

Computers help save costs and time in staff training at the Post branch of the Dutch PTT.

Research Report: Cost- effectiveness of Curriculum Revision

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Introduction

In the second half of the 1980s several studies were implemented to review the training and development effort of business and industry in Europe. In 1988, several of these studies were brought together, and the main conclusion was that human factors in organisations are strategic elements to success. Recent studies in the United States[1] confirm the European findings.

Training and development is increasingly important for the success of organisations. Human capital is no longer seen as a cost factor for the organisation. Management conceives of training and development as the appropriate ategy to keep the workforce competitive.

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In The Netherlands every fourth employee participates in courses[2]. In Great Britain employers reported that just under half of all their employees received some training[3]. The Dutch employer pays 1.5 per cent of the wage costs for training, whereas in France[4] there is a legal minimum requirement that 1.8 per cent of the wage bill has to be invested in training. In Great Britain, the Federal Republic of Germany and The Netherlands participation in medium- and small-sized companies in training is consistently less than in larger companies.

Many companies have problems with the organisation of the training function, though many of them stress the importance of its contribution to the primary mission and main policy of the organisation. As such, training is an instrument of human resource management, and one component of human resource development. During the last decades of the 20th century major waves in the training and development field have occurred[5]. The 1960s were dominated by operator and technical training aimed at job skills and technical knowledge. In the seventies, supervision and management training became extremely popular, focusing on attitudes, personal skills, interpersonal skills and personality development. The 1980s was the decade of organisation and human resource development. The 1990s will be the decade of the competitive edge. Use of new technologies, acceptance of change, learning to learn, cost-effectiveness and cost-benefits will be the major issues in training and development. Many organisations try to establish open learning systems that are computer based, with interactive video technologies and (sometimes satellite-maintained) distance learning systems.

These trends have to be supported by an adequate marketing strategy, in which learning is the key concept. Training and development is a service to the client, and in large organisations even the internal training department has to employ modern marketing strategies to establish situations in which the right product meets the needs of the client[6].

The cost-effectiveness of training technology is a major issue in the field of training and development in large organisations[7-12]. Especially when larger projects are envisioned, organisational decision makers try to forecast costs and effects, often using several strategies for cost-effectiveness analysis. Cost-effectiveness is here conceived of as the relationship between the predetermined effectiveness of a solution for a problem and the costs of the chosen alternative solution. So the emphasis in this definition is on a *a priori* stated standards for success and cost reduction.

In this article the relation between cost and effectiveness indicators is explained, and guidelines to evaluate the cost-effectiveness of training alternatives are given.

An illustration of a cost-effectiveness study is presented that took place at the Post branch of the Dutch PTT. The feasibility study is summarised focusing on the computer-based training approach provided for management decision making. The application of a certain cost-effectiveness analysis is discussed, along with the practical results of the study. This is part of a comprehensive study on the feasibility of computer-based training technology at the Dutch Post, as well as organisation implementation, effects, and the cost reduction of the programme. Data were collected from officials from the central training and development agency in the organisation, managers of training and development departments in branches of the organisation, trainers, supervisors, and on-the-job tutors. In the concluding section of the article the cost-effectiveness of training and development technologies is discussed in the light of the experiences in the study.

The Relation between Cost and Effectiveness Indicators

Cost-effectiveness is the level of congruency between the predetermined and actual effectiveness of a training alternative which is proposed as a solution to a performance problem in work organisations at the lowest acceptable costs. This concept is significantly different from the cost-benefit analysis of training in organisations[13]. Cost-benefit analysis is an economic concept for the ratio between the financial costs and benefits of training in organisations. Studies aiming to reveal the relation between the costs of the training effort, on the one hand, and the economic benefits to the organisation, on the other hand, are extremely difficult because of the many intervening variables that exist between the training effort and business results. A Dutch study in which researchers tried to demonstrate relations between the two[14] failed as a consequence of the complexity of this issue. No single cost-effectiveness indicator exists as a separate statistic to express the relationship between the costs and the effectiveness of training. Both costs and effectiveness have to be studied separately before they can be combined into a final assessment of the cost-effectiveness of a training programme. Cost indicators are defined by several authors[e.g. 13,15-18], and the same can be said about effectiveness indicators[11,19].

An Approach to Effectiveness and Cost Calculations

There is no one strategy to calculate the costs and effectiveness of training methodologies. Therefore we capitalise on a generic problem-solving approach to cost-effectiveness studies, in which the particularities and subtle contextual differences are revealed by an open heuristic framework, developed by Doughty[20] and Doughty and Lent[21].

In fact, the approach that is proposed and evaluated by Doughty and Lent consists of a number of steps to take, in order to answer the question of cost-effectiveness of a training solution to a defined performance problem. The steps are as follows:

- *Description of the context*
The context comprises relevant physical, geographical, political, personal, and economic problems that contribute to an understanding of the problem;
- *Determination of discrepancies between the present and desired situation*
This comprises the determination of problems, performance problems and discrepancies pertaining to change; the intention is that in this stage discussions are held in terms of solutions;
- *Identification of criteria*
This is to formulate standards with which decision makers weight the acceptance or worth of a solution;
- *Clarification of alternatives*
During this stage several alternative solutions are generated;
- *Definition of the solution*
A solution that serves best the needs and criteria explicated by the decision makers is here identified and analysed;
- *Justification of the solution*
If the preceding steps are carefully made, this last step is relatively simple: the criteria to which the solution is weighted, in most cases, are the available financial resources, time, procedures and results, especially those that are related to quality and productivity.

During the planning and implementation of cost-effectiveness studies, models are usually used in which there is too little attention to deliberations in the first stage of the study. Doughty[20] has developed a procedural guideline which consists of five basic questions:

- (1) What are the aims of the study?
- (2) What are the characteristics of the target group(s) of the study?
- (3) Who will design and conduct the study?
- (4) What are the essential design elements?
- (5) What strategies are employed?

Using these kind of guidelines may prevent studies that use naïve cost-effectiveness indicators for determining the cost-effectiveness of training.

The Dutch Post Study

Now we turn to the cost-effectiveness study of the computer-based training (CBT) programme at the Dutch Post. First of all, we give a general overview of the elements of the whole study, then detail the study's design.

The study was initiated by a project at the Dutch Post to implement CBT in 1988, on a large scale, for counter personnel in post offices. This project is analysed following Doughty[20] guidelines to avoid decontextualising the determination of effectiveness and the cost calculation. The reason for this project* which was initiated in the early 1980s, was that standards for training effectiveness and efficiency became tighter and, therefore, in 1982 the central department of social affairs asked whether it would be feasible to implement CBT to improve the effectiveness and efficiency of the training programmes. In 1983 a plan was designed to study the feasibility of CBT for the whole PTT in general and the Post branch more specifically. If this study showed that CBT indeed appeared to be a feasible alternative, the next issue would be how to implement and to institutionalise this approach in the organisation.

In the planning stage an important issue for management was the representativeness of the project. Parameters in the decision-making process about the selection of the specific training programme were the number of trainees, and the heterogeneity of the instructional strategies in the training programme. This resulted in the decision to train counter personnel in post offices, a target group of about 8000 workers, with a yearly enrolment of about 300 employees, and a maximum course length of nine months. The training programme was decentralised by locating it in 12 districts (now merged into five regions), which are more or less autonomous in implementing the training programme. At the beginning of the project an important issue was the choice of authoring language in which the courseware would be written. The project group proposed TAIGA, an authoring language developed by researchers of the University of Twente, and this motion was approved. Together with a new design methodology for CBT materials and the authoring language TAIGA, part of the training programme was transferred in CBT modules. The modules were pilot tested in a field experiment which was devised for 120 trainees, of which 30 were assigned to a control group trained under non-experimental conditions without CBT materials. Comparisons between the experimental and control group were made regarding the following factors:

- Quality of the learning results.
- Time needed for the programme.
- Qualitative experiences of trainees and trainers.

The conclusions of the feasibility study were:

- Training with CBT materials leads to better learning results and a shorter training time compared with the traditional approach;
- The length of the whole training programme could be cut if reduced individual learning time could be integrated; a condition for this was that the organisation of the training had to accommodate the new requirements;
- Trainees as well as trainers appeared to be enthusiastic regarding the implementation of CBT.

The evaluation data were used to perform a cost-effectiveness analysis. This analysis showed that the adoption of CBT under well-defined conditions was desirable, and that the investments necessary to finance this innovation could be returned within a reasonable period of time. In the final report on the field experiment other advantages of the CBT approach were presented:

- The centralised development of CBT materials guarantees uniformity of instructional objectives;
- Trainees are motivated to become self-confident and independent performers;
- Trainees are familiarised with computer tools;
- Training professionals will have more time, due to the implementation of CBT, for the core of their activities and individual tutoring;
- The training programme is made more flexible by the individualisation of the training approach.

Possible disadvantages of the CBT approach are not included in the report, but it can be inferred from the implementation proposals put forward by the project group, that this group was well aware of disadvantages. One possible disadvantage that was foreseen was the regional variation of job design that could prevent the intelligent use of centrally developed instructional materials.

The adoption of CBT within the Dutch Post was clearly a consequence of cost-effectiveness deliberations. In spite of the positive results of the field experiment, however, the mere adoption of CBT would hardly result in a better balance between the costs and effects of the training programme. The prognosis was that in that case the expense of implementing CBT would exceed the benefits coming from reduced individual training time. Reorientation of the course content, and further individualising of the training programme would lead to a significant cost reduction in a relatively short time.

As a consequence of this, implementation had to be preceded by several activities: the installation of a

* A description of the project, the feasibility study, and management involvement in decision making on CBT adoption and implementation is based on Langbroek and Marcelis[22], Barents[23], and Barents *et al.*[24].

management platform that evaluated the course content, which was partially obsolete; a guided implementation of CBT in two experimental locations to assess training time reduction as an effect of the individualised approach; site visits to all training locations to discuss implementation of CBT and to reach agreement on procedures; and, finally, a retraining programme for trainers, whose role was partly changed by CBT implementation.

The content of the theoretical part of the training programme for counter personnel in post offices is divided into two parts: basic and specific. The content of the basic part consists of topics that are approved by the management platform previously mentioned; this part is aimed at activities that are frequently carried out at the counter. The content of the specific part is approved at the decentralised level. Training professionals at the central training department of the Dutch Post have developed all instructional materials and courseware for the basic part of the training programme. For the trainers' curriculum, guidelines for each course unit were developed.

The new course syllabus shows that the total programme takes 19 weeks. The practical part consists of six weeks, and the theoretical part consists of 13 weeks. These 13 weeks are divided into one introduction week, ten weeks for the basic part, and two weeks for the specific part of the training programme.

Within this context an evaluation study was planned to answer six crucial questions for the Dutch Post regarding the whole project of training counter personnel at Dutch post offices:

- (1) Could the new training programme be implemented in the decentralised training locations?
- (2) Was the organisational design of the theoretical part of the training programme satisfying to the trainers?
- (3) Was the content of the theoretical part of the training programme satisfying to the trainers and supervisors?
- (4) Was the design of the practical part of the training programme satisfying to the trainers and supervisors?
- (5) What were the effects of the training programme on the performance of the trainees?
- (6) What were the financial consequences of the implementation of the restructured computer-based training programme?

Briefly, four topics are taken up in this study:

- The feasibility of CBT technology
- The design of the programme
- The effects on performance
- The cost reduction of the programme.

Design of the Study

The evaluation methodology recommended by Brinkerhoff *et al.* [25] was used, especially to contextualise the approach and to establish a relevant cost-effectiveness study. Brinkerhoff *et al.* distinguish seven evaluation stages, all of which were used in this study:

- (1) Determining the goal of the evaluation study
- (2) Designing the evaluation study
- (3) Data collection
- (4) Analysing the information
- (5) Writing a report
- (6) Planning the evaluation
- (7) Evaluating the evaluation study

Six parts of the study can be distinguished:

- The feasibility of the new course design within the training departments.
- The organisational design of the theoretical part of the instructional programme.
- The content of the theoretical part of the instructional programme.
- The design of the practical component of the programme.
- The impact of the instructional programme on trainees' performance.
- The financial consequences of implementing the restructured, computer-based instructional programme.

We distinguished a number of variables that were clustered into a model (see Figure 1). To answer the questions we prepared a data collection plan according to Brinkerhoff *et al.*'s recommendations.

In the next section, we report the results of the study, focusing on the fifth and sixth evaluation question relating to effectiveness and costs of the training programme.

Results

Before a detailed description of the effectiveness results, we present an overview of the number of counter workers trained, the percentage of trainees trained with CBT tools, and the course length. There were 1,406 trainees between 1985 and 1988. Data on the percentage of trainees who received training with CBT tools are available only from 1988 because, in that year, CBT was implemented at a national level. Data on the number of trained counter personnel, the CBT-trained percentage, and the course length by region is presented in Table I. In 1988, 319 counter workers were trained. Of this number, 62 per cent received CBT training. The average course length was 20.6 weeks.

Figure 1. Model of the Variables in the Evaluation Study

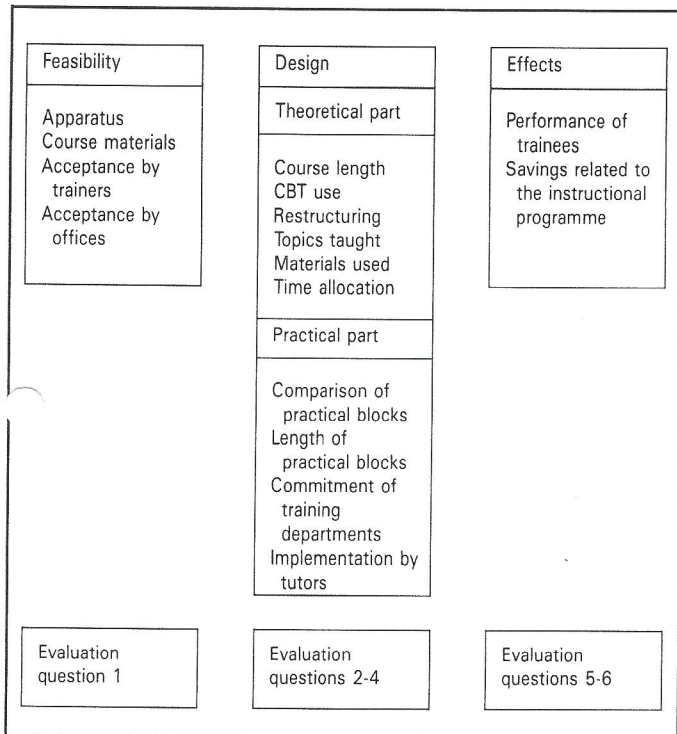


Figure 2. Data Collection Matrix

Information collection strategy	Questions: feasibility	2 Organisational design	3 Content	4 Practical	5 Effects	6 Savings
Questionnaire on quantitative course data with training managers (n=5)	X	X				X
Interview on qualitative course data with training managers (n=5)	X	X		X		X
Questionnaire on content with trainers (n=7)			X			
Telephone interview on practical component with tutors (n=29)				X		
Telephone interview on performance by supervisors (n=29)					X	
Questionnaire on financial issues with national training agency of PTT (n=3)						X

Table 1. Number of Trained Personnel, Percentage of Trainees who Received CBT Training and Length by Region (1988)

Variables	Regions					Netherlands
	1	2	3	4	5	
Number of trained workers, 1988	135	33	83	17	51	319
Percentage of trainees receiving CBT training	23	100	100	76	75	62
Course length in weeks (theory and practice)	20	19.6	25	19	13.5	20.6

The Cost-effectiveness Case Study

The Effectiveness of the Training Programme

Supervisors of trainees ($n = 29$) were asked in open interviews what positive or negative aspects they perceived in the performance of the trainees after the training programme. The two most important positive aspects mentioned were:

- Improved client service.
- Handling all kinds of equipment in the post office.

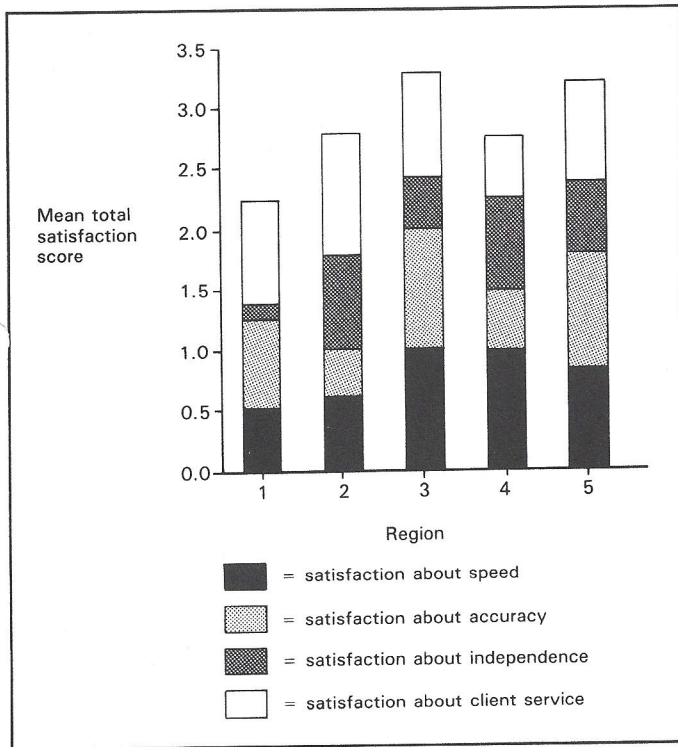
The most important negative aspects were that:

- Trainees have too little knowledge of infrequent counter activities and back-office administrative routines.
- Trainees have too little practice.

After the interviews more specific questions with prestructured questionnaires were asked about a number of aspects of trainees' performance. Criterion variables were speed, accuracy, independence and client service. The supervisors answered a dichotomous question for each criterion, e.g. "Is the speed with which tasks are performed satisfying?". The answering possibilities were yes (score 1) or no (score 0). These questions were asked for each performance criterion. Directly after the question, a short definition was given of the meaning of the performance criterion. For the question on speed, this definition was: "Speed: the level at which the job activities are automated, which for instance can be inferred from the length of the queue at the counter". Then the percentage of supervisors answering these questions positively was calculated. It must be mentioned that these percentages are based on relatively small groups, which means that results must be carefully interpreted.

The average percentage of supervisors who were satisfied with the performance of trainees was: speed (76 per cent), accuracy (76 per cent), independence (48 per cent), and client service (83 per cent). Consequently, the supervisors'

Figure 3. Mean Total Satisfaction Score of Supervisors on the Performance of Trainees in the Five Training Regions of the Dutch Post



data in a given region on each criterion were summed and a mean score was computed for each criterion for each region for all supervisors in that region. This criterion mean could vary from 0 (= all supervisors in a certain region were dissatisfied with the performance of the trainees on that criterion) to 1 (= all supervisors in a certain region were satisfied with the performance of the trainees on that criterion). The means of the supervisors on the performance criteria per region were added afterwards, which gave the total mean satisfaction of supervisors in a region on all four performance criteria. This total could vary from 0 (i.e. all separate means of the supervisors on the different performance criteria in a given region were 0, which means that all supervisors in that region stated they were dissatisfied with respect to the performance criterion) to 4 (i.e. all separate means of the supervisors on the different performance criteria in a given region were 1, which means that all supervisors in that region stated that they were satisfied with respect to the performance criterion). In Figure 1 the mean satisfaction scores on a scale ranging from 0 (= minimum satisfaction) to 4 (= maximum satisfaction) are depicted. The figure shows that the five regions in which the training programme is implemented again show variation. The minimum mean total satisfaction on the criterion variables is about 2.3, and maximum mean total satisfaction is about 3.3, which implies an overall satisfaction with the training programme (see Figure 3). Although some differences on the perceived effectiveness

of the training programme between regions can be noticed, these differences are not statistically significant (Krukskall-Wallis test: $p > 0.05$).

The Cost-reduction of the Training Programme

To show how the cost of the training programme was reduced we have to compare budgeted and actual savings. The feasibility study on the whole CBT project resulted in a prognosis regarding savings[22]. Costs and benefits that were expected at that time are given in Table II. From the table we can infer that total positive returns of 2.3 million Dutch guilders were estimated from 1986 to 1990. As can be seen, the bulk of the savings can be attributed to a reduction of trainees' costs.

In Table III the actual costs and savings during the fiscal years 1985 to 1988 are presented, our study was carried out in fiscal year 1989. The cost factors differentiated in Tables II and III are not exactly identical. Actual costs and savings were computed with a formula published by Head and Buchanan[15], which was adapted to this specific situation. To yield an economic analysis of the CBT project that would be as realistic as possible, all relevant cost factors were included in Table III including such additional factors as trainers' costs and managerial costs. Another, although less important, difference between the two tables is that, in Table III the category "savings" is inserted, instead of "benefits". The reason for this is that benefits of training programmes can be conceived of as financial consequences for the organisation whereas, in this case,

Table II. Expected Costs and Savings (in Millions of Dutch Guilders) of the CBT Project at the Dutch PTT (1986)

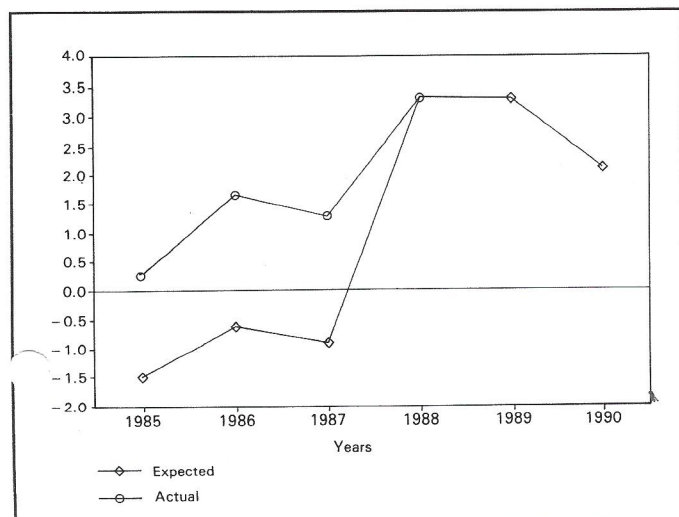
	1985	1986	1987	1988	1989	1990
<i>Costs</i>						
Research	-1.5					
Equipment		-0.1	-1.2			-1.2
Development and maintenance of courseware		-0.4	-0.4	-0.4	-0.4	-0.4
Training of trainers		-0.5	-0.1			
Purchasing TAIGA		-0.5				
<i>Benefits</i>						
<i>Savings:</i>						
development		p.m.	p.m.	p.m.	p.m.	p.m.
trainees' costs			+0.8	+3.75	+3.75	+3.75
<i>Total</i>	-1.5	-0.6	-0.9	+3.35	+3.35	+2.15
Total (nett cash value 1.16N return per annum)						
	-1.5	-0.5	-0.7	+2.1	+1.9	+1.0
Total nett cash value cumulative						
	-1.5	-2.0	-2.7	-0.6	+1.3	+2.3

Table III. *Actual Costs and Savings (in Millions of Dutch Guilders) of the CBT Project at the Dutch PTT (1989)*

	1985	1986	1987	1988
<i>Costs</i>				
Research	-1.500			
Equipment		-0.100	-0.234	-0.234
Development and maintenance of courseware		-0.158	-0.378	-0.221
Training of trainers		-0.010	-0.049	-0.014
Purchasing software for courseware development and training of trainers		-0.059		
Costs of facilities				-0.060
Managerial costs				-0.023
<i>Savings</i>				
Development of traditional materials		p.m.	p.m.	p.m.
Trainees' costs	+1.611	+1.783	+1.734	+3.425
Trainers' costs	+0.161	+0.177	+0.178	+0.394
<i>Total</i>	+0.272	+1.633	+1.251	+3.268
Total (nett cash value 1.16N return per annum)	+0.272	+1.408	+0.929	+2.094
Total net cash value cumulative	+0.272	-1.680	+2.609	+4.703

the aim was cost-reduction of the training programme, meanwhile an acceptable level of effectiveness of the training programme, which means that the concept "savings" more appropriately expresses the intentions of the project.

Figure 4. *Expected and Actual Financial Savings of the Project in Millions of Dutch Guilders between 1985 and 1990*



Expenses only include the implementation of the restructured training programme in which CBT played an important role. Savings were realised by minimising the course length, through implementing CBT. The data show that savings for trainee costs in 1988 were not fully realised (3.425 million Dutch guilders accrued in 1988, whereas 3.75 million Dutch guilders had been budgeted for. This was because not all regions reduced the course length to 19 weeks, the average course length being 20.6 weeks. When we compare the expected and actual financial results of the project (see Figure 4), we see that the actual results were positive right from the beginning of the project, because course length was cut from 1985 onwards. Another remarkable result is that despite a reduction of course length in 1987, compared with 1986, the savings in 1987 were less than in 1986. This was mainly because in 1987, more expenses were necessary for equipment, development and maintenance of courseware, and training of trainers.

Computer-based training played an important role

We calculated costs and savings to relate the budgeted and actual financial results of the training project for counter personnel of the Dutch Post. The total savings due to the curriculum revision are now related to the total costs of training counter personnel between 1985 and 1988 which were 37.4 million Dutch guilders. Total costs, if no curriculum revision had been implemented (with a course length of 34 weeks and no investment in CBT), would have amounted to 43.8 million Dutch guilders, meaning that the project saved 6.4 million Dutch guilders during these years, which is a significant portion of total expenses.

Conclusions

We now turn to the conclusions of this study discussing, first, effectiveness, then costs and finally, the evaluation methodology used.

The overall effectiveness of the revised curriculum, in which CBT played an important role, appeared to be acceptable. All satisfaction scores of supervisors on the performance of trainees after the revised instructional programme were 2.3 or more on a scale of 0 to 4, 0 being the minimum level of satisfaction. This means that the curriculum revision and CBT integration, on the whole, can be seen as successful.

It is interesting to see that, in the region where only 23 per cent of the trainees were trained with CBT, average

perceived effectiveness of the revised curriculum is 2.3; whereas in the two regions where all trainees received CBT, the average perceived effectiveness of the revised curriculum is 3.3 and 2.8 respectively. We cannot go so far as to conclude that CBT leads to more effectiveness, however, since we could not use a (quasi-)experimental design in our study. Nevertheless, the relation between the data is promising. Further research is needed to test the significance of the effectiveness of CBT-supported curriculum revisions in business and industry.

Another interesting finding is that course length does not seem to affect average effectiveness. One region, where the training programme lasted 25 weeks, showed an average effectiveness of 3.3, compared to 3.2 in a region where the training programme was only 13.5 weeks long. This result calls for further research with more powerful designs and measurement instruments to test the relation between course length and effectiveness, corrected for other intervening variables. One important improvement would be the employment of multiple data sources, such as supervisors, peers, and subordinates, to compare pre-post perceptions of the performance of trainees, test results, and self-evaluations. The transfer model of Baldwin and Ford[19] can be recommended (see also Wexley[26]).

Many organisations do not generate training data

We are aware of the fact that, because of the design used in this study, it is not possible to attribute desirable performance of counter personnel in Dutch post offices to characteristics of the revised curriculum, exclusively. Variation in employment practice, culture, task assignment, feedback, job aids, experience with CBT, and the implementation of the revised curriculum, for instance, can contaminate the comparability of classes in different years and different regions. It is, however, very hard in real and complex contexts such as this, to use standardised criterion-referred testing of the learning results, as the regions implement and evaluate training programmes autonomously. If valid and reliable testing of learning results is possible during the project, pre-project data on learning results for all regions have to exist, which make possible a quasi-experimental design to test gain in learning results. Further studies are recommended in which the conditions just mentioned are fulfilled.

We can conclude that the project for curriculum revision in which CBT played an important part was economically more successful than expected, (with anticipated savings

of 2.3 million Dutch guilders in 1990 and actual savings of 4.7 million Dutch guilders in 1988), compared to total expenses of 37.4 million Dutch guilders. This implies that curriculum revisions of the kind described in this project are promising for other complex work organisations that are training considerable numbers of their employees. We do not contend, however, that all savings can be attributed to CBT, because some regions realised a reduction of training time without implementing CBT. This reduction accounted for most of the savings.

It is clear that management supported the implementation of CBT to justify reducing the training programme length. This again indicates the need for further research about the impact of the implementation of CBT and reduction of training time on independent job performance.

The guidelines of Doughty[20] and Brinkerhoff *et al.*[25] proved to be very helpful in structuring this cost-effectiveness study. As with much research on training and development in work organisations, it was difficult to collect data. Many organisations do not generate training data, which implies that in many instances the researchers themselves have to generate their own unique databases. In situations where organisations can provide their own data, there appears to be wide variation regarding the documentation or definition of variables by region, department, branch or division. This makes studies like these very tedious jobs, and this may be the main cause of the fact that so few cost-effectiveness studies are being carried out on the corporate level by organisations themselves. Perhaps the approach followed in our study provides some practical guidelines to follow in other complex situations in which training professionals are planning training cost-effectiveness studies.

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