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ABSTRACT

This paper describes the research strategies employed in the Dutch Technology Enriched Schools (TES) project, which was initiated in 1987 to introduce computers into secondary education, to encourage extensive and intensive use of computers in a small number of secondary schools, and to study the effects of computer use on the classroom, the curriculum, and school administration and management. The project, extending over a five-year period, involved three experimental schools that were equipped with a considerable amount of hardware and teacher facilities. The characteristics of the study highlighted in this paper are: (1) the case study approach; (2) emphasis on the need for cooperation between teachers and researchers; (3) the wide spectrum of effects being investigated; (4) the long-term character of the project; and (5) the generalizability of the findings. (ALF)

Research in technology enriched schools: a case for cooperation between teachers and researchers

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Introduction

This paper will discuss the research strategy employed in the Dutch TES project. Four characteristics will be highlighted: (1) the case study approach, (2) the emphasis on cooperation between teachers and researchers, (3) the wide spectrum of effects being investigated, (4) the long-term character of the project. After the explanation of the research strategy, the question of the generalizability of the research outcomes will be addressed. First, some background information regarding the TES project will be provided.

The Dutch TES project was initiated in 1987 as part of the Ministry of Education's general efforts to foster the introduction of computers in secondary education. The major objective of the project was to create a situation of extensive and intensive use of computers in a small number of technology enriched secondary schools and to study the effects on classroom level, curriculum level and school level. Three experimental schools were equipped with a considerable amount of hardware and teacher facilities. Two research teams were formed, one at Twente University with two experimental schools, and one at the Free University of Amsterdam*** and Utrecht University. The project was sponsored by the Ministry of Education (equipment and release hours for the teachers), the Dutch Institute for Educational Research (two research team of four researchers) and the participating universities (project managers). The project will be finished by the end of 1992.

Case study approach

The Dutch TES project is an example of the case study approach. Both researchers and teachers aim at creating successful applications of the computer in classroom lessons and in the management and administration department of the school. This is a process of continuous planning, implementation and evaluation, in which the final product is not attained after the first trial. Usually, several years of trial and improvement are necessary to arrive at a satisfying result. Researchers and teachers operate as engineers working on computer-aided curriculum parts of various lengths which are eventually accepted of rejected for permanent use.

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The absence of control schools without extensive facilities pre-empts the possibility to conduct large scale comparative studies. This raises the question of how effects of computer use are determined. Sometimes comparisons can be made inside the school by providing instruction with or without computer support to parallel classes at the same level. These comparative experiments are conducted as part of the project. Although the results are generally encouraging (i.e., favouring the use of computers as an aid to the teaching-learning process) the results should be interpreted with great caution. Very often, the content of the curriculum is changed after the computer has been introduced. A subject, which used to take half a lecture hour (like the problem of erosion as part of the geography curriculum), may be extended to several hours because the supporting computer program (like a simulation program to explore erosion problems in a model environment) needs considerable pre-training and requires ample time for actual use during the lessons. Moreover, the aims of the lessons with the computer (like experiencing the dilemmas of a farmer who has to feed his family by carefully cultivating his land) may divert from the original curriculum part. So, the question arises what we may learn from comparisons between lessons with and lessons without the aid of computers, when content, objectives and learning activities are simultaneously changing. It is our experience that technology enriched school is not just an ordinary school equipped with a lot of hardware. A technology enriched school is a school in which a learning environment is emerging, which enables students to learn by guided discovery how to acquire knowledge and skills in an independent and problem-oriented way.

Close collaboration between teachers and researchers

Close collaboration between teachers and researchers is the most important characteristic of the Dutch TES project's research strategy. In some departments, teams of teachers within the same discipline (usually two) and researchers (sometimes accompanied by subject-matter experts) were formed to develop, implement and evaluate new applications. Consensus was sought for during all stages of the implementation process.

This implies that the research activities of the project could not be completely defined and planned at the outset. On the contrary, from the very start of the project the initiative to explore and start possible computer applications was assigned to the teachers. The researchers' task was to support and guide the activities of the team and to ensure that at least two applications were tried out in the classroom during the first year of the project. The teachers show signs of discomfort during the first phase of the project. They expected the researchers to take the initiative and often asked for concrete plans. However, after this period (for some departments the entire first school-year of the project), the teachers were accustomed to the idea that they had to take the lead in the implementation process.

During the development of experimental lessons with the computer as an aid, the researchers assisted by collecting relevant information, evaluating the software with the teachers, planning the actual lessons and developing accompanying materials for students (worksheets) and teachers (directions). When a subject-matter specialist was added to the team, some of these preparations were delegated to the expert. At the start of the lessons, the researcher identified the intentions and expectations of the teachers with regard of the experimental lessons. Expectations were recorded and noted for later use. During the lessons, the researchers observed the activities of teachers and students in the classroom. Afterwards the results were discussed in the team on the basis of the observations of the teachers and researchers, and the intentions and expectations as expressed by the teachers before the start of the lessons. These evaluations usually led to a second cycle of preparation, implementation and evaluation. As explained, sometimes comparisons were made with more traditional instruction of the same subject-matter. Eventually, the

experiences were presented in papers, annual project reports, booklets for teachers in the same discipline, and meetings outside the school to inform unexperienced colleagues.

We contend that close collaboration between teachers and researchers is indispensable in innovation projects like the Dutch TES project. First, teachers bear the ultimate responsibility for all processes in the classroom. Therefore, they must agree and endorse the way computers are integrated in their teaching activities and in the learning activities of the students. Secondly, if teachers do not feel responsible for and in charge of the entire innovation process, they cannot be expected to continue after the TES project has come to its end. As it belongs to the project's objectives to create a stable situation of continuous use of information technology in all education processes in the project school, it is of great importance that the teachers consider themselves as the principles change agents.

Wide spectrum of research and implementation activities

Effects are studied over a wide spectrum, including the classroom level, the curriculum level and the school level. At the classroom level experimental (series of) lessons provide the data about learning effects (both quantitative and qualitative), effects on motivation of students, changing attitudes towards learning, changing opinions and roles of teachers. At the curriculum level, changes in content of subjects taught, and changes in emphasis and sequence of subjects are studied. Although comparisons between the old situation without computers and the new situation with computers are hard to make, case descriptions of new parts of the curriculum in which the computer has been integrated show at the curriculum level that a new orientation towards teaching and learning is emerging. At the school level changes in school management are studied as an effect of the integration of computers in the administration and management department. Apart from that, general changes in attitude towards computers are recorded by annually distributing questionnaires among all teachers of the project schools.

The need to study effects at all levels is evident. At the classroom level, separate experiments to investigate the use of computers as an instructional aid might be envisaged. However, changes at the curriculum level can not be considered unless the classroom level is taken into account. Effects at the school level are brought about by innovations at all levels. Research and development at a technology enriched school should follow a bottom-up approach. It is an expensive operation, because many activities have to be initiated at a lower level in order to see results at a higher level. However, it is the only way to study, within the context of the school, the wide scale effects of integration of computers in education and management.

Long-term project

The project has a relatively long-term character. Changes are studied over a period of five years, with many intermediate evaluations. Such a long period of research and development is necessary, because the changes we are interested in, occur at a very low pace. The loosely organized system of a secondary school does resist attempts to change its behavior. Although the Dutch TES project did not aim at structural changes in educational objectives or the management of the school, these changes were induced by introducing the computer. To create an opportunity to see this happen, a TES project should last for at least four years.

Can the results of a TES project be generalized?

According to Dutch standards, the three experimental schools have been equipped with a considerable amount of hardware and teacher facilities. This raises the question whether the research findings can be generalized to other school settings, where less favourable conditions exist. There are two arguments for

an affirmative answer. First, the project produces a number of prototypical exemplars of successful (series of) lessons in which computers are integrated and used by teachers and students. These exemplars cannot be directly implemented in other schools. However, teachers can use these exemplars as models to create their own computer applications in the classroom. Therefore, carefully documented reports of experiences with computers in the classroom are distributed by the TES project amongst secondary school teachers to inform them what the opportunities of computers in education are. Secondly, factors determining success and failure of computer applications are analysed in retrospect. These factors refer to hardware and software conditions, but more importantly to characteristics of teachers and subject-matter, and the institutional environment of the school. It is expected that the outcomes of analysing success and failures can be translated into recommendations which are relevant and valuable for other schools attempting to integrate computers in education and management.