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INFORMAL EDUCATION BY COMPUTER—WAYS TO COMPUTER KNOWLEDGE†

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Abstract—With the rise of industrial society a regular and institutionalized education system was developed and established. In contrast to pre-industrial society, this modernization was based on a standardization and formalization of education. With the rise of the computer informal education has become an important, and often the only possible, form of learning for acquiring knowledge of computers. Based on empirical project work, the relevant computer competencies are described on four levels, after which the interplay of learning matter and learning methods for handling computers are dealt with. Copyright © 1996 Elsevier Science Ltd.

Learning outside the school has always existed in Germany, as in English-speaking countries. Media-assisted learning is a new and important form of such open learning. However, for imparting knowledge about computers, the emphasis in Germany has been on the role of the school. It will be shown that, despite what institutional education offers, the acquisition of computer knowledge takes place largely outside school.

STEPS TOWARD THE USE OF COMPUTERS AS PART OF EVERYDAY LIFE

The wave of computerization that began in the late seventies necessarily raised many new issues. One was the acceptance of computers in everyday life another was de- and requalification, since as a working instrument the new technology would produce very far-reaching changes in the performance of work. Above all, the computer defined additional learning requirements, even though one initially only had to become accustomed to computerized accounting systems outside one's work, from utilities, banks, and stores with their bar codes on everyday products. With home computers and video games, the private home became additional terrain for the computerization of everyday life. Since representatives of classical modernization were interested only in having people agree to the coming computerization, there was no dearth of references to 'computer kids' in public discussion, since they were less biased and seemed so knowledgeable in handling the new electronic gadgets—although a mastery of computer games rarely involves expert knowledge [1]. By referring to computer kids, one could argue in the late eighties, that youth was definitely no longer hostile to technology although criticism of large-scale technology should by no means be confused with the use of miniprocessors [2]. Intensive use of the equipment was suspected of changing ones personality, e.g. [3], and it was asked whether the computer did not prevent the development of social relations when it became the center of a computer freak's life [4].

The computer in the information society does not merely give rise to a reformulation of familiar sociological questions focusing on a need for shaping society. Questions as to qualification and cooperation, as to how technology changes political rule as to individualization and modernization, are exemplary here.‡ Computerization brings out changes in everyday routines, patterns of life, forms of work and interests, it makes gaps in knowledge apparent, and dysfunctionalities are a necessary concomitant. The latter are attributed to faulty handling of the equipment and programs and to deficiencies in the software itself. Instead of characterizing the chaotic disorder of this modernization, experts have diagnosed a supposed overtaxing of individuals and have defined corresponding educational

†This article is based on a project on "Informal education during youth" conducted by the author at the German Youth Institute (DJI) in Munich.

‡About the discussion of directions on modernization and individualization also see the contributions in the reader by [5].

aims. Instead of talking about rule and technology they talk about acceptance of the technology; instead of talking about competent handling of the computer they talk about a need for 'computer literacy' as a requirement for operating the equipment. Multimedia† is the name of the latest wave of propagation of new media on CD-ROM and via networks in Germany [7, 8]. The manufacturers of these networks, e.g. German Telekom, and the major media companies, e.g. Bertelsmann, firmly demand the acceptance of new technology. Through the technology, new structures‡ are created, which lead to public controversy that even affects trade unions. After all, the new multimedia-world does not only offer more chances, it also carries more risks.

Clearly, the knowledge of how to handle a computer should be taught mainly via the school education system. An analysis of the field shows that the aquisition of computer skills is ensured by informal learning. Computer books and journals, magazines for the general public, radio, television and adult education courses inform about the proper use of this technology. Qualification for using a technology is nothing new. What is new about the new technology is that society as a whole is making itself fit for it. The separation between work, learning and leisure time seems to disappear when it comes to the computer. Information about new software developments is acquired at the news stand, for example, as with hobbies until now.

Unlike the industrial society which relied on a standardization and formalization of knowledge, the information society thus trusts in informal education as the basis for modernization. In the following an attempt will be made to describe how society deals with the challenge of the computer. The specific matter to be investigated will be what is learned when one deals with the computer and which abilities and skills involve knowledge of computers. It will also touch on the relation between knowledge of computers and ways of acquiring it, and the part played by the numerous sources of information in imparting knowledge of computers.§

A number of studies have investigated how individuals relate to the computer, e.g. in terms of computer games,¶ computer freaks [11, 12], newly arising special cultures involving the computer [13, 14]. Gender-specific differences in the approach towards the computer were accentuated just as much as those of age and generation.‖ Younger people are usually more open to technical novelties than older people and male adolescents approach this new technology in a playful manner. The central aspect was always how society would manage to control these new developments. Pessimism about civilization with respect to the computer has often been expressed in Germany, suggesting that individuals and society are being thoroughly shaped by this technology. Postmann [20] uses the concept "technopoly" to describe this in popular scientific terms, conjuring up the picture of a society no longer sufficiently capable of acting *vis-à-vis* technical developments. Thus leaving individuals to rely on informal learning channels and not giving them sufficient support. For an information society based on knowledge this is a contradiction. Computer instruction at school was intended initially to introduce children and those in their teens to its use to ensure social implementation of the computer in all spheres of life and work. In reality this is not how modernization takes place. The industrial modern age—as Beck explains—produces other, unplanned processes which have their own acceleration and their own dynamics. There is a tendency according to Beck ([21], p. 65) for "social structure to shift into the informal and unopen". Individualization here also means breaking away of familiar relations in every-day life. Informalization in the sense of education requires greater self-responsibility as far as the choice of educational content and educational process is concerned.

HANDLING COMPUTERS, A MATTER TO BE LEARNED INSIDE OR OUTSIDE SCHOOL

From the traditional point of view, of modernization, school has the role of ensuring the social modernization process [22–25]. Against this background one must see the discussions on computers and

†In the english speaking region the term 'cyber' has apparently established itself more firmly, to which a corresponding controversy also exists (cf. [6]).

‡The structure producing effect of technical projects is the general theme of the reader by [9].

§The fact that attention is paid mainly to functional use, so that individuals functionalize themselves even in their leisure time, is one of the consequences of unregulated computer education.

¶cf. diverse contributions in [10], especially by Herzberg, in "Kinder, Technik und Natur", Eschenauer in "Computer zum spielen und lernen für Kinder im Vorschulalter".

‖cf. [15–19].

learning conducted in the early eighties, which argued for the necessity of school system education in information technology. See [26, 27] as representative examples. When the German Länder decided to institutionalize computer-oriented learning, the weight of public discussion shifted in favor of a curricular realization, toward transforming this learning matter into an everyday school activity. Since 1989 there has been "basic education in information technology" (ITG) as a new subject of instruction, integrated into the school routine in accordance with Land-specific principles.† In 1984 the Federal Government and Länder Commission for Educational Planning [28] had already decided in principle to introduce instruction in information technology (ITG) at schools. This decision was by no means the result of undivided consent. It was argued against ITG that it is not the task of the school to innovate but rather to pass on traditional and general education. Looking back there were thus endless controversies, critiques and warnings about premature implementation of a new and additional subject of instruction. By contrast, supporters stressed the outstanding role of computer competency as a new, additional, fourth cultural technique supplementing reading, writing and arithmetic. Some authors, e.g. [29] (p. 2), consider the new cultural technique possibly even more important than reading: "It appears likely that the computer will soon be more important in our educational process than schools, and, indeed, may entirely replace the book medium for many purposes".

Organization of learning for the computer

These controversial judgments indicate that the point at issue is not only the handling of modern information technology. It is dynamization of the store of knowledge and the diversity of possible forms of utilization; one must choose from the diversity on offer and master information technology in practice. As far as the former aspect of social control is concerned, Postmann [20] thinks the growing spread of information technology increases the glut of information, which damages social culture. The damage is caused by "information without meaning, by information which we have forgotten how to control" [20] (p. 78). The repacking of information into new media also means production of information-scrap [30]. This development tends to lead to an overburdening of individuals. It is not the lack of information which proves to be problematic, but the strategic utilization of offers. The diversity and freedom of information is thus confronted with the question of which control mechanisms are needed to help in ordering, bundling, channeling and weighting the indeterminable, open offer. Social institutions such as the school fulfill such functions. If such control mechanisms are lacking due to progressive informalization, there is a need for other, noninstitutional initiatives.

Controversies over the relevant matter and places for learning about the computer are about mastering computer technology. The concept of mastery will be differentiated in two respects, (a) mastery and (b) operation. While operation involves abilities to deal with software and equipment, mastery emphasizes one's reflected and strategic relation to the technology. The difference lies in the extent to which the computer is used strategically as a means. One must locate the contexts: both the context provided by the computer itself and the context to which the use relates. This presupposes knowledge about equipment and software. What does that mean? The seemingly universal tool presupposes applicational relations or produces such relations itself. However the meaningfulness of a computer application only comes about through the "suitable" practical relation. The application must be related to a purpose. This is more or less the essence of many critiques [31] which ascribe a negative effect or additional intended or unplanned side-effects to the use of computers.‡

Mastery-definitions of purposes presuppose clear contexts of use. One must first define a clear relation between means and use. Up to now the particular purpose of a special machine, e.g. the threading lathe, was given by the construction and thus fixed. Today one must cope productively with the diversity of possibilities through clear definitions of purposes. One must identify the contexts included in the software. Just as game-players know that a computer game can only realize only one game idea and consequently they procure various realizations of games by collecting, it is clear that professional electronic spreadsheets are for performing calculations, etc. The history of software development can also be seen as an attempt to expand the contexts and minimize the restrictions of the programs; they do not

†A "driver's license for computers" was demanded analogously for the world of electronics. The purpose was not to provide an additional qualification certificate but to secure the way into the modern world of information through education.

‡This is made irrefutably clear by data protection (as politically anchored protection of personality) and by technically provided data security. The certainty that computers realize the purposes assigned to them is in inverse ratio to their spread.

become ineffective. Today's word processing programs are infinitely more comfortable than their predecessors. It used to be possible to write footnotes with only three lines at the most; shifting and copying text fragments and formatting texts was awkward, texts and tables were different worlds. Nevertheless writing has changed: with the typewriter the text was just written; at the computer it is produced.

However, if someone cannot set their own purpose, the purpose is set elsewhere. The user must learn what purposes there are, what contexts are included. Only in this way can the functional technical possibilities be related to a social framework, and only then do programs make sense.† This is fraught with consequences for instruction in using computers organized via the school system. A large part of the operational or functional knowledge to be applied relates to programs which do not exist yet, at the school or at all, e.g. since they concern future fields of work. However, systematically evaluative use cannot take place in anticipation; such learning fields are thus beyond school system organization. What the school can do is to sensitize pupils to the relevance of contexts.

Operation-handling of computers is habituated doing. Just as typing presupposes the keyboard of the typewriter, the handling of programs can only be practiced and learned by actual use, by applying the commands and realizing them on the keyboard. And because these trainable abilities are coupled to practical handling, ITG at school must remain fragmentary in its attempt to impart comprehensive knowledge about hardware and software. The dynamization of knowledge about software means that the school cannot anticipate which vocational contexts and which types of programs will actually be applicable in the pupils' "real-life situation". Computer knowledge thus necessitates an informalization of education since, unlike general knowledge, it is more or less unsuitable for being imparted at school. This will be shown for computer competencies.

Reorganization of learning for and with the computer

Unlike scholastically organized programs, informal education focuses on individual learning orientations and acquisition strategies. However, it relates not only to the acquisition of abilities for using and operating computer technology, but undergoes forward projection when the computer becomes an aid in other learning processes. What was said about the effects for dealing with hardware and software can readily be rediscovered here. Computers change learning processes and thus the learning matter itself. Although seemingly free from particular contexts, the particular contextual link is unmistakable. What this means can be shown by learning programs, since they are intended to change learning processes by permitting an individual learning speed, one's own planning of learning progress, reinforcement and practice as needed rather than by time-table as in school. In idealizing fashion the new form of learning is termed knowledge-oriented in contrast with certifying training within the institutional learning process. Learning is supposed to be more individual, more situation-oriented and altogether more efficient and cheaper. But even if the computer is incorporated only partly into the knowledge-imparting process, one becomes aware of the intervening and shaping effect of this electronic medium. Due to these effects the integration of the computer into everyday school life proves to be more complicated than often expected. It involves new influences that are not always sufficiently controllable and which have a crucial effect on the teaching situation. In the unfavorable case, learning programs are an inappropriate substitute for explaining and reflecting on relations, effectively presenting them only by way of simulation as an interplay of action quantities.

DYNAMIZATION OF THE STORE OF KNOWLEDGE AND INFORMALIZATION

Computer technology stimulates novel socialization processes which are based more strictly on individualization and situation-oriented learning and thus ultimately create room for social differentiation.

More than other social variables, computer technology is characterized by the dynamization of the store of knowledge it carries, as indicated by the shorter half life of this knowledge and the de-differentiation of spheres of life. Information is handled, updated, extended and abandoned within ever

†The operation of a statistics program does not spare one having to know the rules of statistics and their importance in a sociological evaluation, a translation and word processing program does not replace a knowledge of grammar and the rules of spelling, but these software aids do in fact appear useful in pursuing such purposes.

shorter times. The effects of the de-differentiation in society arising with computerization are noticeable, for instance, in the greater interlacing of spheres of life which were previously far more clearly separated: the world of work, places of education and continued education, leisure time and family.† It is readily seen to be clear that such processes of de-differentiation of spheres of life and the related revaluations in social and cultural orientations have considerable consequences for a society's institutional education.

- There is a tendency for the separation between information and knowledge to be blurred. Computer technology is hypostatized, which is indicated by confusion of the ability to handle and procure information with knowledge itself. Access to information by information technologies is occasionally attributed the function of replacing knowledge itself.
- On the other hand it cannot be ignored that the handling of the new information media has strongly changed everyday actions. Computer- and fax-assisted correspondence, electronic play, the search for facts from databases, visibly show a redefinition for everyday actions, making it clear that electronic media technologies are likely to lead to different, socially binding interpretation patterns also with respect to the socially relevant store of knowledge.

School can not in any case prepare for extensive social innovations since its task is to pass on the traditional store of knowledge. In the case of the computer there is the additional special feature, not least due to its dynamics and the diversity of applications, that the relevant knowledge is necessarily acquired outside school. Informal education thus serves the social change wanted by society. This should be made clear by the concepts of "formal" and "informal"; they relate to an organizational point of view?‡ for structuring social learning processes. In English one delimits "formal education" from other educational processes, "non-formal out-of-school education", to describe the different degrees of organizedness of learning [33] (p. 98), [34]. Media offers for the impartment of knowledge are associated with "non-formal" or "informal education". Lenhart [35] summarizes these concepts.

1. Formal education refers to the institution of school, including the entire state education system.
2. Nonformal education substitutes, accompanies or supplements formal education. One speaks of complementary nonformal education when complementary matter is imparted, of supplementary education when "school education is added to at a later time", being extended by "new knowledge and abilities". Substitutive nonformal education replaces formal education [35] (p. 2). As far as nonformal education is concerned, it refers according to Coombs *et al.* [34] (p. 27) to "any organized educational activity outside the formal system—whether conducted independently or as an important part of broader educational activity—which is directed to identifiable target groups and serves the attainment of certain learning aims" (according to translation in Lenhart [35] (p. 2).
3. Informal education is thus not only a small, insignificant residual category, as Lenhart also explains, but involves little "specified educational interactions" which ultimately take on very different forms since they are shaped essentially by the cultural framing of society and its processes of modernization. Translating the relation discussed by Lenhart for the Third World, one can say that this is a more individual perspective of educational processes.

In the past 10 years there has been an unmistakable spread of processes in favor of informalization not only for education. Trends in favor of informalization also include numerous other spheres of life, e.g. youth services, social networks.§ Informal cooperation and organization patterns increase society's innovative ability, just as informal education increases the capacity to adapt to the new technology in favor of rapid social diffusion.

School does not provide better qualifications and informal education poorer ones, or vice versa. Instead the particular qualifications imparted are structured differently and of a different nature. Learning channels and learning matter are interrelated. Those who familiarize themselves with the computer through peers fiddle around, grope for solutions by trial and error, invest a lot of time, hope for social

†An indication of this is the commonness of computers in private households and the additional occupation with new technologies outside work that it signifies.

‡cf. also [32] (pp. 217–249).

§cf. Liebel, who looks at informalization in youth services [36] (p. 305). The occasions for informal group formation are numerous, ranging with the prolongation of the youth phase and the extension of informal networks {cf. [37] (p. 282), [38] (p. 38)}, to the greater room for action that can only be filled informally.

recognition, etc. At the same time this manner of acquisition excludes reflection about the social importance of the computer since such situations are dominated by use (in the sense of play).

COMPUTER COMPETENCIES AND WAYS TO COMPUTER KNOWLEDGE

This section deals with the means of access to relevant knowledge, i.e. where and in what way can knowledge for use of the computer is acquired. Following Spada and Mandl [39] (p. 2), one can distinguish three areas of knowledge: knowledge about states of affairs (knowing that ...), knowledge about actions (knowing how ...) and, finally, knowledge about planning and controlling actions (meta-knowledge). These forms of knowledge are organized in the memory and represented by further processes of knowledge acquisition, application of knowledge, and change of knowledge. The main issue is how individuals acquire new knowledge, seek, absorb and assimilate information, for which purpose new knowledge must be balanced with foreknowledge. Access to knowledge, i.e. the places and channels of knowledge acquisition, are at the same time the assumed but necessary precondition.

Since the cognitive turn in psychology, the reorientation process in the seventies away from the behaviorist perspective toward one that recognizes an active individual, the acquisition of knowledge has been regarded as an active process. Knowledge and learning, which strict behaviorists identified as behavioral change (regarding learning success as changed behavior), is seen in terms of cognitive psychology as the result of an purposefully controlled process in the network of information between individuals and their cultural and material milieu. The use of functional commands on the computer, since it involves habituating doing, is reminiscent of schemes of learning by practice, but this explanatory model does not capture the essence. Now the central problem: knowledge and the ways knowledge is imparted.

Knowledge about the computer is losing its exclusivity and becoming common property. Luckmann would presumably refer to this process of entry into daily life as "the small coin of cultural activity".† To see the concept of knowledge utilized here more vividly one need merely visualize the material, social, personal and temporal relations. While the temporal dimension makes it possible to describe how long knowledge is used, the material dimension serves to typify knowledge in terms of its specific applicational or contextual relation, and the social and personal dimensions to represent social and individual relevance.‡

Computer competencies as a special case of knowledge

Computer knowledge is useful in limited contexts in formal and temporal respects; it is tied to the use of certain equipment and software. Unlike scholastic knowledge, it is not classificatory and valid on a long-term basis. Knowledge valid on a long-term basis is more open and thus not predetermined in time or in content for a specific purpose; it is applicable in different contexts. The lesser knowledge is tied to context the more general it is, and a scholastic impartment of knowledge can be organized accordingly. On the other hand, the narrower the contexts are to which the competencies to be acquired relate, the more specific such knowledge is and the less suitable for scholastic impartment.

With the rise of the personal computer the new concept of computer literacy was introduced into both the public and the expert discussion a good 10 years ago. Computer literacy was to enable people to make use of computers and selected information systems and to be acquainted with "the fundamental structure of software and hardware systems and the use and effects of data processing" [41] (p. 29). Instead of computer literacy we wish to start out from a concept of computer competencies. The advantage is that it takes account of different contexts and provides a systematizing framework for describing computer knowledge as (1) basics, (2) functional knowledge, (3) combinatorial knowledge, and (4) social aspects.

Basics. The elements of knowledge we refer to as "basics" relate to general knowledge about the interplay of keyboard, memory and arithmetic unit as well as screen and printer. Some general knowledge independent of special applications is necessary for some fundamental working logics and relations, even through computer use normally presupposes less and less foreknowledge. One needs to know about the

†Luckmann uses this concept to outline the process by which previously specialized knowledge enters into everyday life [40] (p. 34).

‡For example, a word processing program: a change of version indicates the end of its temporal validity. The contextual link is established by its use for writing; the social dimension is outlined by the learning process for mastering the program.

functional units making up a computer, and about the communication between these units and interlinks, as reflected in a mastery of relevant terms such as "input", "output", "program", "programming language", "file", "bit", "byte", "periphery", "capacity", "operating system", "drive", "main memory" etc.

Functional knowledge. Functional knowledge is directed to the command language for operating software to realize special tasks. For this purpose one needs a grasp of the options made available on the software side. Since the computer and the software which makes it flexible always permit far more performance than one actually intends, or is able, to utilize, the crucial matter is not so much to know all detailed functions but to master the functions that facilitate the regular performance of work. The point is to have an insight into the way the programs work and to be able to operate a computer as a user. In the ideal case this ability takes the form of habituated doing—comparable to using a typewriter.

Combinatorial knowledge. "Combinatorial knowledge" involves estimating the possibilities of applying software in relation to a task by way of comparison. Expert and vocational competency is thus crucial for the performance of tasks, in order to arrive at coordinated and thus suitable computer solutions on this basis. One therefore requires a grasp of the computer aids offered on the market, which one must evaluate systematically in relation to performance of the task. Combinatorics involves opening up new applications, for which purpose one must find proper solutions among the various types of software. Examples for these requirements can be found among the branch-specific software.† Now working with networks has asserted itself, today access to completely new and manifold combinations is possible. Writing, laying out, information research, electronic transmission, nowadays all this is possible simultaneously, even in offices that are technically not too well equipped. As a result the requirements for an analysis of problems and the requirements needed to judge the adequate means by which the computer turns into the respectively convenient tool are growing.

Social aspects. Whenever modernization and technological developments can be understood only as a new requirement, and not at the same time as an expression of a social development, dysfunctionalities become apparent—skepticism, rejection, fear, etc. Put in different terms, an active, innovative and competent utilization of new technologies presupposes that individuals can relate to them not merely as technical, but as socially conceived processes of development. Today the point is not so much the "acceptance" of computer technology, as was intended by the initiators of ITG at schools. It is much more important to avoid a hypostatization of the computer. Yet the euphoria which arose from the spreading of computer technology undoubtedly entices a mystification of the computer.‡ Only then can a social orientation come about, and the technical state of affairs thus be transformed into its personal importance. The following knowledge is helpful for this purpose, e.g. the history and development of data processing systems; the effects of data processing on society and the individual, and opportunities, benefits and risks of its use.

Ways to computer competency

Information and learning offers must be comprehensive and dynamic, in accordance with the dynamics of the software and hardware offers and the diversity of possible applications.

To examine the interplay of computer competencies and acquisition channels we have conducted a secondary analysis of information and learning offers for the computer, distinguishing between (a) organized or institutional, e.g. ITG at school, adult education courses, educational offers from private agencies, companies, youth services, etc., and (b) media offers, e.g. CBT learning programs, computer magazines and books, radio and television (Fig. 1).

It can be shown that the channels for acquiring knowledge have corresponding specific contents. Elements of knowledge with a high need for up-to-dateness must be transported in corresponding ways—magazines, disks, mailboxes, etc. The imparting of more lasting abilities relating to basics and the estimation of social consequences can also be imparted effectively through the school. Conversely, "functional knowledge" must be acquired outside school.

†Fitters can be interested, e.g. in performing heat consumption measurements, balancing the intended installation of heating systems with heat consumption, in stock taking and in reordering conduit fittings.

‡Only on this basis it is possible to understand the enormous outlet of CD-based products. Sold and bought as being multimedial, they are actually nothing more than encyclopedias and dictionaries, equipped with a few illustrations and little sound, but with regard to information research they are not offering a new quality.

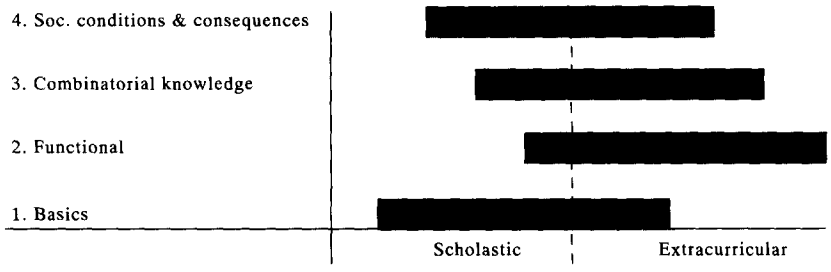

Fig. 1. Form of knowledge in accordance with degree of scholastic

SELECTED FINDINGS FROM THE ANALYSIS OF INFORMAL INFORMATION AND LEARNING OFFERINGS FOR THE COMPUTER

In the course of our studies on informal educational offerings concerning the computer we collected primary data, e.g. on computer magazines, radio and television broadcasts; we also conducted secondary analyses and numerous expert talks with teachers, with representatives from youth services and from large companies, and with producers of learning programs and of computer-related radio and television programs. Altogether we thus made an attempt to collect and evaluate information on a poorly structured and heterogeneous field. Figure 2 provides some first results. One can see at least some first indications of the nature of out-of-school information offers concerning the computer.

(a) Computer courses at adult education centers are characterized not only by relatively low tuition but also by a wide assortment of different courses directed to a growing circle of interested persons. They impart basic knowledge and how to deal with special programs (functional knowledge), and additionally address specific groups of learners (high-school dropouts, women, etc.). Our evaluation indicates that women and men attend such courses with equal frequency. As for the age of participants, young adults rather than youths more frequently take up this offer of adult education courses, which are similar to school instruction. White-collar workers are the educationally more active occupational group at computer courses, as they are otherwise, whereby persons with higher education also clearly dominate.

(b) One can hardly paint a uniform picture of associations and private agencies as suppliers of computer knowledge. Although we also evaluated documents from this area, particularly the offer in youth services are extremely disparate. Since 1982 there have been a great number of job- and school-accompanying projects in youth services as well as leisure-oriented offers. The target groups and subject matter of these offers in youth services vary within a wide range. Although projects for age groups from 10 on and younger exist, offerins for 17- and 18-year-olds dominate. Access to the computer comes about mainly through games, graphics, music and videos. This corresponds to the contexts to be assumed and established for recreation and youth services. Some competencies which we can count as basics are generally acquired in these ways. Furthermore, functional knowledge for the particular type of application is acquired. Relatively often corresponding reports also mention social competencies, which corresponds to the self-image of youth services. Associations and private agencies are the classical suppliers of informal education.

In youth services the "creative" type of access to the computer dominates. The primary theme here is to reduce initial fears that might exist toward the new technologies. In a way youth services has thus overcome the more skeptical attitude that association-linked youth services used to have toward information and communication technologies in the eighties. It thus initially offered many "critical" computer courses, replacing them later by concepts for dealing creatively with the computer, which also taught practical handling. However, these offers are not directly comparable with those from continued and advanced training institutes. Many youths have certainly had their first contacts with the new technology through youth services, and used these offers intensively [42].

(c) CBT (Computer based training): knowledge is not programmable, i.e. it cannot be pressed into yes–no logic. The offerins of CBT software mainly involves aids for developing or forming operative skills in dealing with the computer. Summing up after a survey of the CBT offer available in 1991, the presentation of knowledge in this medium is generally oriented toward commercial rather than didactic matters.

	INSTITUTIONAL OFFER AREAS			MEDIA OFFER AREAS		
	FORMAL OFFERS	INFORMAL OFFERS				
	ITG at school	Adult education	Organized educational offers (here in youth work)	Computer literature	CBT	Radio and television
Concepts	Decision by Fed.Gov.-Länder Comission and Land-specific realization	Regionally organized instruction offers	Socially aware handling of new technologies	Commercially oriented and entertainingly presented information	Commercially oriented range of products	current, open information offers and school-accompanying broadcasts
Offer structures	Partly as separate instruction offer from grade nine on	about 10% of total course offer	Dependent on individual youth *center and concepts followed there*	Oriented toward equipment and *software*	Focal points: - Languages - *Handling of* computer Job-oriented	General knowledge on social conditions and *consequences*
Subject matter	mainly basics, social conditions and consequences of computer use	Basics, functional knowledge	Functional knowledge on graphics and sound, social sensitization	Combinatorial applications and functional knowledge	Computer use, functional knowledge on application software	Social aspects, technical foundations
Utilization	Age groups 15 to 18	25- to 35-year-olds	17- to 22-year-olds (mainly)	Readership wide (male), mainly young	School pupils, merchants, computer fans	Various weightings, now often school-accompanying

Fig. 2. Survey of institutional and media offer areas examined.

There now exists a broad learning opportunity, also in the form of the new electronic media. The computer thus not only takes its toll in the form of additional learning requirements for competent handling of this device; it also opens up new and additional learning channels. The electronic help is no longer based solely on behaviorist learning theories in the sense of operant conditioning; more elaborate products explicitly aim at cognitive broadening. Against the background of new technical developments the learning programs on the computer can take on a more elaborate form. Learning matter supposedly easy to translate into an electronic form was soon also available in the form of disks. This is indicated by the boom in vocabulary trainers on disks, on CD-ROM or in the network. There are a great number of them, but at first they were meager in scope when directed to the general (school) public with little buying power. When one takes a look at professional products it is completely different. For example products conceived for continued in-company training are generally well structured and do not share the weaknesses of cheap products, which sometimes only deserve to be called learning programs because of their form.† Large software companies will presumably enter the market in this product area increasingly with learning and reference works. Undoubtedly there is much movement in this area and the old drill- and practice-programs hardly exist any more.‡

(d) Computer magazines and books focus on imparting operative knowledge (cf. [44, 45]). Computer books are not simply specialized books on a new field, but manuals or instructions for use. A manual serves to provide information about ways of handling equipment and software. Since these helps are tied to existing hardware and software which are constantly being updated, they are of limited validity not only in their content but also in time.

It is to be assumed that computer magazines, like other periodical publications for special interests, e.g. hobbies, satisfy a need for information that corresponds to the specific object (here, the computer) and the related interests. On the other hand, one can detect special features due to the computer's novelty, its limited spread and because it is not yet completely integrated into daily life. The setting and reception of thematic and cultural trends, attempts to tie a typical regular readership to the periodical publication, are features that also characterize other magazines. Computer magazines used to be specialized journals for computer users. With the generalization of computer technology a new type of popular periodical initially arose, although it was still oriented more or less closely toward a special type of hardware and software. With the spread of the new technologies these magazines have given up their strictly technical orientation and integrated new themes. The more the computer becomes common property, the more the computer magazine turns into a new type of popular magazine (possibly already in form of CD-ROM) that reports not only on the application of the electronic helpers, but on all border areas of the new technologies, pointing out potential future applications and discussing the computer in society, for the handicapped, ecology, etc. as well as vocation and career or art.

(e) Radio and television used to focus in their broadcasts on reducing initial fears about the new technology. Beyond this, current program offers provide material for computer freaks. With the institutionalization of basic education in ITG at schools, the program elements directed to a general introduction to the computer are undergoing an analogous formalization; they are being successively integrated into the educational television offer. That is, there are now programs supporting ITG, just as there is a television offer for other combinations of subjects complementing and accompanying school instruction.

Radio and television have particular importance in providing information about new media and new technologies. For the onset of the computerization wave one can detect diverse activities in this area, which were designed partly as entertainment and partly as deliberate instruction. On the basis of our poll of communicators the following picture can be sketched for television. There were both broadcasts intended to anchor the computer, more precisely the PC, as a phenomenon of everyday life in a playful form, and special programs directed to 'fiddlers and freaks'.

The information obtained by this analysis indicates how public broadcasting companies contributed

†Nowadays all PC-users are familiar with professionally styled learning-programs. Most of theses electronic helpers, which are delivered along with the program are actually helpful, what could hardly be said of them 5 years ago.

‡These learning programs are thus not comparable either with the simple, programmed instructions of the sixties and seventies or with earlier offers within the framework of computerized teaching (cf. also [43]).

relatively early with their information and entertainment offer both to imparting systematic content about computer technology and to promoting the social acceptance of computers. Broadcasting companies have unquestionably provided important support for dealing with new technologies: special software programs not available commercially at the onset of the home computer and PC wave were made accessible. Supplying program listings that, once copied, yielded functioning programs was for a long time a special service offered mainly by broadcasting companies (and by magazines). The "philosophy" of "doing for knowing" was occasionally pursued. The BBC and Bavarian television provided help for constructing simple computers. The aim was to make it possible to acquire a cheap computer. The do-it-yourself idea was also intended to impart an insight into the logic and structure of computer architectures. A further thematic strand relates to the social importance of the new technologies. This refers not only to information about new technical developments but above all to problems and links involved in social adaptation to the technology. Subject areas such as computer freaks, industrial reorganization and education were touched on here.

The following trend may be detected. As computer technology progressively enters daily life, computer-oriented broadcasts do not disappear but they are pushed to the fringe of program planning. Instead, broadcasts explicitly conceived as educational and instructional programs are progressively given a permanent place. The majority of these programs are designed to support basic education on information technology at school. Computer broadcasts are thus increasingly intended to accompany the scholastic impartmenting of knowledge and correspond to the pattern of educational broadcasts.

RESULTS

We have talked about computer knowledge and ways to this knowledge. It was shown that both functional knowledge and combinatorial competencies must necessarily be imparted to a large extent outside the school. Figure 3 gives the focal points for the four areas of competency distinguished by us are associated with the organized and media offers of computer information examined by us.

However, the acquisition channels shown do not involve only ways of access to knowledge, but also styles of acquisition and of an individual's procurement of information.

Which conclusions can be drawn from this analysis of informal learning processes? At first glance the necessary abilities seem to be available from formal educational offerings; the handling of computers works. However, it is well known—and is stressed again and again by numerous critics [20, 31]—that not everything that works technically need be efficient. The greater flexibility involved in informal procurement of knowledge and learning processes, and thus the stronger motivational relation to one's interests through the individually controlled learning speed, choice of the place of learning and matter to be learned, etc., certainly speaks in favor of an informal pattern of social modernization. Compensation is provided for the chaotic disorder resulting from the commercial purpose of software production. The efforts of informal coping are thus directed to dealing with the available—albeit occasionally deficient—products from the computer world. The rapid development of this market not only generates a constant demand for learning to cope with new products. On the side it also leads to a high obsolence of the already acquired knowledge of computer handling. Since the usefulness of programs can only be assessed by practical application, after purchase, a great deal of energy and time will foreseeably be expended on pointless, incomplete, wrong and faulty programs. The resources additionally mobilized by informal education presumably also go against familiar social relations, leisure time, etc. as indicated by the broad market of computer literature with an estimated annual turnover of half a billion German marks in the German-speaking region.

Many of the social improvements once promised, e.g. simpler and easier work together with greater freedom due to the time saved, have been rejected in reality as being outdated. Easier access to information does exist today, being already organized to a large part by computer, but this cannot be confused either with a saving of effort or with an increase in knowledge. What is lacking is reflection about what knowledge for computerized society is. It is certainly helpful to look at the ways to this knowledge. Along with changes in the social structure, when it becomes unstructured and individualized, new risks arise in modern society, which are consequential for the individual and social orientation.†

†Such situations are well-known from holidaytrips: one tries to find the way in a foreign surrounding and has to realize that a number of familiar orientation resources, i.e. city signs, signs of direction, language, means of communication, are not reliable.

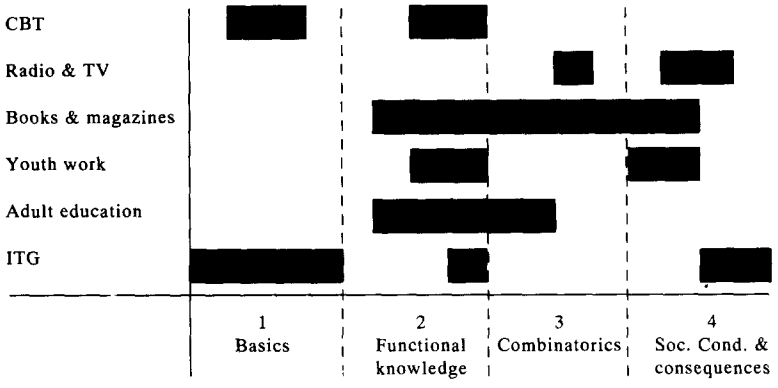

Fig. 3. Focal points of impartment of knowledge

Things we are accustomed to do not work out, instead it is necessary to do groundwork based on ones own impetus.

The breaking away of familiar structures necessarily brings turbulence. (The same can be said of the rise of new structures.) The computer world is an example. Here it is also necessary to take completely new learning steps. Yet at the same time one is confronted with a more general development.

Whenever dealing with a rapid social change, the influence of formal education abates—today, for example, demonstrated by the computer. For this the sociology of catastrophe provides a vast amount of evidence. The chaos of learning computer programs reminds us persistently of a wide insecurity of intentions and consequences of action. Clear rules and regulations do not exist or they are useless in the respective situation. This means a smaller relevancy of the universally available action repertoire to the disadvantage of handling methods which have to be developed by self-initiative. In any case, in such situations, the individual initiative becomes more important.

Along with the progressive cession of biographically as well as socially meaningful educational contents to the disposition and selfinitiative of individuals comes an individualization, i.e. a progressive selfresponsibility for the development of computer-competence. Individual motivations, attitudes, learning strategies, behavior, etc. thus determine the choice of educational contents, educational process and educational success.

An actual acquisition of the technology, with an examination of its importance for individual, organized and social purposes, does not come about efficiently, as evidenced by the increasingly circulating computer myths [31]. They also give an idea of how important it is to deal with the latent secondary consequences of a dynamics of modernization which is gaining a life of its own [21], and must first be focused on at all, since it is informalized and individualized.

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