Developing digital competence - learning, teaching and supporting use of information technology

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Chapter 11. Evaluation of training

The learning aim of this chapter is to be able to design appropriate evaluations of training.

Organisations evaluate their activities to find out whether these are worth the cost or whether they can be done in a better way the next time. In general, there are four levels of evaluating training (D. L. Kirkpatrick, 1959, 1975; Donald L. Kirkpatrick & Kirkpatrick, 2006)

1. *Reaction*. Reaction is the participants' opinion of the course. It is normally gauged during the training session. For example, the reaction can be found through a questionnaire to the participants asking their opinion of the course and the teacher.
2. *Learning*. This is an assessment of what the participants learnt during the course. An exam assesses learning, but in order to evaluate training, the exam should be administered also before the training, so that the difference in competence before and after can be found.
3. *Behaviour*. An investigation of people's use of the IT when back at work or in other business. For example, ask the participants about which functionality in a software system they use two months after the course.
4. *Result*. This is a measurement of changes in organisational performance, for example the number of clients which can be taken care of by means of new IT learnt in the course.

Levels 3 and 4 evaluate the outcome of training, requiring transfer of competence from course to work, see Section 10.1. The four levels are ordered in time as shown in Figure 75.

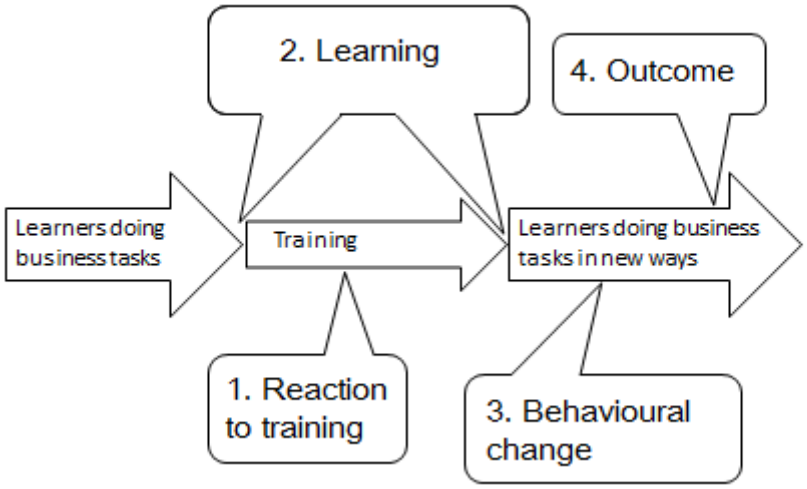


Figure 75. The timing of four ways of evaluating training.

A combination of evaluations will normally provide more relevant results than a single one. For example, an evaluation of behavioural change might find that some of the intended effects

of the IT had not come about. Then an evaluation of reaction to training might point to particular weaknesses in the teaching. It might as well happen that evaluation of learning concludes that the staff has learnt what was intended, but the evaluation of result did not demonstrate any change. This would mean that the training is fine, while transfer did not take place. There might, for instance, be no opportunities to use the competence at work.

A review of research on training in organisations showed that the effect sizes of training for the four ways of evaluation were similar (Arthur Jr. et al., 2003). However, within each study, there were large variations between the effects measured in the four ways. Therefore, we cannot assume that changes of behaviour will occur, even if we can observe that learning takes place during training.

The levels do not imply any causal relationships between reaction, learning, behavioural change and result (Holton III, 1996). Learner motivation will influence the learning process and enabling factors in the organisation have strong impacts on change and results. Despite this known weakness, the Kirkpatrick model dominates as an evaluation framework amongst practitioners (Aguinis & Kraiger, 2009).

11.1. Evaluation of reaction to training

Learners' reactions can be observed in the class as spontaneous statements concerning anything taking place there. The trainer might hear

> *Now I got it right.*
>
> *I don't see the point of this topic.*
>
> *Good I got to know you, so that I can ask you later.*
>
> *The lunch was delicious.*

Statement 1 concerns the learning process, while no 2 is about the motivation for some of the course contents. The third one hints at an important organisational issue, namely that the learner has met somebody whom can be approached for help during transfer. The fourth statement concerns the course environment. Knowing the learners' reactions to any of these topics may be relevant when revising courses.

A teacher observing learners constitutes no systematic approach to evaluation, however. If observation is wanted, an independent person will be able to observe both the learners and the trainers systematically. If no additional person is available, interviews or questionnaires are alternative ways of gauging the learners' opinions. Questionnaires have the advantage of anonymous responses.

Questions in interviews or questionnaires could address any of the topics in the examples above. Since learning and transfer might depend on several factors, and since there can be large individual differences, getting acquainted with other users might be as important as motivation and course environment.

When evaluating the learners' reaction to the course contents, all three subject matter areas of IT competence can be addressed, since there may be a need for adjusting one or more of them. Concerning business fit, questions like

> Did the course address your needs in your job? If some needs were not met, which ones?

could be used. The closed question addressing the needs overall could be responded to on a scale from 1 to 6. The latter, open question can provide knowledge on specific activity fit to include.

Participants' reaction to the IT and information contents of the training could be addressed by asking

> Did the training provide a sufficient background for understanding the IT system? And for using it?
>
> Did the course explain the data in the system sufficiently?

The latter question should be rephrased, targeted to the information taught, for example

> Did the course explain the account types thoroughly enough?

if an accounting system was to be taught. Again, scales could be used in the response, and the closed questions could be followed up by open ended ones as in the activity fit case.

In a case study of evaluation of user training, the users responded that the hands-on exercises with real world data were useful for keeping their motivation (Mahapatra and Lai, 2005). This response was useful for the trainers, who became even more focused on crafting training material to fit the background and expectations of the learner group.

11.2. Evaluation of learning – assessing competence

Assessing IT competence is an activity which can take place for many reasons in various settings.

- An organisation wants their staff to be at a certain level, so they organise a test for everybody to take.
- When planning a course for a group of participants, we want to know their competence, so that the course can start at the appropriate level.
- When a course plan has been settled, we screen the possible participants, so that those at a too low or high level are channelled into other training.
- Employers test the IT competence of job applicants.
- Applicants document their competence through completing a certified test.
- A school administers an exam in their IT class.

- For evaluating a training course, we assess IT use competence prior to the course and afterwards. The difference between the two levels will tell us what the course has contributed with, like Kirkpatrick's model state (D. L. Kirkpatrick, 1975).

Levels of IT competence have been described as skill, understanding and problem solving competence, and tests of competence can be arranged accordingly. Basically, skills are assessed through practical tests, and understanding with written or oral questions and answers. Testing problem solving competence could involve both practical and theoretical tests. A test can assess IT, information or business fit competence or combinations thereof. Telling the accountant Rigo, who sits in front of a computer to

> Print the spreadsheet.

would test his IT skills. Assuming that a reimbursement claim is registered in a database,

> Check the reimbursement claim.

is a task which can be given him to test his IT, information and business fit skills. In order to test his understanding, the following types of questions could do:

> What is a spreadsheet program? (IT understanding)
>
> What is debit and credit? (Information understanding)
>
> What is the purpose of double-entry bookkeeping? (Business fit understanding)

People can express competence which is only at the level of skills also, like Kirsten talking about her sequence of tasks in section 0. Asking questions like

> Which menu choices and buttons do you use for creating a numbered list which starts at the number 3?

does not require a response at the level of understanding; see Mireille's response in Chapter 5.

Business fit competence

Questions concerning business fit could be open ended. Focusing on a software tool:

> Note down a task in your job where you use or could use spreadsheets. What is the advantage of using a spreadsheet in this task?

Taking the activity as the point of departure, we could design a test for the level of understanding possible changes:

> You are organising a sports event. For which activities can IT be helpful, and which IT hardware and software would you use?

Skills test:

> Create a spreadsheet for currency conversion.

Multiple choice questions could also be IT focused:

> Which of the following activities can you use a spreadsheet for when planning a new house?
>
> a. Draw the floor plan.

b. Compare the cost of different floor covers.
c. Find the formulas for areas of rooms and walls.
d. Write the contract for the architect.

Or based on the business:

> You are planning a new house. Which of the following statements are correct?
>
> a. The contract can be written with Adobe Reader.
> b. Tables in text processors can be used for comparing colours.
> c. I can communicate with the architect through sharing a folder on Dropbox.
> d. The floor plan can be drawn with a spreadsheet.

Questions concerning business fit and information should target the learners' experience, such that they are familiar with the background of the question. When testing for an organisation, addressing actual work tasks in the questions would be appropriate.

Assessing problem solving competence

Open ended questions for checking experimentation competence could be:

> Find out what goes right and wrong when copying from a pdf document and pasting into a text processor.
>
> Here is a new application. Find out what it does.

Multiple choice questions could assess the part of experimentation that involves reflection. A test could be:

> You have attached a file to an e-mail to Bob. Then you discover that the file contains some statements which you do not want Bob to read, so you make some changes in the file and save it. You wonder whether Bob will get the changed file. Which of the alternatives below will give you the answer you need? Beware that the alternative should also tell us how to do it the next time.
>
> a. Ask Bob about the name of the file he received.
> b. Check which file that disappeared from your disk.
> c. Remove Bob from the list of receivers and enter yourself instead.
> d. After sending, check the mailbox containing sent messages.
> e. Send the file to yourself from another e-mail account.
> f. Remove the attachment and then re-attach the file before sending.

The flip side of such questions is that they do not necessarily test experimentation competence. If Manu, who answers, is very familiar with the e-mailing, he might answer correctly because he knows a lot about his e-mail service, and not because he is clever at setting up experiments.

IT users can also learn through troubleshooting. A general way of checking users' ideas about troubleshooting is asking about repetitions:

> You observe that the computer responded in a way that you did not intend. You repeat it, and this time it worked out. What can the reason be?

a. The computer regained momentum.
b. There was a virus the first time.
c. You made a typing mistake the first time.
d. The quantum mechanical circuit at the mother board kicked in.
e. The hard disk crashed.

Asking questions like the ones presented for experimentation is also possible, having the same drawbacks, in the sense that we cannot always know whether we are testing the users' troubleshooting competence or the mastery of the particular technology.

In addition to questionnaires, problem solving competence also lends itself to observation. The teacher can observe how the learner handles the software and looks up resources for help. For a pair of learners, also their conversations can be observed. Observations of problem solving come out with significantly different results than questionnaires to the same users (Novick et al., 2007). Assuming that the difference is due to poor memorisation of details of actions, observations seem to give a more correct account of problem solving.

Teachers normally observe learners' activities in order to adjust the training on the spot. Such evaluation is called *formative*, which has a profound effect on learning, d=0.9 (Hattie, 2009). This chapter concerns the *summative* evaluation, which aims at improving the course the next time it is carried out. However, the observations which teachers carry out informally on the learners' achievements may also be included in the assessment of learning.

11.3. Evaluation of behavioural change

Evaluation of reaction to training and of learning can be carried out in any training course, independently of what the learners are going to do afterwards. Evaluation of behavioural change is intended for company specific courses, where it is possible to approach the course participants some weeks or a few months after the course has ended. If the participants use IT in their work in a different way from what they did before, a behavioural change has taken place. Finding the type and extent of such change is what evaluation of behavioural change aim at.

When the IT to be learnt is a software package on a server, users' operations can be logged. Data on changes in user behaviour can therefore be found by analysing such logs. Details on individuals' use of specific functionality can be summarised with much less effort than asking users. Like any surveillance, employees should be informed that their behaviour on a computer system is logged. Some countries or trades may have regulations or agreements concerning surveillance systems.

Logs do normally not tell us all we want to know, however. They provide statistics, but not the reasons why the staff use specific functionality or avoid it. Again, observations, interviews and questionnaires constitute possible ways of investigation. Observation takes more time and provides more detail per individual, while questionnaires reach a larger number of users with less detailed response. Individual and group interviews lay in between the two.

When designing questions aiming at finding reasons, the factors from the Technology Acceptance Model (Section 8.2, p.99) can be a starting point. Usefulness, ease of use, social

pressure, facilitating conditions and combinations of these are likely reasons for the use or non-use of a specific functionality. For example, assume that the logs have demonstrated that the functionality for search for similar cases in the client system is used to a very little extent. A relevant question in a questionnaire to the users could be:

> Regarding the "Search for similar cases" in the client system, rank your agreement with the following statements on a scale from 1 to 6 (1=Disagree completely, 6=Agree completely):
>
> ☐ I find this search very useful in my work.
>
> ☐ This search is easy to use.
>
> ☐ The majority of my peers use this search.
>
> ☐ The computer system responds quickly on this search.

A low score on usefulness may have two reasons. Either, this has not been taught properly during training, so that the users have not understood its usefulness, or the functionality is of minor value. If users say that it is difficult to use, the training might be to blame. If they say that it is easy, the reason for low use may be that it is actually of little value. Peer pressure and technical conditions should also be taken into account.

11.4. Evaluation of result or outcome

The fourth level of Kirkpatrick's model (Kirkpatrick, 1975) is evaluating whether the introduction of IT fulfils its goals, and how the training has contributed to the result. While simple ways of measuring organisational performance, like the bottom line in a company, may exist, drawing inferences from changes in results back to training courses are often difficult due to a high number of intervening variables. For example, the business may observe that the number of clients served after introduction of the new client information system has risen by 20%. The reason for the change may be that the market has increased, that clients are served better, that a new system has been introduced through successful training, or that the staff has managed to get the new system working despite poor training.

A more feasible way is selecting some outcome which is closer to what was trained. Instead of the number of clients, we could for example measure the time for serving each client. This relieves us from dealing with markets or other external factors as possible explanations. Still, the possible impact of training on efficiency of client handling has to be established.

In an evaluation of training of an information system for reporting health statistics, it was possible to count the number of data items filled at any point in time and also perform some automatic comparisons to judge accuracy (Ngoma et al., 2008). In order to gauge the training result, the completeness and accuracy were first measured in several sites, some of which would be trained. After training was completed, the completeness and accuracy were

measured again in the same sites, and the results compared, see Figure 76. The sites which were not trained constituted a control group. If the sites without training had improved as much as those with training, the training would not have had any effect. The untrained improved by 10% while the trained with 50%, leading to the conclusion that training was effective.

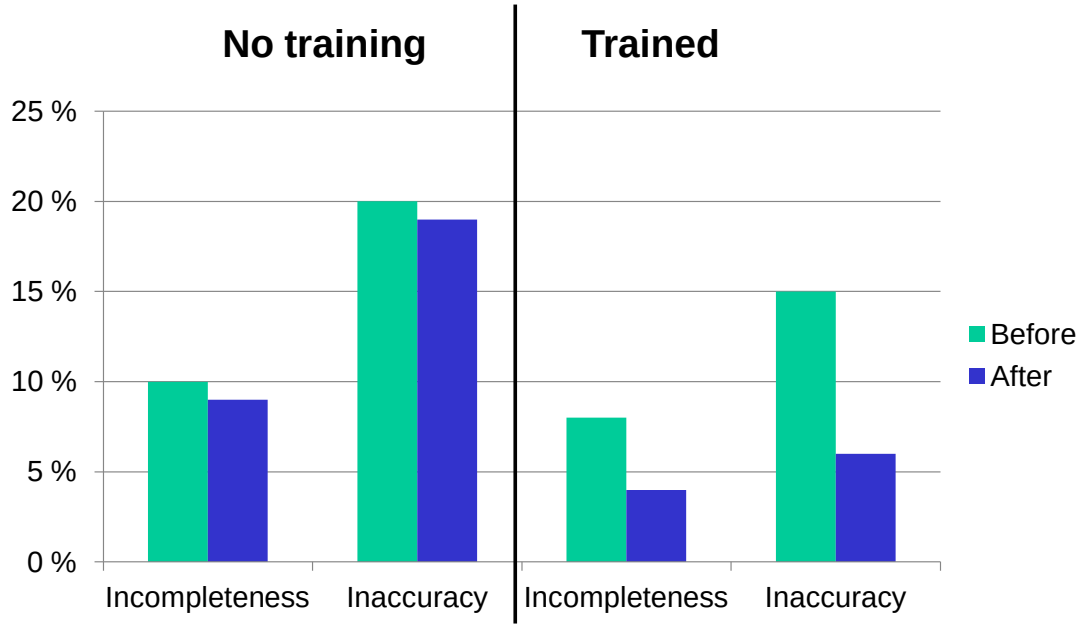


Figure 76. Measurement of results of training. The "No training" sites constituted a control group.

Chapter 12. IT user competence standards

The range of technology, information and business fit which users have needed has evolved over the years. In the 1980's, the file system, individual office applications and possible business information systems constituted the typical collection of IT for users to master. The 90's brought local networks and the Internet, with servers, browsers and e-mail added to the standard repertoire. During the last ten years, Web 2.0, mobile phones, tablets, digital cameras, music players and a number of other personal gadgets have sparked a diversification of modes of interaction as well as hardware. Business systems have moved into the browsers or migrated to enterprise resource planning software.

The continuous expansion of IT applications disables any stable description of the range of IT, information and business fit competence. However, some comprehensive guidelines for IT user competence have been developed, either for the general public, for special occupations or pupils at school.

12.1. Standards and guidelines

An approach to the latter is the FITness (Fluency with IT) report, which describes a comprehensive set of skills, concepts and capabilities, see Figure 77 (Committee on Information Technology Literacy, 1999). This set of competencies includes the three subject matter areas of IT, information and business fit, although business fit is less specified. Contrary to many textbooks on software use, it addresses concepts and principles. FITness go even a step further, by including programming and algorithms, which is considered beyond IT user competence as described in this book.

Most organisations depend on their employees being capable of operating business critical systems. For example, the cashier needs to be able to check out goods and register payment, police officers need to know how to use the communication equipment, and the air traffic controller must be fluent in the IT system mapping the flights. In the latter case, and in other high risk tasks like handling surgical equipment and nuclear power plant control, the operators might have to be certified. A detailed specification of the competence, including information technology, business fit and information competence, will be required for constructing certification tests.

Intellectual Capabilities	Information Technology Concepts	Information Technology Skills
1. Engage in sustained reasoning. 2. Manage complexity. 3. Test a solution. 4. Manage problems in faulty solutions. 5. Organize and navigate information structures and evaluate information. 6. Collaborate. 7. Communicate to other audiences. 8. Expect the unexpected. 9. Anticipate changing technologies. 10. Think about information technology abstractly.	1. Computers 2. Information systems 3. Networks 4. Digital representation of information 5. Information organization 6. Modeling and abstraction 7. Algorithmic thinking and programming 8. Universality 9. Limitations of information technology 10. Societal impact of information and information technology	1. Setting up a personal computer 2. Using basic operating system features 3. Using a word processor to create a text document 4. Using a graphics and/or artwork package to create illustrations, slides, or other image-based expressions of ideas 5. Connecting a computer to a network 6. Using the Internet to find information and resources 7. Using a computer to communicate with others 8. Using a spreadsheet to model simple processes or financial tables 9. Using a database system to set up and access useful information 10. Using instructional materials to learn how to use new applications or features

Figure 77. IT user competencies as described in FITness (Committee on Information Technology Literacy, 1999).

Standards are operationalised through curricula and tests. Competency tests are used in level 2 evaluation of training, see Section 11.2. General tests of competencies are presented below.

12.2. Tests

Both commercial and other organisations have developed IT user competency tests, see (Covello, 2010) for an overview. Three major ones are:

- Educational Testing Service is a US based, non-profit organisation, known for its Test of English as a Foreign Language (TOEFL). They offer the iSkills Assessment, which measures IT literacy (Educational Testing Service, 2011)
- Certiport is a commercial actor, also providing courses and tests for software professionals. (Certiport Inc., 2011)

- ECDL Foundation is a non-profit organisation providing the European Computer Driving License, also known as International Computer Driving License (ICDL). It was founded in 1995 by the Council of European Professional Informatics Societies in order to improve digital literacy across Europe. Later, it has gone intercontinental, and 11 million people have conducted tests given in 41 languages. (ECDL Foundation, 2011)

We will look at some sample questions to see how the tests are constructed. The ECDL is divided into 13 modules, mainly according to software types. In addition, there are three general modules:

- Concepts of ICT
- IT Security
- Project Planning

About Module 1, the ECDL / ICDL Sample Part-Tests (ECDL / ICDL, 2009 Module 1, p 1-2) says:

> *Module 1* Concepts of Information and Communication Technology *(ICT) requires the candidate to understand the main concepts of ICT at a general level, and to know about the different parts of a computer.*
> *The candidate shall be able to:*
> *- Understand what hardware is, know about factors that affect computer performance and know about peripheral devices.*
> *- Understand what software is and give examples of common applications software and operating system software.*
> *- Understand how information networks are used within computing, and be aware of the different options to connect to the Internet.*
> *- Understand what Information and Communication Technology (ICT) is and give examples of its practical applications in everyday life.*
> *- Understand health and safety and environmental issues in relation to using computers.*
> *- Recognize important security issues associated with using computers.*
> *- Recognize important legal issues in relation to copyright and data protection associated with using computers.*

Assume that we constructed open ended test questions for these learning goals, like:

What is the Internet?
Karl responds:

> *A network through which we access all places in the world*

Karl is describing a function of the Internet, so he is at the IT functional understanding level. His understanding may be limited, since he does not specify the different types of functionalities, like the www, email, chat, etc. The ECDL has multiple choice questions for testing understanding (ECDL / ICDL, 2009 Samle Part-Test 1.2, p 3):

> *Which one of the following statements about the Internet is TRUE?*

a. The Internet is a global network that links many computer networks together.
b. The Internet is a private company network.
c. The Internet is a visual representation of linked documents.
d. The Internet is a network operating system.

The statements a-d describes the Internet at the IT conceptual level. Given that Karl responded like above, he would most likely tick the a alternative, so his test result would show that he understands the Internet at the IT structural level.

Concerning software, the spreadsheet module is selected as an example (ECDL / ICDL, 2009 Module 4, p 1):

Module 4 Spreadsheets *requires the candidate to understand the concept of spreadsheets and to demonstrate an ability to use a spreadsheet to produce accurate work outputs. The candidate shall be able to:*
- Work with spreadsheets and save them in different file formats.
- Choose built-in options such as the Help function within the application to enhance productivity.
- Enter data into cells and use good practice in creating lists. Select, sort and copy, move and delete data.
- Edit rows and columns in a worksheet. Copy, move, delete and appropriately rename worksheets.
- Create mathematical and logical formulas using standard spreadsheet functions. Use good practice in formula creation and recognize error values in formulas.
- Format numbers and text content in a spreadsheet.
- Choose, create and format charts to communicate information meaningfully.
- Adjust spreadsheet page settings and check and correct spreadsheet content before finally printing spreadsheets.

The learning goal specifies a series of skills, which are described in some detail. The "concept of spreadsheet" is not explained, so the understanding part of the goal is unclear. The tests are mainly of the practical kind, for example (ECDL / ICDL, 2009, pp. Module 4 Sample Part-Test 4.1, no 8):

Enter a formula in cell F5 with an absolute cell reference for one cell only that divides the content of cell E5 by the content of cell E11. Copy the formula in cell F5 to the cell range F6:F10.

So the goal of skills seems to correspond to the test type. An open ended question which addresses understanding is also included (ECDL / ICDL, 2009, pp. Module 4 Sample Part-Test 4.2, no 11):

Which of the two cells F4 or F5 displays good practice in totalling a cell range? Enter your answer in cell B14.

Answers to open ended questions like this one can be assessed right or wrong or according to a scale, for example skill – functional understanding – structural understanding. .

Responses to multiple choice tests are easy to assess. Assessing whether the candidate has written a correct formula in a spreadsheet also requires only a quick view. Reading, interpreting and grading an open ended answer is much more tedious.

ECDL's division of IT competence into software types hinders questions which relate concepts from two IT tools. For example, the following question could not be included:

What is the similarity between master slides in presentation programs and styles in text processors?

a. They guide the printer.
b. They provide information for the table of contents.
c. They enable coherent formatting of the file.
d. They enable import of slides into word processors.

Also differences between concepts could have been included if the tests could span more applications, for example:

What is the difference between tables and column layout in a text processor?

a. Tables are imported from a spreadsheet, while column layout is generated within the text processor.
b. Tables are only found in spreadsheets.
c. Column layout is the vertical sequence of cells in a table.
d. Tables are composed of separate cells of text, while column layout means that the text is displayed in sequential, vertical stripes.

The Instant Digital Competence Assessment (iDCA) is a recent test aimed at 14-18 year olds (Calvani, Fini, Ranieri, & Picci, 2012). It is organised in the three dimensions technology, cognitive and ethics, instead of the organisation according to IT applications found in the ECDL. Technology corresponds to the IT subject matter area. The cognitive dimension addresses management and evaluation of data, which belong to the information area. Ethics covers general principles and constrains for IT and information use and is a part of the business fit subject matter area. Since iDCA is not compartmentalised into software products, it could cater for the two questions above.

iDCA consists of multiple choice questions and does not address skills by asking the respondents to carry out operations on the computer. Its technological area addresses problem solving.

Competence tests versus self-reporting

Performance on competence tests have been compared with students' self-reporting of their competence level. The latter was gauged by users responding to statements like:

- My spreadsheet skills are good.
- I am a more experienced spreadsheet user than most of my peers.
- I feel competent to use a range of applications.
- I feel comfortable opening and saving spreadsheet files.

The respondents would agree or disagree on a scale.

Most studies conclude that there is no correlation between how people self-report their level of IT competence and how they perform in tests (Ballantine, Larres, & Oyelere, 2007; Grant, Malloy, & Murphy, 2008; Larres, Ballantine, & Whittington, 2003; Merritt, Smith, & Di Renzo Jr., 2005; Sieber, 2009; Sink, Sink, Stob, & Taniguchi, 2008; van Vliet & Kletke, 1994). Low performing users overestimate their capabilities. On the other side, one study found a correspondence between self-reporting and test results of IT competence (Hakkarainen et al., 2000), and this is in line with the general findings that school students have a very accurate conception of their level of achievement (Hattie, 2009). In school, students are used to comparing their work with grades, which provides a good basis for reliable self-reports. Since IT use is a minor topic in schools, people may not have had such experience concerning their IT competence, however. Since the majority of IT competence studies do not find correlations, we consider self-reports and levels of competence uncorrelated.

A consequence of users overrating their competence is that trainers and educators who rely on self-reporting assume a higher entry level than what is the case. For example, in a study of 173 college students 75% perceived their word processing proficiency as high and 20% as average (Grant et al., 2008). In the skills test, questions were grouped as basic, moderate and advanced. Table 11 shows the ten tasks which the researchers had characterised as moderately difficult. Tasks with correctness rank 1-7 are operations on the main document text flow, so no understanding of the data structure of document files is necessary. Tables and headers (rank 8-10) introduce independent text flows, requiring the students to alter their structural understanding of a document as a single sequence of characters to a multi sequence model. The majority of students seem to be stuck in the single text flow understanding, even though they characterise themselves as average or highly proficient.

Table 11. Performance of college students in the US on word processing tasks (Grant et al., 2008)

Moderate tasks	Correct performance	Rank
Count words	91%	1
Add bullets	88%	2
Highlight text	82%	3
Find and replace text	60%	4
Use the Thesaurus	57%	5
Insert a date	54%	6
Justify a paragraph	47%	7
Enter data in a Word table	33%	8
Insert rows in a table	27%	9
Create a document header	8%	10

Although the competency tests do not distinguish clearly between a skill and understanding level, this test indicates that college students have a limited IT understanding. They might base their high self-confidence on their skills in getting a document produced.

12.3. IT competence levels

This book has described three levels of individual user competency: skills, understanding and problem solving in the three subject matter areas. Results of measurements of IT user skills worldwide follow their own ways of grading competence.

In an iDCA study in Italy, the teenagers scored higher on trouble shooting than understanding IT concepts (Calvani et al., 2012). This indicates that people learn some trouble shooting skills before they acquire understanding of many IT concepts.

An international survey of digital reading competence at school level 5 concerned the pupils' ability to navigate and find appropriate web pages efficiently (OECD, 2011). Also, they were assessed on their skills in evaluating the information retrieved. The study therefore mainly addressed the information subject matter area. Interestingly, South Korean children outperformed the students from the other countries, including New Zealand and Australia, Japan, European and South American countries in this ranking. Africa and North America were not represented. While a common opinion may be that people in the newly industrialised countries in Asia are well versed in electronics, while the European children are more literate in the original sense, this OECD study only partly supports such a view. Korean students perform better in digital than in print reading, while the opposite is true in Eastern Europe and South America.

Girls outperform boys in both digital and print reading (OECD, 2011). The same is found in a study of college students in the US (Hignite, Margavio, & Margavio, 2009). An ICT literacy test amongst 6 and 10 year old children in Australia included a range of tasks typical for the age groups. Both technological and business fit competence were tested (MCEECDYA, 2010). Also in these areas of competence girls performed better than boys. A test of high school students in China with iDCA showed no performance difference between the sexes (Li & Ranieri, 2010), while boys performed better than girls with the same test in Italy (Calvani et al., 2012).

The findings that girls outperform boys on technological topics contrast the results from more than 30 previous studies summarised in (Cooper, 2006). One reason for this difference could be that the former IT assessments were more biased towards technology, while information and business fit have been given a larger proportion in recent years. Another factor may be that young children now grow up with mobile phones and social media on the internet, and that communication is more aligned to girls' interests, while boys are competing in computer games. The recent studies showing female superiority were carried out amongst children, while former studies have addressed all age groups.

Socio-economic factors are generally influencing competence levels, and this is also the case for IT related competencies (OECD, 2011). Having a computer at home has a positive effect on children's IT literacy.

Part III - Managing development of digital competence in organisations

The previous parts have considered the individual's competence and learning. In order to consider organisational aspects of IT competence, we shift focus from individuals to groups. We will base the identification of a group on people who share a set of activities, called a *practice*. Such groups constitute the units in a theory of learning at work within the class of situated learning theories. Situated learning refers to learning that takes place within the practice where the learning is applied.

Pedagogical theory – Situated learning – Communities of Practice

According to (Wenger, 1998) a *community of practice* (CoP) has three crucial elements; domain, community and practice. The identity of a CoP is defined by a shared *domain* of interest with shared competence for dealing with that domain. Members in a CoP value their collective competence and learn from each other. Second, members in a CoP create a *community* through engagement in joint interactions and discussions, by helping each other, and also by sharing information. They also build relationships that enable them to learn from each other. However, members of a CoP do not necessarily work together on a daily basis. The third characteristic element of a CoP is the *practice;* the doing which provides meaning and structure to the activities. The shared practice is created by practitioners who develop a shared collection of resources such as tools, experiences, and ways of addressing recurring problems. For example, a group of supermarket workers would constitute a CoP when they share the concern for the goods and customers, they interact, discuss and help each other, and they use common tools for sales and pricing of goods.

CoPs often differ from the formal organisational units, appearing neither on an organization chart nor on a balance sheet. In a small shop with a handful of staff, managers may be part of the cashiers' CoP, and in a large organisation, the accountants spread around in different departments may interact sufficiently to constitute a CoP.

Newcomers get socialised into a CoP by imitating its members, and also by getting punished or neglected if behaving in ways which are not acceptable in the community. The members may also tell newcomers explicitly how to behave, and the novices may have attended formal education which has prepared them for the introduction. When a community of practice receives a new member, it is mainly the newcomer who will have to adapt, while the community is less receptive for changing their practice.

Pedagogical theory – Situated learning – Interaction between CoPs

In line with (Wenger, 2000) and (Cobb et al., 2003), we consider three aspects of interaction between CoPs; boundary interactions, brokers, and boundary objects. In *boundary interactions*, members from different communities take part in common activities. This might be short encounters, like when a manager calls the computer support for getting help in connecting to the network, or longer practices, for example when health managers participate in a course conducted by health information specialists.

A *boundary object* is a material thing which makes sense in more than one CoP, and which also has a structure that is common enough to be recognized in both CoPs (Star and Griesemer, 1989). Boundary objects are used for communication between CoPs, and they may provide a common understanding of a phenomenon as well as give rise to misunderstandings. A database could be a boundary object for accountants and computer scientists, where both parties would recognise its ability to store and retrieve financial data. However, the accountants would emphasize its role of representing the financial affairs of their company, while the computer specialists could regard it as an instantiation of a relational database management system.

Brokers are at least peripheral members of two CoPs and can introduce parts of practice from one CoP to the other. A headmaster could be a broker between the community of teaching practice and the community of school management practice in the town. Construction engineers could be members of engineering, architectural and construction work practices, providing some joint understanding between the three partners.

Chapter 13. Superusers

The learning aim of this chapter is to be able to identify groups with different roles as learners and supporters and to specify conditions for these groups developing into communities of practice.

13.1. Roles

The areas of IT use competence were identified as information, IT, and business fit. Each of these has their specialists, while users in general will be specialists in their business and the domain of the system. In addition, teachers are specialists on metacognition, being a central ingredient in problem solving competence. The areas of practice of these four types of specialists are summarised in Table 12.

Table 12. Areas of practice and corresponding communities.

Role	Area of main practice	Examples
Users	Activities. System domain	Farmer. Nurse. Cook. Salesperson.
Information officers	Information	Accountant. Archivist. Surveyor.
IT personnel	IT	IT support staff. Software developer.
Teachers	Metacognition	School teacher. Business instructor.
Superusers	IT + at least one of the other	

Users are characterised by having the domain of the information system as their primary domain of work. Second, people having information as the main domain of their practice, like accountants and archivists will be called *information officers.* Third, *IT personnel* have IT as their main domain of work, so these are in the IT practice. Fourth, *teachers* enable learning and have metacognition in their competency base. People working in each of these four roles can constitute communities of practice, since they share a main practice.

Finally, some users, information officers or teachers develop specific skills in using computers, so they provide computer support to their colleagues, and this group will be called *superusers.* A superuser can also come from the IT side and adopt competence from one of the other areas. Super-users will be members of at least two communities of practice, hence become brokers between these communities. They can also develop into a community of superuser practice. Each of these five roles will be described in more detail below.

Users

For the majority of IT users, the technology is a means to get work done, and not an aim in itself. Users find IT problems annoying and prefer to spend their time on their primary business. Their shared domains of interests are therefore not IT or data, but any other work area; hence they may constitute communities of non-IT practice. Correspondingly, the eventual learning of IT use taking place in these communities will be of secondary importance to the learning of the main business.

Information officers

Information officers are normally people of other professions than IT, having data management as their main responsibility. This could be accountants keeping the books, clerks doing data entry, statisticians producing reports, epidemiologists analysing data, surveyors measuring locations, or archivists storing and retrieving files. Information officers are the experts on information in the IT use competence model. Having IT as their main tool for work, they often develop into superusers, thereby achieving double expertise in relation to the information system.

In larger organisations, there may be an accounting department, a central archive, or a management information systems group, each having a number of staff working closely together. They could constitute *communities of information practice* within their application area. However, such specialists can also be scattered around in an organization, leaving them few opportunities for developing into a community. In these cases, user forum meetings, e-mail groups, professional societies or the odd phone call may provide sufficient contact for their expertise to be shared and thrive. If they work in a place where there is also a community of information practice in the same domain, like the accountancy department or the central archive, these communities could provide the support for the scattered individuals.

IT personnel

Larger companies or agencies would have IT personnel involved in a mix of activities. Network administration and user support would normally constitute two time consuming ones, while procurement and application tailoring could be other tasks.

The idea of a community of practice is that people share a domain of interest, and we could say that the IT systems and their users in the organization is the domain of the IT personnel. They would normally share information about the technology and its users through lunch conversations, meetings, e-mail, documentation and random encounters in the corridors. Larger organisations could also have a database for storing user requests and responses, where the IT personnel can search for topics with which they are unfamiliar. In these ways they may develop a shared repertoire of cases, problems, software and users, so that they constitute *communities of IT practice*. IT specialists meet users in boundary encounters on the phone and face to face, helping out those who need more IT competence, and they learn about users' business and information through interacting with them. They also have boundary interaction with other communities of IT practice, e.g. at computer vendors, thus keeping updated in the IT field.

Software companies and IT vendors can also have departments for support. For these organisations, their customers will constitute their users. A newly established, small company might just have a flat structure, where all members carry out development and support. These would constitute a community of practice, where the software product constitutes the shared domain of interest. A big vendor, on the other hand, might have a call centre in India with several hundred staff members who serve customers worldwide. If they have the opportunity to communicate and exchange experience, they may also become a community of practice, where the users' requests and the corresponding responses constitute the shared domain. In

between these extremes, there are many medium sized IT companies, where the user support is located in a department of a smaller size, such that the formation of the community is simpler than in the huge call centre case.

An IT department in a non-IT company would use the software and hardware vendors as their lifeline for support. They would engage in boundary interactions with the vendors, and the software and documentation would constitute the boundary objects of these practices.

Teachers

Larger organisations have human resource departments where educationalists are hired for organising and planning training, and who may also act as instructors themselves. Schools are obviously special in this respect, as their main staffs have formal pedagogical qualifications. They would normally constitute one or more *community of teaching practice* in each school.

School teachers and business instructors sometimes also do IT training. In schools, IT competence could be an end in itself or a means for the students to learn other topics. In the latter case, the teacher may be fluent on business fit and information but short on the technological competence. Professional teachers bring training methodology and learning competence including metacognition into the realm of user support and training. This pedagogical competence is hardly found amongst IT personnel or information officers.

Superusers

Superusers are users, information officers or trainers who have specific IT competence and have taken on the role of supporting their peers in an organization (Boudreau and Robey, 2005, Olfman, et al., 2003). ‘Key users’ (Fitzgerald and Cater-Steel, 1995), ‘business coaches,’ ‘subject matter experts’ (Olfman, et al., 2003), ‘power users’ (McNeive, 2009), ‘computer gurus’ (McNeive, 2009), peer-coaches (Poe, Abbott, & Pronovost, 2011) and ‘local heroes’ are other terms for this role. Super-users could have a primary domain of work completely remote from information or IT, for example nursing, sales or farming. They would therefore belong to two communities of practice; one on the IT side, and another on their primary domain, and they would also be brokers between these communities, see Figure 78. They could influence the communities of IT practice with their main competence, and introduce IT competence amongst others.

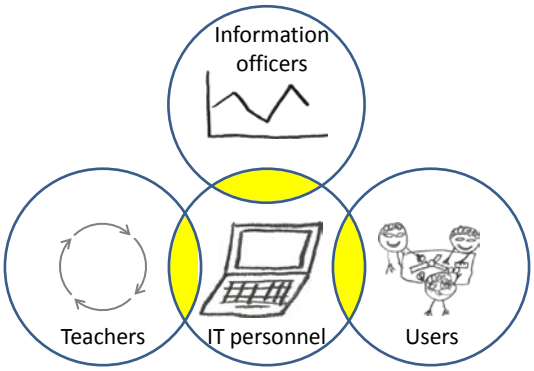
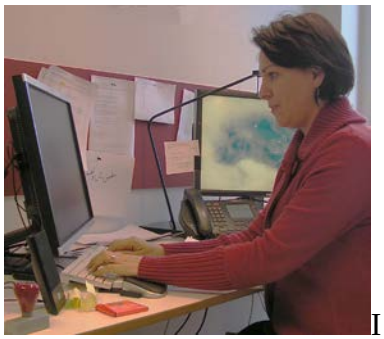


Figure 78. Superusers (yellow) being members of at least two communities of practice and brokers between these communities.

The text boxes present three superusers. Mozhdeh had some experience as an information officer when she did archiving. She became a superuser of an archiving system after her job was changed, but she still draws upon her knowledge of archives in her superuser role. Oksana is a superuser of a system which she uses frequently in her accounting job. She knows the information in the system, how to operate the IT, and how it supports the business. Sigrun has a computing background and was selected superuser for a web publication system. She is familiar with how it can be used for creating structured web pages.

While these three superusers had been appointed, superusers emerge also when no formal appointments are made. In a purchase department of around 100 staff in a Finish company, all staff were provided training when a new information system was installed, but no system of superusers was established (Sykes,



I am Mozhdeh and my main job is administration of international students. Since I had been working with archival systems previously, I was selected as the local super-user when the new system Erchive was implemented. I was introduced to Erchive in a training course. The course covered the IT system but not archive codes and whether a document has archive value. Many user requests concern whether a letter should be archived, and then I have to find out whether it has archival value. There is a list where I can look it up, and I can also call the central archive if in doubt. Other user requests concern how to operate the system. Also, I solve logon problems and upgrading to the recent version of the browser. They need that when Erchive is updated.

Each department has a super-user, and we meet 4 times a year. We discuss changes we would like and communicate these to the IT department. We also get informed about changes and have to bring the news to our local colleagues.

یک کاربر حرفه ای کسی است که خود از سیستم بطور مداوم استفاده کند.

 My name is Oksana, and I do accounting. When staff members claim reimbursement for travels, they fill a form in the human resource system, and thereafter I check the form. I am also helping them getting the information into the right fields. Sometimes I invent solutions to avoid some restrictions in the system. When I cannot solve the problem, I ask staff members to send an e-mail to the central support section and explain the problem, get the answer and to try “to do the best you can on your own.”

I was introduced to the system through a course, but I learnt nothing there. Instead, I have gone through the e-learning material and learnt it that way.

Last week, I presented the system to a large group of people from all departments in a training course. We also helped them out in their practical tasks. Тем самым большему количествоу пользователей стало известно об уловках, чтобы обмануть. систему

Venkatesh, & Gosain, 2009). During a period of three months after training, all staff had either given or received help from others. On the average, a user helped five others, but some became more central, helping out more than ten, thus informally becoming superusers.

A *community of superuser practice* could emerge if they engage in activities where they meet and exchange experience specifically on their superuser activities and role. Almnes (2001) conducted a study of superusers amongst nursing home personnel, and McNeive (2009) reports from nurse superusers in a hospital. Both emphasize that belonging to a group is important for superusers, since their role is the only one of its kind amongst those whom they meet daily. In addition to group meetings, e-mail lists, newsgroups and lists of frequently asked questions may be advantageous. The organised group should also provide the necessary opportunities for the superusers to update their skills, whether new software or other upgrades necessitates it. An accounting company formalised their superusers into a group with a coordinator in charge (Åsand & Mørch, 2006). Mozhdeh and Sigrun belong to such groups.

Selected superusers who were going to help out during implementation of a clinical information system, spent on the average 13 hours per week for preparing themselves (Halbesleben, Wakefield, Ward, Brokel, & Crandall, 2009). The longer time the superusers spent on learning the computer system, the more positive attitude did the users develop towards the system (Halbesleben et al., 2009).

An organised group has to cross the organisational units. In the Finnish company, the department was divided into three product lines, which again was split into a total of 11 groups (Sykes et al., 2009). A lot of the help was given across groups and also across the product lines.

The superuser is the first person in the support chain. She should handle most of the normal requests dealing with use of the computer system, for which she has received special training. In addition, the superuser should be able to take care of user requests concerning the operating system and standard tools. Both Mozhdeh and Oksana help out on information issues like getting the information into the right field and on IT issues like updating software.

I am Sigrun and I have a master degree in IT. Currently, I am the leader of an administrative group of seven and also the super-user for the web publishing system WeBublic for the whole department. A majority of the 250 department staff use WeBublic. The most frequent questions concern operations which are blocked to the common users. They also often ask about how to reuse past information for this year's schedule.

All departments have a WeBublic super-user, but we never meet. However, we e-mail each other and solve many problems in that way. På den måten opprettholder vi en gruppe av Webublic spesialister.

Communicating frequently with users, the superusers receive requests for changes of computer systems. They are in a good position to communicate these requests to the computer department or those in charge of the software and hardware. This aspect of their role should be exploited, such that the requests from the users are taken into account. The meeting of superusers could also be an agenda for discussing and distilling such requests. This is a regular item on the agenda in Mozhdeh's group.

The superusers could also act as communication links in the opposite direction. When system updates occur or tools are replaced, the users need to be informed and trained in the altered functionality. The superusers could naturally take on this obligation, and provide small training sessions locally if needed.

The superuser should be given responsibility of the resources necessary for carrying out the role (Almnes, 2001; McNeive, 2009). A dedicated amount of time for the superuser activities is recommended (Almnes, 2001; Åsand & Mørch, 2006). The resources for sending users for training, is a responsibility that should be attributed to the superuser.

The selection of people for the superuser role is an important issue for creating a decent support system. They could preferably be amongst those whom people often calls for assistance, which would guarantee a caring person. In a survey of users and superusers, Boffa and Pawola (2006) warn against selecting users who are indifferent about or have negative attitudes towards the information system as superusers. Helbesleben et.al. (2009) confirm that a positive attitude amongst superusers spill over to the users.

McNeive (2009) and Poe et.al. (2011) emphasize that they should be champions for the changes that the computer system should support. Almnes (2001) warns against local managers, since they are often too busy and not always available. In addition, many people do not like to expose their misunderstandings to their superior. Sigrun is such a boss-and-

superuser which is not recommended, but she mainly helps out people outside her subordinates.

People who are unwilling to take on the role should also be avoided. They may behave hostile or less caring towards their peers, and if so, the users will soon stop consulting them.

Since superusers help others solving IT problems and also guide them in problem solving, problem solving competence is important for superusers, as stated for the selection of superusers during implementation of a clinical information system (Halbesleben et al., 2009). In addition to computer skills, the superuser also ought to have skills in guiding others, something which the trainer need in particular. Poe et.al. (2011) emphasized that the superusers also should have some teaching competence, placing them also as peripheral member of a community of teaching practice.

Some IT personnel like Sigrun change their career into other occupations, and they will naturally be more skilled in IT than their peers. If they have the necessary inter-personal skills, they would become very good at supporting colleagues as well as communicating with the IT specialists.

The significance of superusers is described in a study of implementation of a companywide information system where adoption was slow (Boudreau and Robey, 2005). It was found that most user groups did not attend the initial training programme, and when the software was implemented, the users found ways of avoiding using it. Rather than entering data, they got some groups of information officers to carry out the data entry. Later, some self-initiated superusers found out how to operate the new software, and this competence was spread in the organisation as folk wisdom. In the end, most people used the system, after the user communities had found workarounds and tweaks in order to get the system performing as needed. This competence was also spread throughout the relevant user communities. The organisational change eventually took place due to the broker role of the superusers.

13.2. Trainers

In a community of practice, the practice would constitute the tasks of the majority, while the minority would be peripheral people who could learn the tasks through interacting with the majority. A training session is of an opposite kind, where the majority of learners is supposed to adapt to the minority of trainers. Unless all trainers are superusers, it is highly unlikely that the trainers and the trainees develop a common knowledge base during a two weeks in-service training session, hence such activities constitute boundary interactions rather than CoPs.

In-service training is acknowledged by Wenger (1998) as useful when providing a place for reflection on the practice, and as an opportunity for getting to know people whom one would otherwise not meet (pp. 249-250). However, Wenger remarks that often in-service training or education are too detached from practice to foster learning which strengthens the individuals' participation in the communities, an issue which was considered under 'transfer' in Chapter 10. This could easily happen when the business fit and information are not included in IT user training, or when business and information included do not match the learners' experience.

Including superusers amongst the trainers could bring training closer to practice. Super-users who are also ordinary users could bring business fit into training. Information officers could include relevant data which users recognise. Super-users who also belong to the community of teaching practice could teach ways for further learning, like problem solving competence.

Leaving the training to IT personnel only creates the risk of restricted interaction between users and trainers in the classroom. Including also a superuser improves the relevance of the training and creates variety amongst the trainers. The latter is in general an advantage for learning. Both Almnes (2001) and McNeive (2009) recommend that superusers should be involved in planning and conducting IT user courses, in order to include user activities in the training contents. Also, users feel more comfortable by being taught by one from their own profession than by a computer specialist.

Oksana lectured and guided other users on the human resource system. Her experience enabled her to convey how the system should be used to support the accounting tasks. She could also bring her inventions to the larger audience.

13.3. Organising training

The accounting company mentioned above appointed one superuser per 10 employees, and gave the superusers the obligation of training the others (Åsand & Mørch, 2006). Being organised in a community of superusers helped them becoming capable of carrying out this task. The same proportion was also utilized when introducing a patient record system for nurses (McIntire & Clark, 2009), while in another hospital, there was one superuser per 15 nurses (Poe et al., 2011). Oksana and Sigrun have similar roles, and they support 250 users. However, the information systems for which they are superusers are only used now and then by most of the staff.

The Finish company trained all 100 users simultaneously (Sykes et al., 2009). The study revealed that there was a positive correlation between how often a user gave or received help and how much she or he used the system. If the goal is high system use, helping each other after training is therefore effective. Seen from the individual user point of view, it would constitute a facilitating condition in the technology acceptance model (Venkatesh et al., 2003), see Figure 61, p.101.

When a new system has a large number of users, training is costly and it leads to disruption of the organisational performance. The latter is unacceptable when clients have to be cared for, like in a hospital, or when processes cannot be halted, like the power plant. To reduce costs and avoid disruptions, training is often provided only to a group of superusers, who are selected from each organisational unit. All staff is given access to user documentation, and the superusers are thereafter supposed to help out the rest of the staff when needed.

13.4. Superusers as leaders

The extent of people's use has been employed as a measure of success of introducing an IT system in an organisation (F. D. Davis, 1989; Venkatesh et al., 2003). Perceived usefulness, perceived ease of use, social pressure and facilitating conditions have been found to influence

the amount of use (Venkatesh et al., 2003), see Section 8.2. Documentation (Chapter 2 and 4-6), training (Chapter 10) and IT support (Chapter 14) constitute aspects of the facilitating conditions, while superusers are members of the community of user practice, hence they can exert pressure on system use amongst its members. In order to know whether to put the effort into training, IT-support or superusers, knowing the relative influence of each of these factors would be needed. No comprehensive studies of all these factors have been carried out, but a comparison or coworkers' influence versus training provides some insight.

In a non-profit organisation in the US, half of the 200 employees responded to a survey on IT use, perceived usefulness, perceived quality of user training, amount of user training, and coworkers' IT use (Gallivan, Spitler, & Koufaris, 2005). 80% of the respondents were female, and the large majority had a university degree. The extent of coworkers' IT use had the strongest impact on an individual's use. Coworkers' perception of the training quality and to a smaller degree also the individual's perception of training quality also influenced the extent of the individual's use. The amount of user training and the perceived usefulness had no influence. The latter contradicts the technology acceptance model (Venkatesh et al., 2003), and there is no obvious explanation for this finding.

This study points to the importance of what happens in the local work group and the possible futility of putting many recourses into training (Gallivan et al., 2005). Given that people follow their colleagues in their computer use, and that a new system is to be introduced, people will only use it if their coworkers do. For an innovation to be taken up, some have to lead, such that the rest of the community can follow suit. Super-users are in a favourable position to be the leaders, since they are well versed in IT in addition to being a coworker of the others. In order to become a strong leader, superusers would need to be well trained and preferably a member of a community of superusers, such that they also can learn from each other. Consequentially, providing thorough training for superusers would be more efficient than training the whole group of users.

The study also points to that the quality of the training is more important than the quantity (Gallivan et al., 2005). Since being able to help others would probably ease the leadership role of the superusers, their training should particularly emphasize understanding and problem solving skills.

IT innovations in organisations are often driven by champions, being people who persistently and convincingly argue for changes (Beath, 1991). Similarly, superusers could take a corresponding role in their department, convincing others to employ new solutions. Champions who get support from the IT department are more likely to succeed, and similarly, they need support from the IT specialists.

13.5. Summary

In addition to IT skills and understanding, users need to learn also business fit and information competencies. Super-users and information officers have the right background for including these competencies in training and support. Enabling the developing of these groups

into communities of superuser practices and information practices could boost their contributions to IT competence in the organisation.

7. **Identify, organise, authorise and cultivate superusers.**
8. **Include IT, information and use competence in support and training.**

Chapter 14. IT support

The learning aim of this chapter is to be able to support users so that they increase their IT user competence.

Learning can take place anywhere and anytime, but some activities are carried out with learning as their main purpose. Having identified the CoPs relevant to building user competence, we can proceed to characterise the activities where the different communities meet and where learning is supposed to take place. These activities encompass training and support.

14.1. Support as boundary interaction

Support is normally a boundary interaction between an IT specialist or a superuser and a user, where the supporter is supposed to help out when the user is stuck. The IT is a boundary object in the interaction, and documentation and data may constitute other boundary objects.

The support interaction normally lasts for a short time, like a few minutes. Contrary to training sessions, the topic of the support sessions are initiated by the users and the support is targeting the user's current problem. Support personnel would normally not prepare specifically for a certain encounter, but they may subsequently note down information about it.

While superusers have the advantage of knowing the business and the information, IT personnel would be the support expertise for IT problems. Also, staff in an IT department in a larger organisation would normally have user support as a main part of their job, while helping others constitutes an additional role for superusers.

When users and IT personnel meet, they talk about the same phenomena in different ways. For example, when a user say

> *we have a group of students who cannot synchronize*

the technician talks about

> *IP-errors* or *server-errors* (Kanstrup & Bertelsen, 2006)

We see the terminology problem from search in documentation (Section 2.1) reappearing. When the user and supporter are co-located, they also have boundary objects like software and documentation which they can look at, point to and interact with, and they can observe each other's actions. When helping out on the phone, the oral interaction is the only communication channel. The following conversation took place when a user of a printer/copier called the vendor's support centre for help. The troubleshooter searches a knowledge base for finding possible solutions (Crabtree et al., 2006):

> *Troubleshooter: OK, and what's the problem you're having with the machine?*

Customer: I'm getting poor quality prints – sort of smudges on them.

Troubleshooter accesses knowledge base and selects 'image quality'.

Troubleshooter: When it's printing?

Customer: Yes.

Troubleshooter: OK, do you get this when it's copying?

Troubleshooter: So you get it printing and copying and they're like smudges?

Troubleshooter selects 'smears and smudges' in knowledge base.

The troubleshooter has to translate the vernacular of the customer to the specialist terminology. Likewise, the customer has to grasp the technical terms 'image counts,' 'xerographic' and 'fuser module' (Crabtree et al., 2006):

Troubleshooter: You know your image counts, which is the amount in thousands of copies that the xerographic and fuser module have done, check them just to see if they're running over their copy limit and causing that problem for you.

Troubleshooter: Of course, yeah, take your time, that's fine.

48 second pause.

Customer: Where do I find them?

Troubleshooter describes how to use the menus to find the counts and customer goes to find them.

70 second pause.

Customer: 43

Troubleshooter: Hi, that's from your fuser module

(writes down count).

Troubleshooter: OK could you - do you know where the xerographic module is in the machine?

Troubleshooter: OK, I'll tell you exactly where it is as there's something I want you to try, just to see if this will rectify the problem for you – if you open the front door of the machine …

After having negotiated a common understanding of the terms, the troubleshooter instructs the customer to carry out an operation, which will lead them through the first cycle of troubleshooting. If the customer remembers the steps such that he can do them without support the next time the problem occurs, he has learnt this particular way of troubleshooting the machine. Since the troubleshooter has this as her main job, she is likely to pick up users' terminology and the technical trouble. Efficient supporters interact with a variety of users and experience a multitude of user problems and terminology, and they are 2-10 times as efficient as supporters with more homogenous interactions (Chi & Deng, 2011).

The interaction between 11 IT supporters and 61 users was observed during implementation of a work flow system in a US bank (Santhanam, Seligman, & Kang, 2007). In addition to support, several meetings were organised for the users and IT personnel to discuss issues. It was found that users mainly learnt IT skills during interaction (Santhanam et al., 2007). The IT personnel gained know-why, i.e., they understood how the IT was fitted in users' business during the same encounters. Also understanding of the technology was shared. User competence, particularly on how the IT is used in business, is hence introduced into the community of IT practice and shared amongst the IT personnel (Santhanam et al., 2007).

14.2. IT support versus superusers

There have been several studies on the type of support which users prefer, and the results seem to depend on many factors.

Interviews of 40 users with education above high school in the US, showed that users preferred asking IT-personnel and colleagues at roughly the same rate (Novick et al., 2007).

In a survey amongst university staff in Norway, 49% preferred support from the IT services, while 31% chose colleagues (Nilsen & Sein, 2004). There were 222 responses to the questionnaire (37% response rate).

A survey of US middle level managers' opinion on support gave the opposite result. 38% preferred superuser support, 26% other colleagues and 19% an IT centre (Govindarajulu, Reithel, & Sethi, 2000). These results are based on 98 informants (response rate 11%).

These three studies agree that users prefer support from both IT personnel and superusers, but there is no consensus on which one is superior. A survey in Norwegian organisations investigated some possible causes for choice of support (Munkvold, 2003). Responses came from 277 informants, yielding a response rate of 41%. Short distance to the IT support personnel made users go there, while when the distance was longer, users preferred colleagues. Higher skilled users consulted the IT support to a lesser degree, while they solved problem more often themselves than did less skilled users (Munkvold, 2003).

Convenience and skills may therefore be reasons for choosing one source of support to the other.

14.3. Support quality

In a qualitative study, 39 users in the Finnish public and private sectors were interviewed about their learning preferences (Korpelainen & Kira, 2010). In general, they prefer learning IT use on the spot. Formal training courses take too long. Said one of the interviewees:

> *There are so many [user training] courses and other rubbish that I can't be bothered to do an extra thing. I haven't left a single task uncompleted, so why would I bother. [. . .]. I don't need the extra information, and I am not interested. I am only interested in being able to do my tasks; I just want to find the information and complete my tasks. That is all I need the system for.* (Korpelainen & Kira, 2010, p. 42)

Also, users hardly read documentation (Novick et al., 2007), they rather ask others, unless they try and err or succeed. Getting support is therefore essential for most users both for learning and for solving IT problems without learning how to do it themselves the next time.

A survey of 484 users in a US university examined the correlation between support factors and user satisfaction (Shaw et al., 2002). The factors which influenced satisfaction the most are listed in Table 13. Factor 1, 5 and 6 are all qualities of IT support. Factor 3, user understanding, is partly influenced by training and support. Factor 4, software upgrades, is also a product of decisions in IT departments. Many users get annoyed when new upgrades appear, since they have to relearn the software, however, others push for new versions.

Table 13. Factors influencing user satisfaction (Shaw et al., 2002).

Rank	Factor
1	Fast response time from system support staff to remedy problems
2	Data security and privacy
3	User's understanding of the system
4	New software upgrades
5	Positive attitude of information systems staff to users
6	A high degree of technical competence of systems support staff

In general, the findings point to the central position of user support and learning issues for user satisfaction with IT. Software upgrades and response time were the only factors found to correspond with studies from the beginning of the 90's.

When broken down into three distinct user groups, administration, academics and students, there was a great variation in the factors. This corresponds with a previous study, concluding that the specific business of a user department influences its perception of IT support (Speier & Brown, 1997).

Users' opinion of the performance of the IT support gave the lowest score to documentation to support training (Shaw et al., 2002). This issue is not amongst the general top factors influencing satisfaction, since users regarded it as less important. However, non-academic users had this item in their top factors of dissatisfaction (Shaw et al., 2002). Low quality of training material is particularly bad since instruction sheets and models for understanding used during training are twice as effective for problem solving compared to other material (Novick et al., 2009).

The physical place where users find IT support personnel has been called a *helpdesk*, while the phone call support is called a *helpline*. A survey of user satisfaction with helpdesks and helplines in the Netherlands compared user preferences (van Velsen, Steehouder, & de Jong, 2007). There were 64 responses concerning the helpdesk and 242 (11% response rate) for the helpline. Concerning the helpline, user satisfaction depended to a high degree on the quality of the solution which the support personnel came up with. Surprisingly, the users who contacted the helpdesk were more satisfied when having a good time at the helpdesk, while the solution was of secondary importance. Thus, the helpdesk should have friendly staff, while the knowledgeable ones should be working on the helpline.

14.4. IT departments

Information Technology Infrastructure Library (ITIL)

Communication tools and knowledge databases for IT supporters

See Bruton (2002) How To Manage The IT Helpdesk - A guide for user support and call centre managers, chapter 23.

9. **Provide a variety of support channels and frequency.**
10. **Train local groups of users, not only individuals.**

Chapter 15. Mutual learning during business fit

There have been numerous cases where IT designers have developed systems which do not fit users' business and which therefore have not been used. When developing an information system or any digital device, the IT personnel involved in the design hence need to know the business into which the software and hardware are going to fit. While IT personnel have the IT competence, users would know the business fit, and information officers know the information to be included. In order to bring all competence areas into development, users and IT personnel are often cooperating in what has been termed participatory design.

While IT personnel's need for understanding users' business was recognised early, it was also noted that for participatory design to become effective, users also needed to learn about IT, so the term *mutual learning* was adopted (Bjerknes & Bratteteig, 1987).

Based on the identification of roles of users, IT personnel, etc., this chapter will characterize the competence of these roles during development of IT applications in organisations.

The competence needed for a development group consisting of both users and IT personnel was suggested by Kensing and Munk-Madsen (1993) to consist of six categories as shown in Table 14. "Abstract knowledge" corresponds to understanding, while "concrete experience" leads to skills. According to Kensing and Munk-Madsen (1993), before starting cooperation, users would have the concrete experience with their own work and not necessarily more. This implies that if they used computers, they would have the skills, but not necessarily understanding of the technology or the business fit. IT personnel would start out with the technological skills and understanding.

Table 14. Areas of knowledge in user-developer communication (Kensing & Munk-Madsen, 1993).

	Users' present work	**New system**	**Technological options**
Abstract knowledge	Relevant structures on users' present work	Visions and design proposals	Overview of technological options
Concrete experience	Concrete experience with users' present work	Concrete experience with the new system	Concrete experience with technological options

The IT personnel have the responsibility of creating conditions for users to understand their current work structures, particularly data flows and data structures. Also, the IT personnel in a project should enable both partners creating the vision and design proposals and provide experience with a new system (Kensing & Munk-Madsen, 1993). This categorisation of competence in mutual learning has been repeated until lately (Bratteteig, Bødker, Dittrich, Mogensen, & Simonsen, 2013; Bødker, Kensing, & Simonsen, 2004a, pp. 61-65).

This book emphasizes information as a separate area of competence for IT users. While changes in technology often lead to altered processing or transfer of the same information, other projects are driven by changes in the information. In a case of health management

information system, health managers had noticed that most of the collected data remained unprocessed or unused (Braa & Sahay, 2012). While the unused data might have been part of the "relevant structures on users' present work" for those who collected and entered it, it was of no relevance for the managers. The major work in developing the information system was to reduce the amount of data with 95% and agree on definitions of the remaining data and on rules for calculating indicators. Since information seems to constitute a separate area of competence also during development, information officers will be considered a relevant group also for mutual learning.

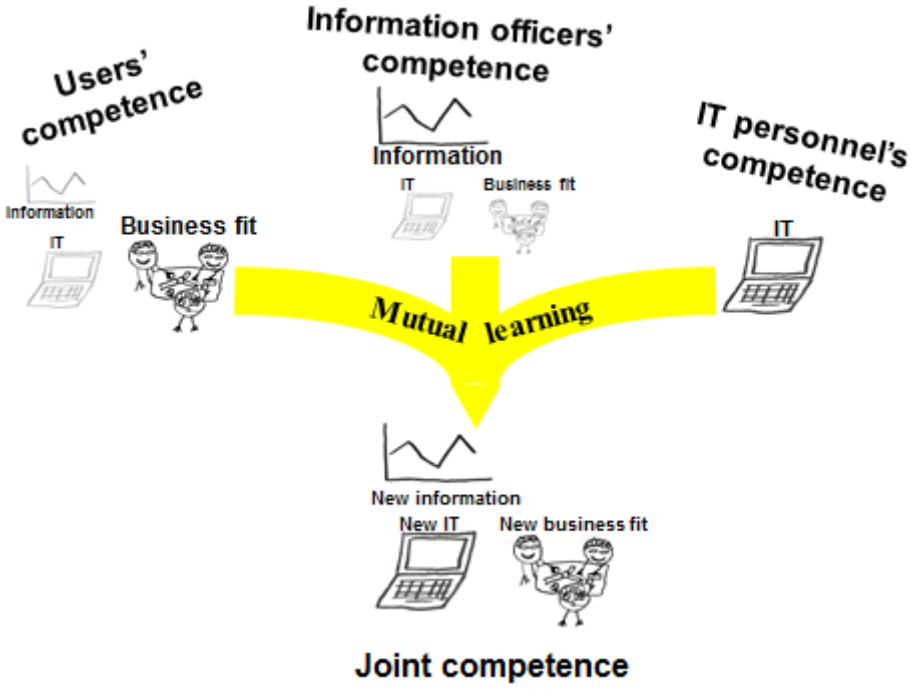


Figure 79. Developing joint understanding amongst users and IT personnel through mutual learning.

Based on users' and information officers' skills and IT personnel's understanding of IT, mutual learning aims at developing a joint competence for both groups, consisting of structural understanding in all three areas of a new system, see Figure 79. Competence for envisioning new business fit belongs to the problem solving level of business fit competence, see Section 8.1.

In order to reach joint understanding of a new system, the two partners first need to understand parts of the current situation. Mutual learning can be considered as consisting of three processes.

1. Users and information officers learning about IT
2. IT personnel learning about the information and business fit.
3. Based on such a mutual understanding of each other's competence areas, they jointly create understanding and skills of the new information, IT and business fit.

Users normally do not constitute one homogenous group. Rather, they do a variety of jobs in different departments and levels in the organisation. When building new systems for larger

parts of an organisation, a diverse group of users and information officers would be needed to bring in all the organisation's skills in information and using IT for the different activities (Markus & Mao, 2004). Including some existing superusers would have the advantage of bringing competence of the relation between IT and business into the project team.

15.1. Users and information officers learning about IT

This is what the two first parts of this book is about. The special requirement here is that users and information officers need to learn about technological options which can be utilized in their organisation, but which currently are not in place. Implementations of these options in other applications can be used for practical training, and functional and structural models can create some understanding.

The two other learning processes differ from those having been presented previously in this book, so they will be elaborated in the sequel.

15.2. IT personnel learning about information and business fit

As seen in the previous chapter, IT personnel learn about business fit during encounters with users (Santhanam et al., 2007). This can be done in more systematic ways, including interviews and observations. Interviews can provide an understanding of how information and IT fit in the organisation in a broader sense than for one user, thereby contributing to understanding the current situation. Observations can complement interviews through providing understanding of how individuals use IT and information for their business.

Interviews may give a skewed understanding for several reasons, one being that the user have skills, but lacks the understanding for expressing the business. This can be mitigated through making the interviews as concrete as possible, making the user telling what she actually does. Carrying out the interview at the workplace enable talking about the information and the IT being present, thus details of work can be included.

Other users may have more elaborate understanding of their work than anticipated. In a study of information officers in a lawyers' office, the interviewer noticed that they frequently discussed the meaning of codes (semantic understanding) and that they

> *… were continuously experimenting with alternative strategies for coding documents. One lesson we (re)learned was the degree to which workers themselves are engaged in reflecting on and redesigning their own practice. (Blomberg, Suchman, & Trigg, 1996)*

They concluded that for learning about users' business, the investigator should search for the knowledge work in what is called routines, and the routines in what is called highly qualified work.

Interviews and observations need to be thorough enough to avoid generalisation based on single cases. Anthropologists experienced in studying work in organisations emphasize that investigations should include

> *comparing observations of the same individual over time and in different settings; comparing interview and observational data from the same individual, investigating*

apparent disparities between them; and comparing what people say about each other with what they can be seen to do, again using apparent disparities to guide further investigation. (Forsythe, 1999)

Aiming at learning the diversity of users' business, investigations should ideally continue as long as one learns something new. In reality, there will be budget and deadlines which limit the amount of interviews and observations which IT personnel can carry out.

15.3. Joint creation of understanding and skills of new system

After users, information officers and IT personnel have learnt about each other's area of competence, they would have a platform for joint creation of new systems.

User participation during development of information systems has in general been found to contribute to better solutions and less user resistance during implementation, although that is no automatic consequence (Bano & Zowghi, 2013). One way of obtaining the positive outputs has been identified as engagement or involvement, meaning the importance and personal relevance of a system to a user (Hartwick & Barki, 1994). Involvement in participation can be strengthened by allocating responsibilities for some tasks to users. It has been noticed that one reason why users do not involve themselves properly during development is scarcity of time. Rather, they become engaged after implementation, when changes are more costly (Wagner & Piccoli, 2007). Either, management can allocate sufficient time and promote engagement during development, or more of the mutual learning can take place during support, as illustrated in the previous chapter.

Many ways of mutually creating new visions and plans have been proposed, and comprehensive methods are found in the literature on user participation (Bødker, Kensing, & Simonsen, 2004b; Greenbaum & Kyng, 1991; Simonsen & Robertson, 2013). We will point to three techniques with learning outcomes in different areas, and these techniques can strengthen engagement.

Visiting other installations

Users, information officers and IT personnel jointly visit another organisation which has implemented a similar system. When representatives from the other organisation demonstrates and explains the function and structure of the system, the visitors can acquire an understanding of its information, technology and business fit. When trying the system themselves, they can obtain some skills.

Prospective users and information officers discussing with people in corresponding positions in other organisation enables identification with these people, which can trigger engagement. Another way of strengthening involvement can be to make every visitor responsible for reporting the experience concerning their speciality to the whole group when returning home.

Future workshops

The aim is primarily to create an understanding of current business fit and of future IT, information and business fit. Users, information officers and IT personnel participate through three phases:

1. Critique session
2. Fantasy phase
3. Realisation phase

During the critique session, the participants create a joint understanding about problems in the current situation. The result of the critique phase could include statements like

> *We have to log into three different systems. This is annoying, especially since you are logged out if inactive for a while. And I always mix up the passwords.*

The fantasy phase is intended for developing ideas and visions for a different future situation through brainstorming technological solutions and work processes. The participants can come up with a list like

> *The computer will see who I am, such that there is no need for login.*
> *All customers will enter their invoice directly into out accounting system. All we will have to do is controlling.*
> *I wish we had an overview of all heavy-duty stuff on an app, such that we could easily see the closest site when allocating staff to customer visits.*

In the realisation phase, plans for implementing proposals that can be realised are worked out. The realisation also contributes to enrich the understanding of new systems such that users and information officers can learn the technological options and the IT personnel can obtain insight into the business fit.

Future workshops do not require any specific professional background. This means that anyone can be allocated responsibility for any of the phases, thus strengthening their engagement.

More comprehensive introductions to future workshops can be found in (Greenbaum & Kyng, 1991) and (Bødker et al., 2004b).

Prototypes

While future workshops provide some understanding about possible designs, prototypes provide the concrete experience. A prototype is a technological implementation of aspects of an IT system. It may provide some functionality, show parts of the user interface, demonstrate a new technological option, etc. When working with prototypes, the IT personnel will have the specific role of developing the IT solutions.

When trying out a prototype, experimentation will be a main way of learning for users and information officers. They will see whether it can do what they expect. They may also explore other aspects of the system. Experimentation and exploration contribute to both skills and understanding of the IT.

A functional prototype may also contribute to information competence, while a prototype of user interface will have less chances of triggering learning about the information in the system.

In order to learn about business fit, the prototype should be tested in the business where it is going to be used or in similar conditions.

Development and testing of prototypes take place in an iterative fashion. IT personnel learn about the same topics as the users and information officers when observing their operation of the prototype and discussing their experience.

Responsibilities can also be distributed during prototyping. Information officers could for instance be required to find their most complicated data structures to see whether the prototype can handle them. Correspondingly, users can find typical and exceptional cases to be used for testing functionality.

15.4. Summary

User participation in development of information systems is considered advantageous. To achieve fruitful participation, users need to learn about new IT options, and IT personnel need to learn about information and activity fit. In order to design new solutions, users, information officers and IT personnel need to develop joint understanding and concrete experience of information, IT and business fit for future use of new technology. This mutual learning can be enhanced if users and information officers become personally engaged, something which requires sufficient time and responsibilities during development.

Users and information officers having participated in mutual learning during development will be well suited for joining the training team of a new system and act as superusers.

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