### 4.3.6. Procedures

The measures were administered in a controlled environment (a conference room within a business school) with end users randomly assigned to the
treatment conditions. The balanced experimental design had 25 subjects completing repeated measures on package, method, and trait, and doing so under one of four combinations of order and specificity. Each subject completed the demographic measures, the questionnaire measure of competence, the software tests, and the two measures of computer self-efficacy. The order in which the software packages were administered was varied randomly to control for sequence effects.

5. Findings and discussion

The data from the experiment were used to test the validity of the competence instrument using a full multitrait-multimethod procedure. The results of this test are reported in detail elsewhere [18]. Briefly, the basic instrument validity was found to be satisfactory. Competence and self-efficacy (questionnaire measures) demonstrated Cronbach's alpha coefficients of 0.86 and 0.93, respectively.

5.1. Distribution of breadth, depth, and finesse

The breadth, depth, and finesse scores for each of the subjects were calculated from the questionnaire items. Table 1 shows the overall average of the competence scores, and Table 2 illustrates the distribution of the results from 100 test participants across the three dimensions of competence. The breadth, depth, and finesse of each participant was categorized as either low, medium, or high. The number in each cell indicates the number of participants with that combination of breadth, depth, and finesse.

Most subjects fall on the diagonals in each table. This implies that users tend to develop their breadth and depth of knowledge, and their finesse in applying information technology, in parallel. Some, however, may be 'unbalanced' in terms of the three dimensions.

The true novices in this sample (people who scored low in all dimensions) had experience in only a small number of application domains, usually less than five. These were predominantly word processing and spreadsheets, but also included graphics and PC operating systems. They had typically taken two courses and had knowledge of one or two types of hardware, usually a personal computer. Their depth of knowledge of applications was also limited (averaging less than one on an eight-point scale where 0 is No Knowledge, 1 is Very Limited Knowledge, and 7 is Complete Knowledge). Similarly, the depth of their foundation knowledge was also quite limited, with a response of about one on the eight-point scale. In terms of their ability to apply information technology in their work creatively, the true novices also scored quite low with an average of between 1 and 2.

At the opposite end of the spectrum were the true experts (people with high scores on all three dimensions). These people exhibited a much greater breadth of experience in terms of applications. The experts had taken an average of 12 courses and had used a much broader variety of applications. They reported a better developed knowledge of software applications (averaging 3 out of 7) and foundation concepts (averaging 4 out of 7), and perceived themselves to be reasonably creative and skilful with IT (averaging close to 6).

In our sample group, more subjects perceived themselves as having low breadth and depth of knowledge

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<th>Table 1</th>
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<tr>
<td>Means, std. deviations and ranges of User Competence and self-efficacy</td>
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<td></td>
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<tr>
<td>Competence</td>
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<tr>
<td>Breadth</td>
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<td>Depth</td>
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<tr>
<td>Finesse</td>
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<td>Self-efficacy</td>
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<th>Table 2</th>
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<td>Distribution of participants across the three dimension of User Competence</td>
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<td></td>
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<tr>
<td>High finesse (32)</td>
</tr>
<tr>
<td>breadth</td>
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<tr>
<td>low</td>
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<tr>
<td>Medium finesse (35)</td>
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<td>breadth</td>
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<td>low</td>
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<tr>
<td>Low finesse (33)</td>
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<tr>
<td>breadth</td>
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<td>low</td>
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but also as having a relatively high degree of finesse. Thus, an individual’s perception of his or her ability to apply the technology creatively is to some extent independent of his or her perceived knowledge of its specifics. In general, innovative use of the technology seems to depend more on the level of knowledge within a specific domain than on the breadth of experience across many domains. Thus, this ‘finesse’ expertise is probably not immediately transferable to new areas of learning.

5.2. Demographic factors

The relationships between User Competence and the participants’ age and education were assessed, as were relationships to employment status (student versus non-student) and gender (Table 3). None of the dimensions of competence were found to be related to age and only breadth was related to educational level. The employment status of the participants was found to be unrelated to any of the dimensions of competence.

However, gender was found to be significantly related to competence. The women in this sample reported having significantly lower breadth and depth of IT knowledge than did the men. Interestingly, an examination of the mean self-efficacy and software test scores for men and women revealed no differences between the two groups. There are several possible explanations for this. First, men and women may differ in their level of competence with regard to the full range of software packages assessed here (10 were measured for UC) but for only the two packages captured in the software tests, Word Perfect and Lotus 1-2-3, they could possess similar levels of syntax knowledge. Thus, both the questionnaire and test results would accurately reflect gender similarities and differences in competence. Since word processing and spreadsheets represent the most common packages and because these are known by true novices and true experts, this explanation makes intuitive sense. It is also possible, however, that the difference in gender scores represents a difference in men’s and women’s perceptions of their skills, rather than differences that really exist. Thus, women may be inclined to rate their skills lower than their male counterparts. The likelihood of this explanation is tempered by the lack of difference in self-efficacy and finesse scores for men and women. If the difference were truly one of perception of skills rather than skills per se, we would have expected a difference in the computer self-efficacy scores of men and women: this was not found, and thus it seems more probable that the gender differences in competence are real, and exist in the level of knowledge of men and women for packages other than spreadsheets and word processors.

5.3. Computer self-efficacy

An individual’s reported competence in the use of computers was also found to have much in common with his or her confidence, or self-efficacy. A summary of the correlations between User Competence and self-efficacy is shown in Table 4.

Thus, we conclude that end user self-efficacy is significantly related to UC. It would be valuable if we could say for sure that higher self-efficacy leads to greater competence. While such a conclusion seems

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Relationship between user competence and demographic characteristics</th>
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<tbody>
<tr>
<td>How tested</td>
<td>Breadth</td>
</tr>
<tr>
<td>Age</td>
<td>Correlation</td>
</tr>
<tr>
<td>Gender</td>
<td>MANOVA</td>
</tr>
<tr>
<td>Means for:</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>16.9</td>
</tr>
<tr>
<td>Men</td>
<td>26.8</td>
</tr>
<tr>
<td>Employment status</td>
<td>MANOVA</td>
</tr>
<tr>
<td>Education</td>
<td>Correlation</td>
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Table 4
Correlations between User Competence, self-efficacy and usage

<table>
<thead>
<tr>
<th></th>
<th>Breadth</th>
<th>Depth</th>
<th>Finesse</th>
<th>Self-efficacy</th>
<th>Test score</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breadth</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Depth</td>
<td>0.83</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Finesse</td>
<td>0.49</td>
<td>0.67</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Self-efficacy</td>
<td>0.36</td>
<td>0.46</td>
<td>0.30</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test score</td>
<td>0.41</td>
<td>0.29</td>
<td>0.31</td>
<td>0.01 (n.s.)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Usage</td>
<td>0.25</td>
<td>0.33</td>
<td>0.37</td>
<td>0.13 (n.s.)</td>
<td>0.22 (0.03)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

All p < 0.01, except as noted in table.

reasonable, this type of study does not allow us to conclude it; common self-report bias or other forms of bias may be present in the data.

Interestingly, self-efficacy, like finesse, was more closely related to the individual’s depth of knowledge than to the breadth of his or her experience. Thus, in judging one’s end user capability, people seem to rely less on their knowledge relative to the total sphere of computing and more on how well they understand specific domains of use.

5.4. Usage

End users who have higher breadth and depth of knowledge of computers use them more frequently and for longer durations each day. This is not surprising, since, as breadth increases, the number of tasks that one could perform better using a computer increases, increasing the potential time that one could spend using the computer each day. Finesse was also strongly related to frequency of use and time of use, reinforcing the notion that creative ability develops from continued use on the job.

5.5. Software skills

The questionnaire measure of competence and the software skills test are indeed related. Thus, an individual’s perception of his or her overall knowledge of information technology and ability to apply it is significantly related to his or her scores on a test of syntax knowledge for Word Perfect and Lotus 1-2-3. This lends us additional confidence that the measures of User Competence are valid and relevant.

6. Implications

The findings of this study have a number of implications for practitioners. First, it provides a usable instrument for measuring an end user’s competence in terms of the breadth and depth of knowledge and the user’s ability to apply the technology creatively. Applied to the entire organizational community of end users, this instrument could be used in the workplace as a way to assess an organization’s overall potential for exploiting information technology. It could also be used to identify individuals or organizational sub-units that are not operating at their potential competence level, and thus serve as a mechanism for allocating more EUC training, education, and support resources. Also, it could be used as a kind of ‘EUC report card’ for the organization over time (although it must be remembered that the instrument measures only the competence level of the end users, not the effectiveness of their computer use).

The relationships observed between the measure of User Competence and the direct test of software skills suggests that the two measures might be best used in a complementary fashion. There is clearly a relationship between User Competence and syntax knowledge for specific application packages, and yet they are measuring different things. Ultimately, the objective is to understand the impact of User Competence on an individual’s job performance. However, until it can be clearly established which, if either, of the measures more accurately predicts performance, having both perceptual and objective measures will provide a broader base from which to understand end users’ potential for using IT effectively.
The paucity of significant relationships between demographic variables and User Competence suggests that information technology capability is becoming widespread. User Competence was not related to age or employment status. The fact that education was related only to breadth suggests that managers who want users to develop a broad range of end user capabilities should focus on user education. Age is apparently not related to competence, which means that organizations need not wait for the next generation to bring User Competence to the workplace. User Competence must be fostered carefully in conjunction with the users’ level of base skills. It also suggests that older workers, who were at the extreme 20–25 years more senior, are as effective in their use of IT as younger workers.

In the face of the general lack of significance of the demographic variables, however, the difference between men and women is of particular interest. However, it is not clear whether the difference reflects less competence, or a difference in perceptions. Nevertheless, in our study, as in other gender related studies, women do not rate their perceived competence as high as men do; this may imply that particular attention should be paid to female end users, so that they do not underestimate their capabilities, and consequently fail to fully employ end user tools to their capacity (see CACM and IEEE articles in past five years).

Lastly, there is self-efficacy. As has been found in other disciplines, and in other studies of computing behaviour, an individual’s confidence in his or her ability to use a computer is a strong predictor of the person’s actual ability. In this study, self-efficacy was found to be significantly related to breadth, depth, and finesse. Somewhat surprisingly, it was most strongly related to depth, suggesting that self-efficacy judgments reflect how well an individual understands specific aspects of IT (for example, a database package), rather than how many different things he or she knows (for example, a variety of application and hardware knowledge) or how creative he or she is in applying the technology.

Compeau and Higgins found that training, particularly that which incorporates learning by observation, was an effective way of promoting higher self-efficacy, and moreover that higher self-efficacy had a significant impact on performance during training. The link in the present study provides further evidence of a causal relationship between self-efficacy and the development of individual capabilities. Thus, from a practical perspective, managers need to understand that self-perception plays an important role in the formation of individual computer abilities, and to explore ways in which these can be enhanced through appropriate training and support. Firms can develop more skillful and capable employees by boosting their confidence to reflect an accurate view of their overall capabilities.

7. Limitations

However, the reader should note the limitations of this study, especially those related to sample characteristics and measurement. In terms of the sample, two concerns are important. First, the sample is not randomly drawn from the population of end users. In addition, the presence of students as a significant component of the sample (60%) raises questions of the generalizability of the results. The demographics presented earlier serve to mitigate this concern. All of the subjects were knowledgeable about word processing and spreadsheets, and were regular users of computers. Thus, all of the subjects were familiar with using technology to aid in the accomplishment of their daily work. This just happens to be tasks associated with student life for some of the study participants.

Since the data gathered are cross-sectional in nature, conclusions about causality are necessarily limited.

8. Conclusions

The development of a sound measurement instrument for assessing EUC potential is an important step. Organizations have already committed tremendous resources to end user technologies and end user training, with little means of assessing whether these investments are paying off. In fact, most managers admit that their level of ability with various aspects of EUC is lower than it ought to be. This lack of expertise is compounded by the fact that there is a constant stream of individuals moving into organizations whose level of User Competence is very low or
non-existent and who need education and skill development in order to improve their UC. Thus, having some benchmarks from which to understand individual and organizational competence in EUC will make it easier for organizations to allocate resources for training and support.

Armed with the ability to assess UC, the next task is to understand the levers that organizations can use to manage the development of the right User Competence in its staff. The factors that play an important role in this development include job tasks, general work environment and climate, technological capabilities, and individual characteristics.

The complex, multifaceted structure of the User Competence construct also suggests the need to refocus training and support programs. Although these have been provided in most organizations to various degrees, the evidence suggests that more must be done. Training programs are often focused on syntax knowledge. While this is necessary for developing UC, it is not sufficient for developing a complete range of end user capabilities. Rather, the application of these tools to the job tasks must be added to the training focus. EUC training and education should move beyond simple skill development, to provide a foundation of concepts and principles that serve as a basis for many different kinds of EUC activity, both now and in the future.

Appendix A

User competence questionnaire sample scales

A.1 Samples of breadth and depth

A.1.1 Section A

This section asks about your knowledge of software applications. You will be asked to estimate how much you know about a wide range of software applications.
A.1 Finesse scales

1. How often do you apply a computer to new and different problems?

   Never Frequently
   1 2 3 4 5 6 7

2. In general, how capable are you at applying computers to solve problems at work?

   Extremely poor Extremely good
   1 2 3 4 5 6 7

3. In general, how creative would you say you are in using software packages to solve business problems?

   Extremely uncreative Extremely creative
   1 2 3 4 5 6 7

4. In general, to what extent are you innovative when using software packages to solve business problems?

   Not at all To a large extent
   1 2 3 4 5 6 7

5. How often do you try to apply a computer in new ways when solving a problem?

   Never Frequently
   1 2 3 4 5 6 7

References


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