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From Intra to Inter Organizational Development and Computer-Supported Learning

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Summary: The objective of this paper is to provide a contextual background of contemporary research on Computer Supported Learning. Many researchers and developers, focusing on e-learning issues, have a relatively narrow perspective on how their R&D activity is related to R&D in the field of Technology and Society (TaS). This paper is presenting a brief retrospective overview of how the focus of R&D on TaS issues in Norway has changed during the past half-century and some recommendations of the path of future R&D with emphasis on the requirements in the field of computer supported learning. Based on the role of technology in society throughout history, a background is provided for enhanced understanding of the present R&D emphasis. With the industrial revolution and emergence of modern capitalist societies, the initial R&D on TaS was focusing on workers conditions and the development of industrial democracy. From this situation, with focus on intra organizational conditions, R&D on TaS gradually changed focus towards inter organizational issues. Technological development has to some extend been accepted as inevitable and the R&D community has adapted a semi-deterministic perspective, refraining from probing deeper into and considering the possibilities of understanding how to effect the driving forces behind technological development. Future R&D on TaS should be based on experience from intra organizational Systems Development and apply experimental, multidisciplinary approaches to development of technology supported inter organizational solutions. Finally it is proposed that the R&D community, based on moral, ethical and humanistic considerations, has obligations to focus more on how R&D on TaS can contribute to strengthen education programs in developing nations.			

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Tittel: Fra intra til inter organisatorisk utvikling og IT-støttet læring			
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Sammendrag: Målsettingen med denne artikkelen er å gi en bakgrunn for dagens forskning på området IT-støttet læring. Mange forskere og utviklere som fokuserer på e-lærings problematikk har et forholdsvis snevert perspektiv på denne aktivitetens tilhørighet til Forskning og Utvikling (FoU) innen området Teknologi og Samfunn (ToS). Artikkelen presenterer et kort tilbakeblikk på hvordan fokus for FoU på området ToS i Norge er endret i løpet av det siste halve århundret og gir noen anbefalinger om retningen for framtidig FoU med vekt på behovene innen IT-støttet læring. På bakgrunn av teknologiens rolle i samfunnet gjennom historien gies det et grunnlag for å bedre forstå dagens FoU fokus. Med den industrielle revolusjonen og framveksten av moderne kapitalistiske samfunn var den tidlige FoU innen ToS opptatt av arbeidsforholdene i industrien og utviklingen av industrielt demokrati. Fra denne situasjonen, med fokus på organisasjonsinterne forhold, endret FoU aktiviteten gradvis fokus i retning av mellom organisatoriske forhold. Teknologisk utvikling har til dels blitt akseptert som upåvirkelig og FoU miljøer har i noen grad inntatt et quasi-deterministisk perspektiv, og avstår fra å trenge dypere inn i problematikken om hvordan drivkreftene bak teknologi utvikling kan påvirkes. Framtidig FoU innen området ToS bør baseres på erfaring fra organisasjons intern systemutvikling and anvende eksperiementelle, tverrfaglige tilnærminger til utvikling av teknologi støttede mellom organisatoriske løsninger. Som avsluttning foreslåes det at FoU miljøene, av moralske, etiske og humanitære grunner har en forpliktelse til å fokusere mer på hvordan FoU innen området ToS kan bidra til styrke utdannings program og opplæring i utviklingsland.

Innhold

A brief retrospective presentation of Norwegian Research and Development (R&D) on Technology and Society (TaS) and the present emphasis on Development of Computer Supported Learning Systems.

Introduction

The objective of this paper is to provide a contextual background of contemporary research on Computer Supported Learning in order to give a satisfactorily background for comprehending and understanding the contemporary emphasis on some of the present research issues in the field of Systems Development. It is hoped that the presentation can contribute to enhanced insight in and understanding of the socio-cultural perspective of Systems Development issues and curriculums. And further, to better understand the background for why R&D in the field of Systems Development, to an increasing degree are concerned with pedagogy and learning processes in combination with information technology. This requires some insight in the history of R&D on TaS. With this point of departure, it must be emphasized that the issues and references presented in this paper is not comprehensive and representative for the total Norwegian R&D in the field of TaS. The choice of literature and issues is based on what serves the purpose of the brief retrospective view, and biased towards what is particularly relevant for researchers at Hedmark University College (HUC). References to the author's own publications and reports are therefore not reflecting what is considered most important in the field of R&D on TaS in Norway

A reason for emphasizing the importance of a socio-cultural perspective, as a basis for understanding contemporary systems development, is that this may enhance the understanding of what may and what should be the focus of future R&D on TaS. The distinction between may and should is elaborated in order to emphasize the difference between future TaS R&D activities, based on the present driving forces and alternative driving forces. Limiting the presentation to Norwegian R&D does not imply that TaS R&D activity elsewhere, internationally, is inferior or less significant than what goes on in Norway. In particular in the other Scandinavian countries, R&D on TaS is largely comparable with the situation in Norway, now and in the past. When presenting and discussing the development of TaS R&D, the issues involved are often closely related to issues on the political agenda. The relationship between technology and society is in many cases significant for peoples' everyday life, both privately and at work and therefore, frequently on the agenda in the public debate. In the present paper, it is largely attempted to keep the discussion inside what is related to the TaS R&D community, but in some cases the overlap with political issues is both natural, desirable and unavoidable.

Technology and Society (TaS)

> The term technology combines the Greek *techne, "art, craft"* with *logos, "word, speech,"* and did not appear in the English vocabulary before the 17th century. A precise definition of the term technology is still not agreed on and may never be, but it is generally accepted that the term can broadly defined as *"the means or activity by which man seeks to change or manipulate his environment"*. (Encycl. Brit. 2003)

In the present paper, the discussion is largely limited to the part of technology, which, somewhat imprecisely, can be said to represent tools or artifacts.

Artifacts

It is commonly accepted that one of the major factors, which separate humans from animals, is the ability to systematic construct and apply artifacts. Other species than humans, the animals, make and apply artifacts, but as opposed to humans, this is a result of instinctive behavior. Artifacts have a variety of roles in different societies and social constructions, ranging from symbolic signals, status determinators and efficiency providers (Hetland P. 1990). Development and application of artifacts is closely related to the development and evolution of what we commonly call modern civilizations and societies. The correlation between the presence and application of advanced artifacts and the degree of material standard of living in a society, measured by GNP pr capita, is significant. Throughout history, from the early use of artifacts, such as stones for cracking nutshells to present artifacts such as computers and electronic communication systems, the material standard of societies, applying the artifacts, has developed correspondingly. However, until a few hundred years ago, advancements in the development of artifacts were relatively slow and followed a linear progression process. Advancing from a situation where spears and bows and arrows represented the most sophisticated artifacts to a situation where the state of the art artifacts were metal swords and simple firearms, took several thousand years. In contrast to this it only took a couple of hundred years to advance from the first simple firearms to nuclear weapons and space technology. But in the mid 1700 with the main industrial revolution, the rate of change in the innovation, development and application of artifacts increased dramatically, resulting in an exponential development progression.

The Industrial revolution

What is commonly denoted and referred to as the main industrial revolution, started in Britain in the mid 1700 and revolutionized, among other things the means of production. In the TaS research community it is common to distinguish between phases of industrial development and also several industrial revolutions. Introducing the first, second and even third industrial revolution allows for more precise characteristics and differentiation between situations related to the introduction of mechanical artifacts, artifacts based on computers and communication technology and innovations in the field of medicine and biotechnology. However, with the objective of the present paper, “providing a brief retrospective view” the changes in the mid 1700ties are referred to as the main industrial revolution.

> The main features involved in the Industrial Revolution were technological, socioeconomic, and cultural. The technological changes included the following: (1) the use of new basic materials, chiefly iron and steel, (2) the use of new energy sources, including both fuels and motive power, such as coal, the steam engine, electricity, petroleum, and the internal-combustion engine, (3) the invention of new machines, such as the spinning jenny and the power

> loom that permitted increased production with a smaller expenditure of human energy, (4) a new organization of work known as the factory system, which entailed increased division of labor and specialization of function, (5) important developments in transportation and communication, including the steam locomotive, steamship, automobile, airplane, telegraph, and radio, and (6) the increasing application of science to industry. These technological changes made possible a tremendously increased use of natural resources and the mass production of manufactured goods. (Encycl. Brit. 2003)

With some exceptions, the main industrial revolution involved most European countries during a time span of approximately hundred years between 1750 and 1850. As a result, the efficiency of the manufacturing of goods and products took a giant step forward and the GNP pr capita of the countries involved increased correspondingly. However, with the industrial revolution many characteristic features of societies also changed. From feudal societies the industrialized societies and the capitalistic way of organizing societies and working life evolved.

> “political changes reflecting the shift in economic power, as well as new state policies corresponding to the needs of an industrialized society, sweeping social changes, including the growth of cities, the development of working-class movements, and the emergence of new patterns of authority, and cultural transformations of a broad order. The worker acquired new and distinctive skills, and his relation to his task shifted; instead of being a craftsman working with hand tools, he became a machine operator, subject to factory discipline.” (Ecycl. Brit. 2003)

With the emergence of the new capitalist societies in Europe came also an increased consciousness of the new working class. The workers became to an increasingly degree concerned with working conditions, welfare and the employment effects of technology-based automation of production processes. Technology-determined unemployment was a major concern of the workers and organized resistance against the new manufacturing methods increased in the late 1800. Introduction of new artifacts in the manufacturing process, combined with capitalistic ways of organizing the industry changed the power structure in societies. A few persons, the industry owners, the capitalists, controlled the societies and the majority, the working class was left with little power to control their lives and working conditions.

Marxism

Many individuals have contributed to analysis and critique of the new capitalist societies emerging from the industrial revolution but few have been more influential than Karl Marx (1818 – 1883). Marx is one of the founders of the theoretical basis of the socialistic movement and he combined theoretical analysis of the capitalistic system with active political engagement. As a professional, Marx is not normally considered a scientist or researcher, but by to days definition of research, his social and economic analysis would most likely be qualified as outstanding achievements in the field of social sciences. More than most analysts, his work has had enormous implications, both with respect to the initiation of social processes of change and our understanding of societal conditions during the past 150 years. One of his major publications, (Das Kapital, 1867) represents an analysis and a critique of the capitalist society and identifies the phenomena “ownership to the means of production” as perhaps one of the most significant keys to the understanding of the capitalist society is. Marx claimed that the ownership to the means of production is one of the most significant characteristics of the capitalist society and decisive when it comes to understanding the power structure of capitalistic societies. The owners of the means of production or manufacturing artifacts, are in power with optimalization of profit as their main goal, and the operators of the artifacts of production, the workers, are powerless. As a result of the organizing of work and design of manufacturing technology in capitalist societies, the workers were alienated. With the latest evolution of societies and development of artifacts, the structure of ownership of the means of production has become more vague and hence the power-structure in society is not as “clear cut” as it was a century ago. But despite this, the work of Marx still plays an important role as an inspiration to the understanding of TaS related issues. In particular, the understanding of the development of R&D on TaS, benefits from insight in and understanding of Marxist analysis and his capitalist critique.

Scientific Management

During the post Industrial Revolution period, countries in Western Europe and the US developed rapidly and became the worlds' leading industrial nations. In the US, capitalism was "purified" and great efforts were put in to increase the efficiency of the manufacturing industry. A major contributor to these efforts was the American engineer Fredrick Winslow Taylor (1856-1915) who is known as the founder of Scientific Management. The principles of Scientific Management can briefly be described as a management method based on the separation of work tasks and leadership with increased specialization, division of labor and detailed planning of work tasks. In this way the shop floor workers are refrained from control over their work situation and considered as cogs in a large, mechanical machinery. Scientific Management was originally meant as a method for increasing the efficiency of workers, but it also fitted well into the capitalistic manufacturing system by allowing a further shift of power from the shop floor towards the management and industry owners. Scientific Management has later been synonymous with a method of organizing work process promoting the capitalists' exploitation of workers. With the application of scientific management, manufacturing technology played and important role as a means of controlling the labor force. By designing manufacturing technology in certain ways, specialization and increased division of labor could be accomplished.

Early R&D on TaS

Research and Development in the field of TaS is a relatively new discipline both in Norway and most other countries and closely related to the establishment of formally organized and institutionalized Social Sciences in the post World War II period. During this period, development of technology took a considerably leap forward with the introduction of electronic computers. Up to the mid 1900, TaS analysis had been dealing with mechanical artifacts, but with the advances of electronic development during World War II a new technological era began. With these changes, R&D on TaS were faced with rapidly changing conditions and correspondingly challenges of making prognoses about the future. For a couple of decades, electronic computers were relatively simple numerical calculating machines compared with the present state of the art computer technology. But in the late 1960ties and early 1970ties electronic computers became commercially available and were increasingly integrated as artifacts in work places and the private sectors of society. With the establishment of Social Sciences and focus on TaS in the 1950ties one of the immediate concerns was to investigate work life conditions and in particular the effects of Scientific Management on workers and work conditions in factories and manufacturing plants. These early approaches to the study of work-life conditions were both directly and indirectly inspired by the Marxist analysis and his critique of the capitalistic way of organizing society and work life. Marxist analysis had drawn the attention to both the undemocratic power structure and the unsatisfactorily work condition in capitalist societies. R&D activities related to TaS has since, to a considerably degree been polarized. The part of the research community, only indirectly inspired by Marxism, has approached R&D with a social democratic, cooperation-based perspective, largely ignoring the power structure of capitalist societies as a determinant of technological development and working conditions. The other part of the research community, more directly inspired by Marxism, has approached R&D in a more critical way, claiming that the power structure must be changed if real improvements are to be accomplished.

The Positivism Debate

In the early 1970ties the discussion of approaches to social science research was high on the agenda in the Norwegian research community (Mjøset 1991). With social science being a relatively young scientific discipline, attempts to separate social science from the more mature, natural sciences led to an intense public debate, frequently referred to as the Positivism Debate. The most common critique against applying a natural science inspired approach to research involving social issues is that natural science is based on the affirmations of Positivism that all knowledge regarding matters of fact is based on the "positive" data of experience. This view assumes that neutral, value independent and objective observations are possible. This critique is also a core issue in the Positivism debate, initiated a few decades ago and is still going on, even if the intensity of the debate has decreased. The critique of positivistic approaches is undoubtedly, to a large degree justified and is considered as a major factor, contributing to the popularity of Action Research approaches. Consciousness of the possible pitfalls of attempting neutral observations should be a major concern of all development projects dealing with TaS issues. Balancing the need for precise information and testable experiments with initiatives to avoid laboratory like conditions, represents a considerably challenge for TaS R&D.

Human relation

> "In the 1930s the emphasis of management researchers shifted from individuals to the work group. Of primary importance was the human relations research program carried out by Elton Mayo and his

> associates at the Hawthorne Western Electric plant and their discovery of the "Hawthorne effect" – an increase in worker productivity produced by the psychological stimulus of being singled out and made to feel important. The ideas that this team developed about the social dynamics of groups in the work setting had lasting influence". (Ecycl. Brit. 2003)

The emergence of the Human relation school can be considered a reaction to the unsatisfactory consequences of the Scientific Management approach, especially with respect to the working conditions of factory workers.

The Socio-Technical tradition

In the early 1960ties, a research group at the Institute of Industrial Environmental Research, at the University of Trondheim started cooperation with the Tavistock Institute of Human relations in the UK, and further developed the ideas of the Human relations perspective (Thorsrud E. et.al. 1970). Based on studies of technology and work conditions in coalmines in the UK, the Socio technical approach to R&D of work life was developed. The socio technical approach represented a break through and a considerable step towards a better understanding of the relation between technology, individuals and organizations. In particular, the socio technical approach is associated with the term "joint optimalization" of the technological and the social systems at work places and consider this as a major goal and basis for improving the quality of work life.

Cooperation experiments (LO – NAF)

Based on the Socio technical philosophy, the researchers at the Institute of Industrial Environmental Research, at the University of Trondheim, initiated a comprehensive project, actively involving the unions (LO) and the employer's counterpart organization (NAF). The project, (Samarbeidsforsøkene – Cooperation experiments) was focusing on the development of Industrial democracy, quality of work life and the design and functionality of manufacturing technology. One of many important, fringe results, of this project and the research conducted by the research group was to contribute to establishing and forming the content of the Norwegian work environment act. With this environment act, representatives of unions obtained the right to participate, with full insight, in projects involving introduction of technology at the work place. The act also gives directions of how the organizing of work and work conditions should attempt to enrich the work conditions by avoiding monotony and ensuring variation in work tasks. Retrospectively the project, and the Socio technical approach has been criticized, for not taking issues of power structure sufficiently seriously, and thus only ensuring superficial or cosmetic changes.

The Norwegian Iron and Metal Union Research Project

In the early 1970ties the first generation of computers were introduced in organizations and manufacturing systems. At this stage the computers were mainly applied as parts of control or cybernetic systems in production lines. Computer applications such as Word-Processing and Economy Management Systems was still immature and only used for experimental purposes. But for some of the experts in computer science, it was already at this stage obvious that computers had a considerable potential for changing work life conditions, both with respect to the quality and contents of work tasks and the decision-making structure in enterprises. On this background the Norwegian Iron and Metal Union Research Project was initiated by Kristen Nygaard at the Norwegian Computing Center (Nygaard K. Bergo O. T. 1971). The Norwegian Iron and Metal Union Research Project did represent one of the first major attempts to approach the task of introducing computers in organizations in a systematic way with user participation, and initiated what is later denoted as Systems Development the Scandinavian way. In contrast to the Cooperation experiment, the Iron and Metal project did not assume that cooperation with the employee's organization was automatically possible, and declared that their approach was biased towards Union interests (Nygaard K. Bergo O. T. 1973).

Workers collective

In the late 1950ties the Norwegian Sociologist, Sverre Lysgaard undertook a study among workers and their relation to management in a Norwegian manufacturing plant. The result of the study was presented in the book (Arbeiderkollektivet – Workers collective), which identified conditions for a workers' collective to develop.

> "The book represents the most important post war, Norwegian, contribution to the understanding of the class conflicts in industrialized societies" (Aubert W. 1961)

A workers' collective is an informal organization among subordinated workers in a company and serves the purpose of giving the workers a protected membership in the technological/economic system of the company. The workers collective is acting as a buffer against the technological/economic system. According to Lysgaard the workers situation can be considered as a dilemma where they in one respect, are dependent upon the company for providing them with the means of keeping a satisfactorily standard of living. They have to cooperate in order to ensure that the company is reasonably profitable. But at the same time the workers require ways of protecting themselves against undesirable effects of the company's attempts of pursuing profit.

Systems development and Intra-organizational focus

Systems Development the Scandinavian way is a characteristic of systems development with strong emphasis on user participation and democratic decision process. The main concern of early systems development researchers in Scandinavia was that user participation should be a natural part of the project for democratic reasons. Introduction and alterations of computer-based information systems in organizations was anticipated to have considerable effects on and consequences for the employees in enterprises. However, as the field of Systems Development has matured through the years, it is now commonly accepted, also by those who are not primarily concerned with democratization and workers conditions, that user participation is required if the computer-based information systems shall perform efficiently.

Early systems development approaches were based on the assumption that it is possible, in advance of the development project, to establish a satisfactory systems requirement specification. Experience gained since has clearly shown that this is rarely possible. The potential users of computer-based information systems are not in a position to define in advance what they require or predict the implications of the new technology and neither are the professional systems developers. As a consequence, systems development has gradually shifted from what is commonly termed as the waterfall approach to more experimental approaches. The term waterfall is a metaphor applied in order to illustrate that turning back is hard or impossible once the development process has started, comparable to the problems of going against the current in a waterfall.

> “Experimental approaches assume that organizations are pluralistic and continuously changing. Experiments involving different solutions are required to disclose the user requirements, to test technological solutions and evaluated alternatives in practical environments. Experimental approaches is preferred, based on the understanding that systems development processes not can be pre-planed and controlled in detail. The approach is determined by the actual situation and is action oriented because the structure will be adapted to the progression of the process” (Øgrim Leikny 1993).

However, with experimental systems development the systems requirements gradually evolve as a result of testing, evaluating and redesigning the prototypes during the development process. Applying experimental approaches is based on many years of experience from systems development, which clearly indicates that with traditional systems development, most systems requirements need to be considerably changed during the course of a development project.

> "The user requirements as a basis for the projects could not be described completely. New requirements emerged throughout the projects. As a consequence steps back to the previous development phases had to be taken continuously" (Kautz. K. 1993)

> "prototyping is a strategy for performing requirements determination wherein user needs are extracted, presented and developed by building a working model of the ultimate system - quickly and in context" (Boar 1984).

With traditional systems development the development process is formally terminated at the end of the project and alterations and systems improvements are considered a part of maintenance or defined as a new project. Experimental systems development is focusing less on the product and more on the process.

> "It understands systems development as a process that does not stop when a development project stops. It comprises development and use" (Kautz. K. 1993).

Recent TaS R&D

In the 1980ties the development of and increased availability of efficient data-communication systems brought a new dimension to the field of TaS. The computers were no longer isolated artifacts, providing the users with high calculating power. Systems could be introduced which allowed efficient transfer of data between computers. To begin with, the data-communication systems only allowed intra organizational solutions enabling technology based coordination and cooperation inside the boundaries of single companies. But gradually, the data-communication systems were extended beyond organizational borders and enabled inter organizational contact between computers. The first inter organizational computer-based information systems were applied in booking services for travel agents in the mid 1970ties (Bansler J. 1987). Whilst the computer terminology up to the late 1970ties was restricted to and content with the term "computer-based solutions" the introduction of data-communication networks called for new terms such as Telematics and later Information and Communication Technology (ICT), reflecting that computers could communicate at a distance.

Telematics and regional development

With the introduction of Telematics the focus of TaS R&D activity was partly shifted from intra organizational issues to inter organizational and inter regional issues and applications. The Telematics concept was promoted with "geographical distance erasing" properties and had a considerable appeal on politicians and the public debate was strongly effected. (Faugli B. Odden S. 1986). During parts of the 1980ties, with peripheral regions in Scandinavia, struggling to avoid economic stagnation and reduction in population, telematics–based solutions were often considered as a solution. Telematics experiments, involving regional Distance Work Centers and Distance Education Centers were planed and tested and considerable experienced was gained for the benefit of TaS R&D communities (Hetland P. Knutzen P. Meissner R. Odden S. 1989).

> “The message from the public Teleutvalget in Norway in 1983 was optimistic: A unified national telmatics network, with branches to every fjord and local community should be the foundation of new work places and regional growth and prosperity (NOU 1983: 12) Distance work, telecommuting, videoconferencing, telemedicine and distance education was presented as examples of future work life, health care systems and schools” (Jansen A. 1998).

Sponsored R&D

Traditionally, R&D activities has either taken place within government owned educational institutions, such as universities and colleges or in private enterprises. The exception has been military R&D, which represents a considerable part of all global R&D activity. In the mid 1970ties, the separation of independent and relatively “free” R&D activities conducted in educational institutions and other R&D became less distinct. As part of the attempts to establish R&D on TaS as a means of achieving prosperous regional development, regional research institutions were organized throughout Norway. The regional research centers were semi-independent organizations in the sense that they were partly based on governmental funding and partly on income from the sale of R&D activities. The buyers of R&D activities and results were both public institutions and private organizations. To some extend this organization of the Norwegian nationwide research activities contributed to increased efficiency but also to a situation with less independent and “free” research. By having to “sell” the R&D results in a marked, the driving forces behind R&D on TaS is believed to have changed from what independent and qualified researchers considered important issues to what the marked was willing to pay for. By this change in the financing of R&D, the more establishment-critical TaS research faded to some extend away, leaving an R&D activity, largely orientated towards delivering results, beneficial for the economical power centers in society.

State of the art TaS R&D

The main difference between Recent TaS R&D and “State of the art TaS R&D is largely contributed to the introduction of the Internet. Improved data-communication systems in the 1980ties had a considerably impact on the focus of TaS R&D, but this impact was relatively insignificant compared to the impact of the Internet. During the first part of the 1990ties the Internet became available. With more stable communication solutions for both private and professional users and in particular the E-mail, introduced a radically new concept of electronic communication. This situation allowed both researchers and developers to pursue the paths of geographically independent solutions, initiated and inspired by the telematics concept a few years earlier. With the Internet, the visualization of geographically borderless and global solutions was possible.

Learning on the agenda

The experience from several decades of R&D on TaS clearly indicates that it constitutes a complex problem area. The majority of Systems development projects are still relatively unsuccessful (Chaos Report, 2000). Of all Systems development projects in the US in the late 1990ties, only a small percentage was successfully completed. Approximately 30% of all projects were never completed and the completed projects required more than 80% additional time and resources than originally planed. And it is no reason to believe that the situation in Norway differ significantly from the situation in the US. Also with pure research projects on TaS, the results are frequently of unsatisfactorily quality when it comes to understanding and explaining important phenomena. An effect of these, less than satisfactorily conditions, has been a gradually increasing concern about how to enhance and integrate learning effects in development projects, ensuring that the developers continuously gain useful experience for improving development process.

> "Strategies for stimulating innovations – and diffusion process must include both offers – and demand activities and a broad emphasis on development of infrastructure. It is particularly important to support structures and activities which can stimulate learning and knowledge enhancement, both through vertical and horizontal networks" (Jansen A. 1998)

Computer supported learning

With lifelong learning on the agenda, worldwide, efficient and flexible educational programs of high quality are increasingly in demand. A growing proportion of the population needs continuously refill of knowledge or a more comprehensive reeducation to comply with the rapidly changing working life conditions. Many of these learners are fully or part time occupied in jobs, have family obligations, reduced mobility due to handicaps or are for various other reasons unable to spend long periods of time with physically presence on campus. Off-campus students represent a new category of learners requiring flexible learning conditions and constitute a new an important part of the student market. Providing efficient and high quality educational programs for this new category of students is a major challenge for most educational institutions. For the past half a century, flexible learning possibilities have been successfully available through traditional distance education programs organized as correspondence courses. However, with modern ICT and particularly the Internet, the conditions for delivering distance education, is dramatically changed.

Presently, most approaches to development of efficient and high quality computer supported educational programs for off-campus learners are suffering from an insufficient understanding of the complexity of the tasks involved. Most systems appeared to be implemented as high-tech solutions for off-campus students using powerful computers and the Internet without achieving more than could be done by using old-fashioned books, chalk and blackboard and sometimes not even that. The IC technology is superimposed on traditional lecture-based learning processes. A prevailing attitude among many ICT specialists and educators seemed to be that with access to the Internet it is trivial to organize and deliver off-campus education programs. This attitude is reflecting an insufficient understanding of the complexity of developing and implementing systems involving people, technology and organizational issues.

A shift of educational "paradigm"

When applying computers and telecommunication for supporting learning process as part of formal educational programs it was gradually realized that the pedagogy must be changed an adapted to the technology and visa versa. Technology and pedagogy must be matched in order to achieve optimal solutions. Utilizing the potential of modern technology requires that more attention is paid to the pedagogy applied and not allowing a one sided focus on technological development.

> "Traditional education, with classrooms and lecture theaters as significant learning environments, applies a pedagogy, which can be characterized as a knowledge PUSH approach. A presumably skilled and competent person, the teacher, attempts to push knowledge across to the students in a classroom or lecture theatre. The teacher lectures and the student listen and have the role of passive, rather than active participants as if the knowledge the teacher has can be transmitted directly to the students. Cultural constraints and efficiency considerations have reinforced and maintained this type of educational systems despite a growing appreciation that it does not provide the students with optimal learning conditions. With advances in the field of educational psychology and pedagogy, during the last century, it gradually became clearer that optimal learning processes, in most cases, requires favorable conditions for active search for new knowledge and reflections. Learners should be active participants, interacting with peers and experts in the learning process and

> provided with conditions for pulling knowledge from the surrounding environment. During the last few decades, with development and advances in the field of instructional technology, the educational community has gradually realized that applying alternatives to traditional education systems has become practically feasible. This has initiated and contributed to increased efforts to develop and implement educational systems, combining efficiency and alternative pedagogy. The progress in this field is not particularly high, since traditional thinking prevails, accompanied by other development-inhibiting factors". (Faugli B. 2003)

Experience from the past decade of computer supported learning process clearly indicates that the R&D activity in the field of education has much to gain from shifting focus from technology to pedagogy. As with systems development the focus on users and organizational issues is a prerequisite for successful development process and results.

> "A frequent charge leveled against technological innovations in education is that they often seem to be designed to exploit the capabilities of the technology rather than designed to meet an instructional need; that is, that they are technology-driven rather than theory based" (Koshmann T. Kelson A. C. Feltovitch P. J. Barrows H. S. 1996)

> "when educational IT is examined there is often little evidence of it being grounded in any learning theory" (Jones A. 1996).

And when a connection to learning theory is apparent it is frequently related very traditional pedagogy

> "Instructional theories, though, which have been influential in American educational software design, have in the main drawn on behaviorist ideas" (Jones A. 1996).

The state of knowledge in this field indicates clearly that designing e-learning systems for off-campus students is far from a trivial task.

> “ it is extremely difficult to develop good CSdCL (Computer Support for distributed Collaborative Learning) products anchored in the principles of lifelong learning” (Fjuk A. 1998).

And further:

> “it is yet a huge challenge to offer the students, often collaborating from homes, computer-based solutions that serve to support their collaborative learning process” (Fjuk A. 1998).

However, the presence of internet-based educational programs with unsatisfactorily quality may not entirely be contributed to insufficient understanding of the tasks involved. It is reasons to suspect that in some cases, the driving force behind implementing less satisfactorily solutions may be the desire to make fast profit in a new and expanding commercial marked.

Future TaS R&D

With the present rate of development of Information and Communication Technology (ICT) it can be expected considerable changes in both work life and private life conditions in the years ahead. A systematic, theory and politically based approach to R&D is required. With more advanced technology and a population, the users, becoming more accustomed to handling advanced technology, a new technology orientated culture will emerge. New generations of users will adapt to new situations and conditions, not only because they are introduced to a particular technology at early ages, but also because changing conditions will be the rule and not the exception. The future users will be accustomed to and used to live with chancing conditions. Much of the present TaS research has the characteristic of explorative approaches, and this is necessary as long as we are relatively uncertain with respect to what we want to achieve. It is however pertinent to ask if more goal directed approaches may be beneficial and help to promote more result-oriented R&D on TaS.

A “touch” of Positivism

The positivism debate in the 1970ties had considerably positive effects on the research community by placing research methodology formally on the agenda. However, the debate also created attitudes and “schools”, clearly defining how social oriented research should and not should be conducted, and unfortunately, in many cases these arguments were not based on scientific reasoning but more on belief and ideologically. To a certain extend this is still the situation and there are indications that the TaS research community is paying a price for this. Much of to days R&D activity on TaS can be criticized for not providing very useable results and failing to draw reasonably précis conclusions because they do not conduct proper measurements and apply precise evaluation methodologies in fear of being accused of applying positivistic approaches.

> Developing and testing any process, system or product requires a definition of what constitutes successful solutions. It must be possible to identify and differentiate between solutions of varying quality. Absence of such definitions leaves the developers with no means to maneuver. It becomes impossible to evaluate the experiments and consequently, the developers are without the possibility of drawing conclusions and suggesting improvements. The more accurate the phenomena of quality is defined and operationalized the better is the maneuverability and the more efficient and focused the development process can be conducted. (Faugli B. 2003).

Progress may be gained by applying more goal directed approaches to experimentation with new learning processes and educational solutions. By defining more precise goals and conducting evaluation based operationalized success criteria, developers may gain experience more efficiently than with most contemporary approaches. In order to achieve more efficient and goal directed R&D activities, a more open-minded attitude from the R&D community towards positivistic approaches may be required. And perhaps a step towards merging social and natural science approaches may be the solution for future R&D on TaS.

Changing technology, lower thresholds of acceptance and internationalization

With changing technology and changing user-culture, habits and competence, it can be expected that the existing thresholds for applying successful ICT-based solution in the future will change considerably. Present R&D on TaS issues is struggling with relatively immature technological solutions and a generation of users, not familiar with the conditions provided by modern technology. In the decades to come a new generation of users, accustomed to high tech solutions as an integrated part of their life, in schools, at work and privately will emerge. These users will be in a far better position, than the majority of the present users, to utilize and adapt to new conditions. For future R&D focus on TaS issues this will have considerable implications in the sense that the contemporary challenges will be trivial and the planning of future R&D should take this into account. The R&D community is presently striving to find solution to problems that in a few years time will appear trivial or obsolete. For R&D in the field of distance education and regional development the question of availability of technology is presently of major interest in order to reach the more peripheral and geographically remote communities. But in a not so distance future this will most probably be of little concern. With the development of new, high power computers, high capacity communication systems, in particular with satellite-based TV and mobile systems the availability of efficient technological solutions will be an insignificant problem for the population in even the most geographically peripheral districts, both nationally and globally. The technological development described above will take place, due to the strong marked mechanisms as the driving force behind the development efforts. Even if this may qualify as a deterministic perspective, it is never the less necessary for the research community in the field of TaS to accept some of the future development as given. The immediate consequence of this perspective is that the focus of future R&D on TaS issues should both be based on the acceptance of the described development as more or less inevitable but simultaneously focus on how to effect techno-politics and the driving forces behind technological development. Lessons can be learned from systems development and the experiences from this field should be applied in a wider context. The key issues will be experimentation, multidisciplinary approaches and considering R&D on TaS as a continuous and “never ending” projects.

Experimental approaches with testing, redesigning prototypes and implementing satisfactorily, but not necessarily final solutions, can advantageously be attempted on a wider scale than intra organizational systems development. For example when planning and developing technological infrastructure on a national, semi national or international scale, a more systematic, experimentation-based approach may be beneficial. The main philosophy behind this is grounded on experiences from the field of systems development, where it is accepted that the developers rarely are able to come up with a satisfactorily requirement specification during the early stages of a project. As with intra organizational systems development this requires projects with multidisciplinary competence among the members. Social scientists, economists and computer scientists should be included and their competence systematically organized in the same projects aiming at developing inter organizational and inter regional technology-scaffolded solutions. And further, it must be accepted that development projects represent continuous process and will not be terminated when an apparently satisfactorily solution is reached. Once a satisfactorily and workable solution is reached, conditions, technology and insight will have changed, requiring further development. The perhaps greatest implications of enhanced conciones and focus on these factors will be the psychological effects on R&D on TaS in the future. By being aware that many TaS projects must be considered as multidisciplinary, continuous experimental processes, the expectations towards final results will be more realistic and provide a background for more suitable project organizations. A near at hand example may be a regional college, embarking on the development of technology supported educational programs for off-campus students. Understanding that this project will be the normal state of affairs in the future may help the institution and its managers to adapt more suitable approaches. With the general history of R&D on TaS, presented earlier in this paper, it should also be obvious that the development of computer supported educational programs should be considered in a broader context than what is common among developers to day. Developing and implementing computer supported learning for off-campus learners, as part of life long learning, represents a complex problem area, with implications for many aspects of the users private and professional situations. Lessons from early R&D on TaS issues has taught us that the technological development and availability of new solutions and possibilities can have implications for democratization, power structure and quality of working life in societies. Future development and handling of new technology should seriously consider the necessity of a more conscious and wide-perspective techno-policy.

As a final, and partly value loaded statement about what is significant and what is less significant now and in the future, attention is drawn to the present global situation and the potential of what R&D on TaS in the field of computer supported learning can accomplish. Globally we are to day faced with challenges, in particular with respect to the situation in developing nations in the south and eastern part of the world, which we on a moral, ethical and humanitarian basis not should ignore. One of the keys to improving the conditions in the developing world is enhancement of knowledge and availability of information among the population on many levels in the societies. Modern ICT solutions have a considerable potential for improving the situation in the developing world (Faugli B. 2003) and should be in focus of future R&D on TaS. However, this final suggestion is included both to direct the attention to an important and much ignored field and to illustrate that the future paths of R&D on TaS involves both professional and political issues.

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