Are workplace end-user computing skills at a desirable level? A New Zealand perspective

Completed Research Paper

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Abstract

End-user computing is part of many occupations. The most requested end-user computing skills are experience with word-processing and spreadsheet applications. Often an employee's skill level may not be good enough to be deemed effective. Frequently this occurs because employers expect that employees will have the requisite skill level without formally assessing this. This paper presents a study involving the testing of people who, in their jobs, use word-processing and spreadsheet software. Two instruments were created to assess skill in common work place computing tasks. The results showed that the majority of participants could only manage very basic spreadsheet tasks, even though the use of spreadsheets was part of their employment. Results for word-processing skill was more positive, with most participants completing all of the basic and some moderately advanced tasks. These results confirm that end-user computer skill, while required, is not at a level that could be deemed proficient.

Keywords

End-user computing, spreadsheet skill, word-processing skill, workplace computing

Introduction

End-user computing skills are required in many jobs. Although the requirements may vary, most jobs that require computing skills specify the use of spreadsheets and word-processing software (Holtzman and Kraft, 2010).

Although there are many definitions of end-user computing, for the purposes of this study end-user computing refers to *"The application of information technology by individuals who do not normally think of themselves as computing professionals."* (Panko, 1989).

A mismatch can occur when the skill level of employees is not at the level necessary to productively use the software required for a job. This may occur because employers expect that employees will have the requisite skill level without formally assessing it. Gibbs and McKinnon (2009) found that employers, while realizing the need for well-developed computing skills, often did not know how to articulate their computing requirements or how to test them. Frequently employers assumed that new employees, especially young people, would have the skills required. A report commission by the Institute of IT Professionals New Zealand (IITP) found that many non IT businesses have their productively levels hampered by the lack of effective computing skills of staff (Bunker, 2010).

In their study Holtzman & Kraft (2010) found that the computing skills most sought by employers were those associated with budgeting and forecasting and the use of spreadsheet software to create appropriate business models. They also noted that word-processing and email skills were sought by all employers in their study. In addressing the question "What do employers really want?" Hansen and Hansen (2010) say

that, although employers all want a specific set of skills, there are a number that are required in most jobs. They say that it is necessary for job seekers to be computer literate, including an understanding of hardware and software. The most common software skills required are the ability to use spreadsheet and word-processing software. Employers require employees who have appropriate computing skills when initially employed and who can extend their computing knowledge and work with different software applications. Studies investigating computing skills in specific industries reported similar results. Tickle, Kyng and Wood (2013) said that, although employers employing graduates to work in the financial area would prefer all of them to have skills in specific financial software, at the very least they expect all employees to have well-developed spread-sheet skills. Employers thought that graduates should have gained a platform of spreadsheet skills at university which workplace training could build on. Actual workplace spreadsheet skills were rated by both employers and new graduates as being at a lower level than is necessary. These results were similar to those found by Holtzman and Kraft (2010).
The increase in the use of technology in many different roles means that, for a computer system to be used effectively, the users must have the necessary skills and knowledge (Suen, 2012, Barker & Fielder, 2010). In a study on the use of Information Technology, specifically for Human Resource (HR) professionals, Suen (2012) said that IT skills have become one of the required competencies in HR roles and more advanced computing skills are becoming vital for HR professionals to succeed in their careers. He found that end-user computing competencies affect overall job performance and that inadequate end-user computing skills can restrict how a person progresses in their role.

Cory and Pruske (2012) also found that the end-user computing skills required by employers of graduate accountants were the effective use of spreadsheet and presentation software. Employers placed more weight on spreadsheet skills than other software skills. While students at universities have well-developed social networking skills, their end-user computing (EUC) skills are under-developed and not likely to reach the level required in the workplace unless they are given formal tuition while completing their degrees. In their list of the most important generic skills required of graduates, the top eight involved some type of computing headed by the ability to use spreadsheet and word-processing software, creativity in problem-solving, and working in a Windows environment.

Murray, Sherburn and Perez (2007) say that computer technology has changed the face of the workplace. Where once computers were used by some staff members in an organization, most people in a workplace are now responsible for their own computing. This responsibility has meant that people entering the workforce need to have the skills required to succeed. In their survey of employers they found that, although it is clear that those in the workplace need to be more computer literate than in the past, the extent of the required IT literacy is not clear. They also say that the concept of computer literacy is a constantly moving target but noted that all respondents to their study agreed it was imperative for new employees to be familiar and proficient with common office software when beginning a job.

In reviewing a study of skills required by US employers, Holt and Brockett (2012) reported that 81% of employers surveyed ranked the need for well-developed computer application skills as high, but these same employers also stated that the end-user computing skill level of graduates was often lower than required. Gibbs, Steel and Kuiper (2011) also found a discrepancy between the end-user computer skills of New Zealand business graduates and the skill expectation of those employing them. Graduates have no real expectation of the type of computing that will be required of them in the workplace, while employers expect that, because they are young and have a university qualification, graduates will have advanced computing skills and will require no training in this area. Some of the mismatch is brought about by the lack of detail employers supply about computing skill requirements when recruiting. Unfortunately, this mismatch may be exacerbated by the tendency of graduates to have an inflated view of their EUC skills.

Although previous literature tells us that there are discrepancies between desired and actual skill level, there is very little evidence of workplace testing. This paper presents a study involving the testing of people who, in their jobs, use word-processing and spreadsheet software routinely. The creation of the instruments used is summarized, as are the results from the testing undertaken to see if workplace computing skills was at a level considered appropriate. .

The study

This study uses two assessment instruments, consisting of practical end-user computer tasks, to assess the ability of people required to use such software in the workplace.

The decision was made to create instruments for this study rather than to use any of those already available. The reasoning behind this included the flexibility available in creating an instrument for a specific purpose. Instruments that are available freely online often consist of multi choice tests which test recall not skill. Other testing systems are available at a cost and are often difficult to adapt to a particular need. Also, and perhaps most importantly, it is often very difficult to find verifiable statistical evidence of a test's validity.

Specifically the aim of this study was to address the question:

> *Are the skills of people required to use spreadsheets and word-processing software for employment at a level that could be regarded as proficient?*

The assessment instruments

The assessment instruments were created using a two-panel approach utilizing a multi-stage iterative process. The stages involved were:

1. task classification development
2. task development by panel 1
3. assessment testing by panel 1
4. task rating by panel 1 and panel 2
5. adjustment of tasks based on feedback from both panels

Stage 1 in creating the content for each instrument involved defining the categories of skill or task for each of the applications tested (Table 1). Categories were defined, initially using the author's own experience in teaching end-user computing and then comparing these with the skills tested in several online tests that are easily and freely accessed. Finally, categories were evaluated by an independent academic expert in EUC.

Spread-sheet task classification	**Word-Processing task classifications**
1. Cells and formatting	1. Text and paragraph formatting
2. Functions and formulas	2. Styles
3. Charting	3. Numbered lists
4. Sorting and Filtering	4. Tables

Table 1 – Task classifications for spreadsheet and word-processing assessments

Stage 2 involved the development of the tasks in each of the classification categories. This involved a content development process undertaken using two separate and independent panels of end-user computer experts (panel 1 and panel 2).

In stage 3 of the development process panel 1 tested the instruments by completing the assessment as a user would. Comprising ten users for the word processing test and eleven for the spread-sheet test, the panels were a mixture of academic experts and industry experts. (Table 2)

The academic panel members were people currently involved in the teaching of productivity software at a tertiary level. The expert users were people who used this type of software to a high level in their jobs. These were people identified as the "go to people" in an organization, those who others would ask for help.

Identification of panel members was made in a variety of ways; some people were identified by way of an organization expert list, others by recommendations from peers.

Expert user Panel 1	
Spread-sheet Experts	11 Users
Academic Expert	3
Expert user	8
Word Processing Experts	10 Users
Academic Expert	3
Expert user	7

Table 2 - Composition of SS and WP Expert Panel 1

The time to complete each task was recorded. Members of panel 1 were asked to complete a questionnaire rating the content and difficulty of each task.

Stage 4 of the process involved the formation of a second panel of end-user specialists (panel 2) to assess the objectives of each task in each instrument. The reason for having a second panel was to ensure that an independent view of the content objectives was made by people who had no exposure to the test instrument. Panel 2 consisted of seven members, all involved in the teaching or workplace training of end-user computer skills. (Table 3)

Expert User Panel 2	**7 Users**
Corporate Workplace computer skills experts	5
Academic End-user Computing Experts	2

Table 3 – Composition of Expert panel 2

Panel 2 members were not required to complete the tests but were asked to rate each of the skills being tested as either essential to test or not essential to test. Panel members were also asked to rate the difficulty of each task as being either basic or moderately advanced.
The final step, stage 5, involved the adjustment of task content and description based on feedback from both panels.

Following a round of development and piloting of instruments two assessments were created. These instruments were a fifteen-task spreadsheet assessment and an eleven-task word-processing instrument. The assessment tasks and difficulty ratings are shown in Table 4 and Table 5.

Spreadsheet task	Difficulty rating
1. Basic Cell formatting.	Basic
2. Using a simple Sum function.	Basic
3. Using a Count function.	Basic
4. Using a conditional function to count values meeting a criteria.	Moderately Advanced
5. Using Text Functions.	Moderately Advanced
6. Using a fixed cell reference in a formula.	Basic
7. Create a pivot table with one summary value	Basic
8. Using a conditional function to return value.	Moderately Advanced
9. Naming a Cell.	Moderately Advanced
10. Creating a simple Column chart using adjacent ranges	Basic
11. Creating a one series column chart with numeric values as the x axis.	Moderately Advanced
12. Sorting multi column data.	Basic
13. Using a Lookup function in a formula.	Moderately Advanced
14. Using a simple filter.	Moderately Advanced
15. Create a validation rule	Basic

Table 4 - Spreadsheet tasks and difficulty ratings

	Word-processing task	Difficulty rating
1.	Applying basic paragraph formatting.	Basic
2.	Changing a paragraph's alignment	Basic
3.	Copying formatting between paragraphs.	Basic
4.	Indent a paragraph.	Basic
5.	Creating multi-level lists.	Moderately Advanced
6.	Applying pre-set styles to text.	Basic
7.	Modifying a pre-set style.	Moderately Advanced
8.	Inserting text and page number into page footer	Basic
9.	Updating a tables	Basic
10.	Positioning an image within a block of text.	Moderately Advanced
11.	Working with sections within a document.	Moderately Advanced

Table 5- Word-processing tasks and difficulty ratings

Participants

For this study participation was sought from people in a number of different organisations seen as representative of the population of workplace computer end-users. Members of this population are employed in a number of different organisations over many different disciplines (Holtzman & Kraft, 2010). Due to the routine use of workplace technology it is difficult to define the exact characteristics of this population as it is so extensive.

The ninety participants recruited for this study, both male and female, were employed in many different roles including, administration, secretarial, research, finance and education and were required to use spreadsheet and word-processing software were recruited for this study. Recruitment involved a combination of volunteer sampling and a snowball approach.

Volunteer sampling, a nonprobability sampling method, occurs when a researcher appeals to people to participate in a study and is appropriate in situations where the researcher has some knowledge of the population ((Moser & Kalton, 1971; Babbie, 2007). One of the main disadvantages of the volunteer sampling method is it involves only those who wish to participate and as a consequence the self-selection may compromise the sample. This sampling was seen as appropriate for this particular study as participation was required from only those people who met the criteria of using the software being tested.

Invitations were made, by email, to people from a variety of different organisations. Some of these were known to the researcher and some approaches were cold calls. The cold calls were made to organisations in the researcher's geographical area, with email contacts sourced from website details. The initial contacts resulted in either direct recruitment of the person contacted or the email being forwarded to that person's colleagues or a notice about the study being placed on a workplace noticeboard or workplace intranet.

The participants were asked to provide information regarding the number of computer applications they were required to use in their employment and the average number of hours a week they used a computer in their employment.

The assessment process

Each of the participants completed both assessments.

The instruments were automated with each sheet or page containing navigation buttons participants used to start a task and move to the next task. Examples from each assessment are shown in Figure 1.

For each of the tasks participants were presented with the task, but with the data hidden. Once the task had been read the participant could begin by clicking on the Start Task button. This action revealed the task data and also began the background timing. The data was hidden to prevent a participant from beginning the task and not starting the timing mechanism. The purpose of the timing mechanism was as a measure of expertise. Participants were unaware of the background timing, to avoid creating a time pressure. A participant could choose to skip a task by simply choosing the Next Task button.

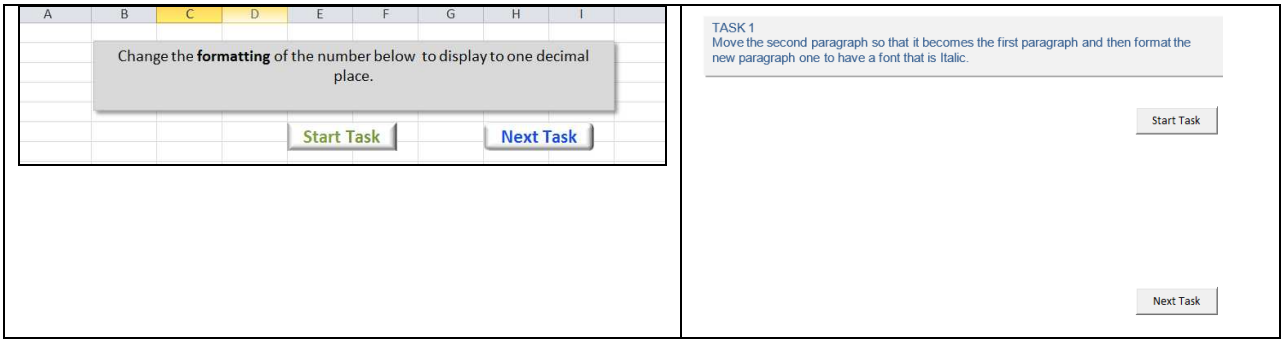

Figure 1 - Examples of a spreadsheet task and a word-processing task

The assessments were scored using number correct, where correctness referred to the use of an appropriate function or formula, not necessarily the actual cell result. This approach was taken in order to address the artificial nature of a testing situation where people may have felt under pressure to perform. The researchers were more interested in knowing if a person was familiar with a particular function or formation of a formula rather than if they inadvertently selected an incorrect range etc. In saying this the researchers are very aware of the problems associated with "mistakes in spreadsheets" but acknowledge that often mistakes may be made due to a person's lack of knowledge of the appropriate functions or features (Powell, Baker & Lawson, 2008).

Results and discussion

The following sections discuss the results by assessment.

Spreadsheet assessment

Participants were recruited on the basis that they used spreadsheets for their employment; however, the scores, for tasks considered common workplace tasks, were very low, with the average for the study being just 47% correct. Only 34% of participants scored more than the study average. Eight of the fifteen spreadsheet tasks in this assessment were rated by the implementation panel as basic tasks that everyone using this software regularly should be familiar with. The remaining seven tasks were rated as moderately advanced tasks. The results from the spreadsheet assessment, while lower than those expected by the expert development panel, were comparable with the results from other studies (Grant et al., 2009).

It is not surprising that, in this study, the two most basic tasks were those with the highest rate of correctness. These basic tasks involved adding up a column of values and changing the formatting of a cell. However, it is a little more surprising that other tasks, considered basic by the experts, were not

carried out correctly by more people. Examples of this included using an absolute cell reference in a formula or sorting a data range by more than one sort category.

The average results for the spreadsheet assessment implies that the majority of these regular spreadsheet users are only able to complete basic tasks using this tool. Five participants (5%) completed the entire assessment correctly, whereas three participants could only complete two of the fifteen tasks.

Also disappointing was the number of spreadsheet tasks that were not attempted. This may be because spreadsheets have many features that people are unaware of. In some types of employment, spreadsheets may simply be used to record and tabulate data, while, in others, chart editors and other visualisation tools are the most common features used (Chambers and Scaffidi 2010; Baker, Powell, Lawson & Foster-Johnson 2009).

Many of the participants were clearly reluctant to even attempt a task. This seems to indicate a lack of confidence to extend skills and to try something a little outside their

Table 6 provides a summary of the spreadsheet results.

Task number	Difficulty level 1: basic; 2: Moderately Advanced	Proportion correct (n = 91)	Proportion inspected and skipped	Proportion incorrect	Proportion skipped without inspection
1	**1**	0.96	0	0.04	0
2	**1**	0.97	0.02	0	0.01
3	**1**	0.48	0.47	0.03	0.02
4	**2**	0.26	0.46	0.24	0.04
5	**2**	0.18	0.70	0.04	0.08
6	**1**	0.36	0.26	0.30	0.08
7	**1**	0.42	0.20	0.14	0.24
8	**2**	0.35	0.34	0.05	0.26
9	**2**	0.12	0.80	0.01	0.07
10	**1**	0.78	0.16	0.02	0.04
11	**2**	0.34	0.29	0.21	0.16
12	**1**	0.59	0.32	0.07	0.02
13	**2**	0.20	0.65	0.04	0.11
14	**1**	0.78	0.16	0.02	0.04
15	**2**	0.19	0.65	0.01	0.15

Note: the shading in the rows indicates the skills rated as moderately advanced.

Table 6 – proportion correct for each spreadsheet task

Figure 2 shows the number of participants who correctly solved the different tasks. The tasks rated as moderately advanced are represented by the striped bars in the graph.

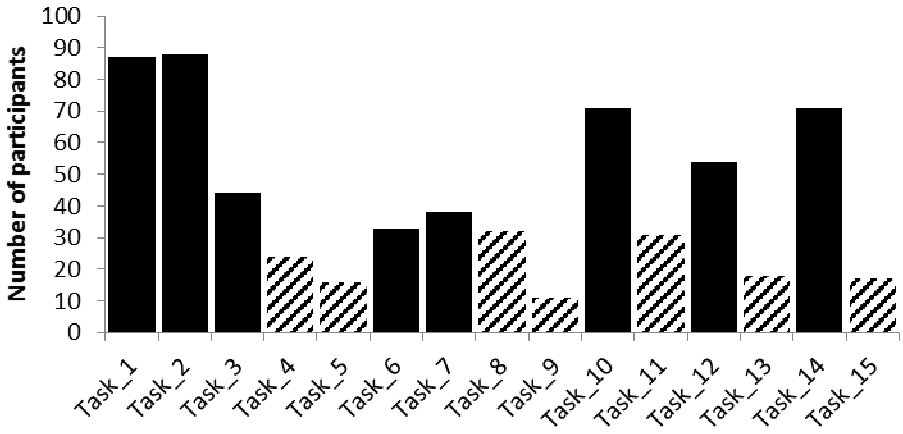

Figure 2 – Number correctly completing each Spreadsheet Tasks

Results of a comparison between the number of correct tasks and the time taken show that a longer time taken to complete a task did not lead to a higher score. In fact, those who received the highest scores, generally did so in the shortest times. This shows that the participants who knew how to complete a task did so efficiently.

Word-processing assessment

The study average of 67% correct for the word-processing assessment suggests that the participants felt more comfortable with this assessment than they did with the spreadsheet assessment. The expert panel, involved in the assessment development, classified 67%, seven of the eleven tasks, as being tasks everyone in the workplace should be proficient in. This result helps to confirm that the tasks rankings were accurate This is pleasing, but perhaps not that surprising, given that word-processing software is probably the most common office application that people will use (Holtzman & Kraft, 2010). Where once typing and then word-processing was a function carried out by secretarial staff, most roles are now responsible for their own computing of this nature (Kennedy, 2013).

Table 7 presents the results of the word-processing assessment. Unlike the spreadsheet assessment, no tasks in this assessment were skipped by any participant. This may be because there are many different ways to perform word-processing tasks.

Task number	Difficulty level	Proportion Correct	Proportion Incorrect
1	1	0.96	0.04
2	1	0.91	0.09
3	1	0.67	0.33
4	1	0.85	0.15
5	2	0.76	0.24
6	1	0.90	0.1
7	2	0.38	0.62
8	1	0.82	0.18
9	1	0.99	0.01
10	2	0.60	0.4
11	2	0.32	0.68

Note: the shaded rows indicate expert skills.

Table 7 - Proportion correct for each task

Although word-processing applications include advanced text editing and referencing features, the tasks performed using this software are mostly at a basic text editing and formatting level. Grant et al. (2009) and Hanson et al. (2011, 2012) found that participants' perceptions of their word-processing knowledge were close to their actual skill. It should be noted though, that no participant in this current study completed all of the tasks correctly. The task which was completed by the least number of participants was one ranked as expert by the panel and involved using advanced document layout features. The insertion of section breaks into a document helps to achieve different page layouts within a document but is an area that people do not seem to be able to complete easily. One reason why the results from the word-processing assessment were higher than spreadsheets could be that a typical word-processing environment such as that in MSWord is very similar to other environments such those in Email programs etc. This familiarity with the formatting features etc. may mean that people are likely to feel comfortable using a keyboard and the formatting features common among different applications types (Dymond, Neeper & Fones (2010). A number of word-processing tasks, such as formatting text, can be achieved using a variety of different methods. While not all methods are efficient, the end result can be satisfactory. The same is not necessarily so when using spreadsheets. Spreadsheet applications have many features and a certain level of knowledge is required in order to complete tasks more complex than entering data. Even a basic formula requires some knowledge. For the word-processing assessment there was no relationship between time taken and the outcome of the assessment.

Combined assessment results

As mentioned previously, participants came to this study from many different occupations. Table 8 shows, by occupation, the makeup of the combined score. There is no surprise that the highest combined score was for those people who identified as ICT specialists, followed by analysts and people working in the fielding of accounting. It is interesting to note that, while the combined average for administration workers (including secretarial staff) was low, the average for their word-processing scores was, perhaps predictably, quite good compared with other groups of participants in this study.

Occupation	Number	Combined assessment	SS assessment	WP assessment
Accounts	9	0.62	0.62	0.61
Administration	20	0.47	0.33	0.67
Analyst	5	0.76	0.69	0.85
Environmental Planning	2	0.58	0.43	0.77
HR	2	0.44	0.37	0.55
ICT	3	0.79	0.87	0.70
Library	4	0.48	0.33	0.68
Management	7	0.49	0.41	0.61
Marketing	4	0.48	0.40	0.59
Misc.*	3	0.54	0.44	0.67
Project	4	0.48	0.33	0.68
Research	26	0.59	0.53	0.69
Self-employed	2	0.40	0.30	0.55

**Table 8 Assessment results by occupation*

**Participants in the occupations represented by only one person were grouped together in the miscellaneous category*

Those who had a good result for the spreadsheet assessment also achieved a good result for the word-processing assessment. However a good result in the word-processing assessment was not a predictor of a good result for the spreadsheet assessment. This difference may have occurred as a result of anxiety that is sometimes present when users, are required to use tools for which they have a lower level of understanding such as spreadsheets (Singh et al., 2013). Another explanation for this is that word-processing is done by many people in many roles and does not require much knowledge to achieve simple, basic tasks.

Conclusion

The results from this study lead to three possible conclusions. The first, is that the assessments used in this study were not at the correct level for general workplace computing. The second is that participants in this study do not have the level of end-user computing skill necessary to be effective end-users. Given the caliber of the expert panel used in compiling the assessment, the latter conclusion is the more likely. This conclusion confirms the ITTP report (Bunker, 2010) saying that end-user computing skills were not at a sufficient level for workers to be deemed proficient and effective. The third conclusion, is that these assessments were actually assessing the participant's ability to correctly navigate through a number of tasks. While having some merit, this conclusion may be may be somewhat negated given the number of spreadsheet tasks skipped. Skill in the use of spreadsheet software is particularly low compared to what is required. Although the results from the word-processing assessment were better it was nevertheless surprising that no-one person correctly completed the word-processing assessment.

The results from this study have implications for both employers and for employees who are computer end-users. Lack of information about an employee's level of computing skill may mean that a person is employed in a role for which they do not have the appropriate level of skill. Partly, this may happen due to the absence of actual quantifiable testing of end-user computing skills. . Often, as computers are

considered a common tool, skill level is just assumed. These assumptions may be made by both parties. Employees who have never had their computing skilled measured, may assume, due to lack of relevant feedback that their skill is at an adequate level. Likewise, employers may not actually realize the skill level actually required for a person to use common software effectively. These mistakes can occur because both groups do not have enough information about end-user computing skills required. An assessment tool, such as the one created for this study, could be used in a workplace to train as well as test end-users.

This study was undertaken from a New Zealand perspective, in future work we hope to carry out similar testing in other parts of the world in an attempt to see how representative these current results are.

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