The influence of workflow systems on team learning

Offenbeek, Marjolein A.G. van

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Marjolein. A.G. van Offenbeek,
Faculty of Management and Organisation,
University of Groningen
P.O. Box 800, 9700 AV Groningen,
The Netherlands

Abstract

The question is raised what influence a team's use of a workflow system will have on team learning. In office environments where the work is organised in semi-autonomous teams that are responsible for whole processes, workflow systems are being implemented to effectively and efficiently realise the control and co-ordination of the work over different stages. By changing the rules and resources of a team workflow applications will have an effect on team learning. This influence is thought to be substantial, because by monitoring and manipulating work information, workflow systems offer support for the integration of entire work processes instead of separate activities. From a theoretical perspective it is analysed how five workflow functions can enable as well as constrain different processes of team learning, dependent on the choices being made during the selection, development, implementation and use of a system. Especially, routing, actor assignment and procedure management may implicitly enforce many norms and values. This is expected to constrain cognitive learning processes. For the behaviourally oriented learning processes either enabling or constraining influences are expected to result depending on the authorisation rights. The theoretical assessment in this paper forms the starting point for empirical research and offers practitioners points for reflection.

1. Introduction

In this paper the effects that work flow systems may have on team learning will be analysed from a theoretical perspective. This question has been triggered by the trends in today's organisations towards teamwork coupled with the ever increasing use of information and communication technology.

In a rapidly changing and differentiated environment, a flexible work organisation that is capable of collectively learning is deemed to be desirable (Argyris and Schön, 1996). The dynamics and complexity of the contemporary organisational context is highlighted by various developments, such as the shorter life-cycle of products, the globalisation of the market, the call for certification, strategic alliances, rapid technological developments, more demanding clients. In order to realise such a work organisation, we see an increase in teamwork in companies (Osterman, 1994), which is directed towards the stimulation of innovative capacity and quality consciousness (Anderson and West, 1996; Lambert and Peppard, 1993). One of the expected yields of organising the work in task-oriented teams is stimulation of collective learning.

At the same time, information and communication technologies (ICT) are being applied in the primary process: tasks have been automated, information is being generated and made accessible and communication is receiving more and more support. In the last decade, the various ICT applications are becoming more and more integrated (Scott Morton, 1991). The ICT developments facilitate some of the changes in the work organisation that are considered to be desirable, such as those involving a larger flexibility and shorter lines. In an organisation in which work is organised in terms of processes (instead of functional lines) and teams, ICT applications should enable the control and co-ordination of dependent elements. In addition, the possibilities of ICT for the empowerment of the staff and the stimulation of learning processes are emphasised in the literature (e.g. Davenport and Short, 1990; Rockart and Short, 1989). Team learning is understood in this paper as the processes by means of which a team creates knowledge and work routines that lead to adjustment and development of working behaviour (section 2).

Workflow systems are one kind of systems that are being used to integrate(automated and human) activities. However, it is unclear whether they are also fit for the empowerment of staff and the stimulation of learning processes. A workflow system refers to an automated system that supports the management of workflows by means of a number of the following functionality's: work routing; monitoring and controlling of the work; informing the actors; the allocation of activities and the authorisation of actors; procedure management (Joosten, Ausserns, Duitshof, Huffmeijer, Mulder, 1994). They are being used, ever-increasingly, in office environments in the financial and insurance world, (semi-)governmental instances and so forth. When the work is organised in more or less autonomous teams that are responsible for whole processes (in stead of a work organisation built around functional lines), workflow systems are being implemented to effectively and efficiently realise the control and co-ordination of the work of those teams over different stages.

The influence of these workflow systems on team learning could be substantial, because by monitoring and manipulating work information, workflow systems offer support for the integration of entire work processes instead of separate activities. Peppard and Rowland (1995) state that eventually workflow management may become the backbone of many computer networks. After having thus set the stage, it is time to return to the central question: In which ways may the learning processes of a team be influenced by the usage of a workflow system? The objective is to produce a theoretical assessment of the possible influences different workflow functionality's may have on team learning.

The goal of this assessment is twofold. First, it can be used as a sensitising framework in empirical research to study the actual influence of work flow systems in specific situations. Second, it may help practitioners in their thinking about criteria and guidelines for the development and use of workflow management applications.

Story line of the paper

Studies on the influence of technology on the work organisation in general have pointed out that an implemented system will allow certain behaviour and will make other behaviour impossible, but that the influence of an ICT system will not be a priori determined (soft determinism). Consequently, the precise way in which a WFS influences team learning depends on the choices being made during the selection, development, implementation and appropriation of the system. Nevertheless, following the logic of soft-determinism, by comparing the characteristics of workflow systems with the requirements for team learning we can infer which influences may occur and which are quite unlikely to occur. After having presented our conception of team learning as a process, in section 3 the possible influences of a WFS are analysed. To illustrate this analysis, in section 4, three typical but different examples of WFS-use are put forward that would be expected to lead to different effects on learning. Section 5 contains concluding statements.

2. Theory

The link between technology and structure

Not much work has been published yet on the link between automated systems in general and collective learning (scarce examples are Daft and Huber, 1987; Argyris, 1993; Bolland, Te'en and Tenkasi,1994). From all kinds of approaches, however, much research has been carried out into the link between technology and structure. The results invariably indicate that the effect of technology is not deterministic (e.g. Child, 1988; Sproull and Goodman, 1990; Smeds, 1990; Heming, 1992) The same technology can produce different effects, depending on the institutional context (Scott, 1990; Whittington, 1992) and the social construction by the actors (Weick, 1990). In other words, the issue involves the interpretations and the choices that are made in the selection, development and use of the technology. However, when management is not aware of the organisational and social consequences of IT architecture and applications, that is exercises no human agency, the existing properties of the work organisation are magnified. This is called the 'booster' effect (Roe, 1989): existing patterns seem only to be breached when design criteria are very explicitly taken into account in the choices.

On the one hand, a part of the social structure is established in the WFS during the selection and development, so that an implemented system allows certain team behaviour and makes other behaviour impossible. On the other hand, a certain amount of room for free choice is always available for a team, in the way in which and the degree to which one makes use of a system (e.g. Barley, 1986), leading to a different effect on learning. Ultimately, a team can even initiate an adaptation of the physical features of the application, or stop using it at all. Following Orlikowsky (1992) the structural properties that become embedded in a system consist of the rules and resources that human agents draw on in their everyday interaction. These rules and resources mediate human action, while at the same time they are reaffirmed through being used by human actors (Giddens, 1984). For this reason, one should examine the links between the physical features of the workflow system, the social structure within which the team functions and the way in which the team makes use of the workflow system. Both the social and the physical aspects represent interesting individually areas of research, studying the intersection of these forms of reality will be more important (Sproull and Goodman, 1990). However, for this moment, only the physical features of a WFS and the influence these may have on team learning are analysed. The influence is inferred from the kind of rules (interpretative schemes, norms) and resources that these features provide a team with. In section 4 examples can be found of the reciprocal relation between the social structure and the technical system (Weick, 1990; Van der Meer and Roodink, 1991). The theoretical assessment in section 3 is worthwhile as it can direct further empirical studies into the relations described above.

Team learning

The term 'team learning' is used to refer to the processes by means of which a team creates knowledge and work routines that lead to adjustment or development in the range of a team's potential behaviors (cf. Dodgson, 1993; Huber, 1991; Kasl, Marsick and Dechant, 1997). According to this definition team learning occurs consciously. Adjustment can be understood as a change in team behaviour that reinforces existing rules and resources. Development can be seen as changing rules (norms, values, insights) and resources and thereby as a change of structure as well as team behaviour. Accordingly, in this definition team learning is realised by the thoughts and actions of individuals, in conjunction with their interaction. Team learning is collective when norms, values, insights, rules and/or procedures change at team level, and the behavioural repertoire of the team alters.

Various approaches to the concept of collective learning are taken in the literature (see overviews of Fiol and Lyles, 1985; Daft and Huber, 1987; Dodgson, 1993; Huysman, 1996). Modern information processing approaches incorporate both systems-structural and interpretative perspectives (Huber, 1991; Dillen and Romme, **1993;** Huysman, 1996).

From an interpretative standpoint, Weick and Westley (1996) argue that organisational learning is an oxymoron. In their view the act of repunctuating continuous experience is what is meant by learning; that is a change in intersubjective meanings. Such a change mixes together order and disorder. Collective learning asks for sufficient order to sustain a learning entity (e.g. a team) and sufficient disorder to generate doubt and curiosity, to mobilise forgotten material and new alternatives. Thus the likelihood of learning drops quickly when routines, rules, order embedded in information and communication systems overwhelm capacities for unjustified variation (disorder). Therefore, workflow applications that enlarge capacities for retention and identity may facilitate team learning, but only if they do not juxtapose too much order. From this perspective learning consists of three interacting processes: investigating activities, assigning meaning and undertaking action (Daft and Weick, 1984; Weick and Meader, 1993). From a systems-structural perspective the acquisition, distribution, storage and retrieval of information are important (Daft and Huber, 1987): the logistic processes of collective learning.

Using grounded theory method in a series of case studies Kasl, Marsick and Dechant (1997) found five processes of team learning (table 1). Two of these processes are behavioural; Crossing boundaries and Experimenting. In crossing boundaries Huber’s acquiring and distributing information can be recognised. The other three; Framing, Reframing, and Integrating perspectives, are cognitive in nature. These can be seen as forms of Huber’s information interpretation process of learning.

In all processes elements of the mixing of order and disorder can be recognised. For example ‘Integrating perspectives’ will contribute in going from disorder to more order within the team. While ‘Crossing boundaries’ will help in introducing the necessary disorder and questioning existing order. Thus, the five processes fall within the realm of the given definition of team learning, and are empirically relevant. Therefore, they will be used in section 3 to evaluate the possible influences of workflow systems on team learning.

Huber’s fourth learning process ‘storage and retrieval of information’ is not represented in the processes of Kasl et al.. Obviously, the latter view storage and retrieval as a condition for team-learning, rather than a process. Their condition ‘Operating principles’ encompasses amongst others how well a team has established a set of commonly held beliefs, values, purpose, and structure. Nevertheless, in this analysis storage and retrieval will be included, as it is a) an important element in the mixing of order and disorder and b) a significant part of Huber’s concept of team learning. The team has to store what it is learning in a retrievable manner, otherwise it will constrain their future or ongoing learning as a team.

Table 1: Team learning processes (Kasl et al., 1997).

Learning process	*Definition*
Framing (cognitive)	Framing the team’s initial perception of an issue, situation, person, or object based on past under-standing and present input.
Reframing (cognitive)	Reframing is the process of transforming that perception into a new understanding or frame.
Integrating perspectives (cognitive)	Team members synthesise their divergent views such that apparent conflicts are resolved through dialectical thinking, not compromise or majority rule.
Crossing boundaries (behavioural)	Individuals seek or give information, views, and ideas through interaction with other individuals or units. Boundaries can be physical, mental, or organisational.
Experimenting (behavioural)	Team action is taken to test hypotheses or moves, or to discover and assess impact.
Storing and retrieving information (behavioural)	The processes by which the team stores information and knowledge for future use, as reflected in their operating principles.

3. Framework for assessment

In this section the possible influences of workflow systems will be assessed. A team will use one or more of the WF-functionality's that were described in the introduction. For each combination of a workflow functionality and a team learning process or set of activities it will be argued what possible influences could be expected. It can be said that team learning will be structured by the WF system as far as the actors draw on a) the resources and b) the rules (norms and interpretative schemas) that are embedded within the system (section 2). Thus, the influence a workflow function can have on a team learning process, can be determined by asking the following two questions:

a) Does the WF function offers the team rules that enable/constrain this learning process?

b) Does the WF function offers the team resources that enable/constrain this learning process?

For each workflow function (section 1) the results of this exercise are shown in table 2 and will be discussed below.

Routing refers to the functionality that determines or suggests which tasks should be executed and in which order. It means that workflow systems can transport information objects like images, documents, files automatically between applications on different locations (Joosten et al., 1994). When the system provides for the team members a transparent picture of the route pursued and the decision-making rules at the basis of this, this function can help in reflecting upon the route pursued. That is the process of **framing** is enabled. In case the system would also offer alternative routing possibilities and the corresponding rules for decision-making this enables **retrieval of information** and could stimulate **reframing** to a certain extent.

In some other ways routing may constrain team learning processes. Due to much of the planning being taken over by the system, the team members may less actively monitor whether the work process is progressing satisfactorily. They rely on the routing, trust the rules of the system and pay less attention to the whole. Moreover, routing reduces the necessary interaction between team members and others regarding work distribution Thus**, crossing boundaries** may be constrained by the routing functionality. Next, the suggested and/or prescribed routing can make team members blind to other routing possibilities which would deserve preference in all or certain cases. With other words **reframing** may be constrained by the routing functionality. Routing may also restrain **experimenting** with other routes. Fixed routing prevents the team from pursuing another route when they imagine that, or wish to examine whether, it may lead to better results.

Monitoring and control functions provide information about the workflow. Monitoring refers to statistical information, which enables (managerial) actors to use quantitative information to adapt the workflow. Tracking refers to a query on the current status of a specific workflow, which enables a team to give instant answers to e.g. customers about the status of work (Joosten et al., 1994).

When team members themselves receive or can request more monitoring information than before in a comprehensible form, this can help in tracing and analyzing bottlenecks etceteras, that is in **framing and reframing**. When the team members can track the status of their own workflow and one another's tasks, this provides a rapid (mutual) feedback possibility. Meaning that **crossing of boundaries** is enabled.

At the same time team members can be anxious about **experimenting** with their work routines, when management is watching them via the monitoring information, or even via the possibility they have of directly asking questions about which task a team member is currently performing, what speed this person is working with, etceteras. When the electronic management of work and work information replaces direct contact, there is talk of a lower media richness (Daft and Huber, 1987), which may constrain learning processes that rely most heavily on sensemaking, that is **integrating perspectives and reframing**.

Notification refers to the system notifying team members or other workflow servers of tasks and deadlines (email, fax, to-do-list) (Joosten, 1994). When team members think that they can handle the notifications competently , this can increase insight into the present work and thus stimulate **framing**. If team members are forced to adhere to the 'things-to-do list' and to comply with deadlines, and cannot themselves employ any priorities, this will impede **experimenting**. Usage flexibility is low. Also, such a situation reduces the need for individual thinking and team interaction about working routines which may constrain **reframing,** and even the initial **framing** in the first place. Notification means resources for **storage and retrieval** of information about the workload.

Actor assignment is the function of assigning activities to people in a flexible way (Joosten et al., 1994). With the authorization function the access to actor assignment and modification rights of individuals, groups and roles can be defined.

On the one hand, much authorization for modification offers team members the resources to change norms and procedures concerning distribution of the workload, that is enables **experimenting**. On the other hand, when the team is not authorized to do so, a constraining effect will be expected. In the same way rigid access rights can frustrate team members in obtaining information about one another's tasks or about other teams, which reduces (electronic) feedback possibilities. In contrast, full access rights enable team members to engage in **crossing boundaries**. With automatic actor assignment, there will be less need for work consultation. If this results in less personal contact as a team, it will constrain the team in engaging in **framing, reframing** and **integrating perspectives**.

Procedure management refers to means for (re)defining workflow steps, the sequence of these steps, the routing along certain steps and conditions containing the rules on which the route is determined (Joosten et al., 1994).

When this function offers the team itself resources to (re)define steps, sequence of steps etceteras, this will increase the possibility of establishing and spreading new collective work routines. If not, **experimenting** will be constrained. However, only a high transparency of this functionality and usage flexibility will enable experiments. The usage flexibility will be determined by the number of adjustable parameters. Modeling tools can also enable experimenting on paper. The meta-model underlying such a tool will offer rules that enable the initial **framing** of the workflow by team members, but can constrain **reframing** in which these rules would be altered. The function offers an authorized team resources **to store and retrieve** procedures and thereby knowledge.

Table 2: Potential influences of workflow functions upon team learning processes.

	Framing	Reframing	Experimenting	Crossing Boundaries	Integrating Perspectives	Storage and retrieval
Routing	+	+ or -	-, if fixed	-	0	+
Monitoring & control	0	-	-	+	-	+
Notification	- or +	-	-	0	0	+
Authorization	0	0	+ or -	+ or not	0	+
Actor assignment	-	-	0	0	0-	+
Procedure Managemnt	+	-	+	0	0	+

0 = no influence + = enabling influence - = constraining influence expected

It can be concluded that a workflow system can have a substantial influence on team learning processes. The direction of this influence will depend on the choice and design of work flow functionality's. That does not mean that the use of a workflow system makes no difference. In contrast, following the logic of the booster-effect (section 2) a considerable effect can be expected, only the direction is dependent on conscious or unconscious choices.

For developmental learning, where norms and values (rules) are being questioned, the effects may more often be detrimental. Especially, routing, actor assignment and, procedure management functionality's may implicitly enforce many norms and values. This will constrain the cognitive processes, especially integrating of perspectives and reframing. For the behavioral processes, experimenting and crossing boundaries, enabling as well as constraining influences can result depending on the authorization rights. The table reflects our belief that the effects are to a large extent dependent on the specific set of workflow functionality's and the way in which they are used. In the remainder of this paper it will be illustrated a) how the direction of this influence can vary, and b) how some detrimental effects of work flow systems might be compensated for.

4. Three examples

The three following stories are in no way exhaustive. They are stereotype examples of workflow automation that are merely meant to assist the reader in forming a better image of the issue in question: how different workflow systems might have different effects on team learning dependent on the choices being made. In order to select diverging examples two contrasting metaphors for information systems (Gazendam, 1993) were used: the mill and the cell. The first example pictures a WFS that has many characteristics of the 'mill metaphor', in the second one the WFS shows resemblance with the 'cell metaphor'. The third one combines elements of the 'mill' at the individual level of system use with elements of the 'cell' at team level. In this last example efficiency gains that were realised through the use of the 'mill' were translated in time for extra activities that may enable team learning.

WFS and learning: a 'mill' example

A mill processes large volumes of material in an efficient, precise, reliable and rapid manner. The design philosophy is to formulate the most efficient algorithm to flow work through the organisation and generate an appropriate reaction for each event.

In a department where insurance is issued to customers, and also administered and updated, there were serious problems with the growth of the paper archives. For this reason, a workflow system, combined with a digital imaging system (scanned, electronic instead of paper documents) was implemented. In this case, the work lines are not particularly complex. Various teams in the department now operate using the same work processes. This uniformity at departmental level can impede the implementation of improvements at team level. The users have no possibilities to choose among alternative paths. At the one hand, an enabling element for collective learning could be that staff becomes more aware of their tasks in the organisation as a whole. On the other hand, for the management, the possibilities for monitoring and controlling have increased and this has not been appreciated by the staff. This can lead to even less freedom for experiments, the avoidance of risks and a reduced feeling of responsibility among the personnel. The new possibilities of the software as such can stimulate a further improvement of the processes. But as this 'one design for all' gets expanded and refined, this will increasingly restrict substantial change possibilities. A system manager has been appointed, who can compile new processes, but only as long as these are constructed out of existing activities. The staff members can only be allocated to defined roles and groups. Up until now, the improvements in the tool itself suggested by teams have not been implemented by the supplier of the application. Here, learning is hindered not by the technical system itself but by the activities of others that prevent them from changing the system according to their insights that resulted from working with the system (see section 2, the reciprocal relation between social reality and technical system).

WFS and learning: a 'cell' example

A cell is the smallest part of an organism that is able to exist by itself, can multiply itself and has a limited lifetime; it can communicate by sending and receiving streams of material. It's design philosophy is to support flexible, client oriented working methods, to allow for competition between systems, and to accommodate regular changes in business processes.

An organisation consists of several research groups and a group that provides supporting services. In many of these services, the staff data are very important. When changes occur in the organisation and/or the personnel structure, various supporting services have to be set in motion. In this organisation, the choice has been made not to have the work controlled automatically by the system, but to rely upon individual responsibilities and the normal mutual social control exercised by the staff members. The feeling of responsibility among the staff has increased, because the progress of the process is, in fact, automatically registered and is visible to all. Managers cannot inspect data at the individual staff member level, but can nevertheless see these at the individual work stream level. These choices can encourage collective learning. Communication about the work in progress is not automated but takes place rather informally. The integration of the work has increased. The system transgresses the demarcation lines between the groups. For this reason, the communication between the groups takes place much more quickly than previously, leading to more informal communication, which, in turn can also stimulate collective learning. This is a case of iteratively developed customisation, which is much more flexible than the (then available) standard tools. Complaints have been accurately redressed up until now. Intensive user participation in the project has produced many ideas for further peripheral applications. The WFS is developed and grown by using it, incorporating information in it, and adapting it to the users, while both WFS and users are subjected to the organisation. Learning can take place within the boundaries of this wider system. This indicates that not only the design criteria but also the development strategy can have an effect upon collective learning.

WFS and learning: a mixed example

Clients (20.000 to 30.000) who apply for social welfare are served by the 300 people working within this department. The work history of the client determines the allowance. This work history can be very complex - it often sums up to six pages of information. The work organisation is divided into teams of 15 persons. First, a dossier of a client gets archived centrally, then it is deposed in the teams electronic box with cases. The system has no algorithm to distribute the cases (the workload) between the individual team members. The moment a member starts to work on a case, it is his/hers.

The workflow-system can be seen as a co-ordinating and controlling system, a layer above the existing transaction processing system. The WFS determines the routes to be followed, but the team members perform the prescribed activities themselves. With the information in the case a team member follows the steps of the decision path. The WFS controls the time for each activity. A built in timer warns the worker twice when he takes too much time. If the worker does not react to the warning, a warning signal is given to a higher hierarchical level. Within one's own worklist, a member is free to determine the work order, but he has to stay within the prescribed time limits. We would expect that such a WFS does not stimulate team learning.

However, some other characteristics of this case may benefit team learning. It was legitimate to temporarily leave the WFS in order to be able to handle all kinds of exceptional cases for which the WFS offered no support. Furthermore, because of the existence of the WFS the worker can give more attention to the individual client and his specific situation. The time saved and the full case handling, allow the worker to call the client personally and invite him to his office. First the workers only gathered written information. This may stimulate a team member to conceive of possible innovations in the work process. Also, a tool was offered to simulate work processes, thereby enabling the team during special work meetings to better analyse their processes and the effect of alterations. Team members can discuss their ideas and wishes with a process manager. This manager can implement incremental innovations in the work process and in the WFS as well. So the users themselves are responsible for the incremental development of the WFS.

Still, the trend towards 'full-case handling' by a staff member, decreases the interaction that is needed on a daily basis between team members. Full case handling can stimulate individual learning, but there is no reason to assume that this alone creates better conditions for collective learning.

The first 'mill' example shows many aspects that may constrain team learning processes. This is not a necessary feature of workflow applications. The second 'cell' example shows that WFS can also be designed, implemented and used in a way enables team learning more than it constrains it. The third example shows the importance of analysing the impact of the WFS in the wider context of the team's work structure and climate. Here, because of the nature of the work (highly repetitive cases) the efficiency that the 'mill' metaphor offers is highly desirable. At the same time, the case shows that disabling learning properties of the 'mill' may be compensated for in other ways. Determining the net effect, however, would ask for a contextual and longitudinal analysis of the team's learning.

5. Concluding remarks

The table and examples presented show that on a conceptual level there are important links between WFS usage and team learning, and that the link is dependent on the context in which WFS is applied, on the functionality's provided, and on the design and usage of these functions. This is why is it advisable to arrive at specific design criteria and development guidelines for this type of automated systems. Thus far, this diagnosis offers practitioners nothing more that points for reflection when they want to apply automated workflow systems in their organisation. To arrive at valid criteria and guidelines, it is important to complement the theoretical line of argument in this paper with the concrete experiences of teams that work with a WFS and the analysis of variety among them. Especially the instances (table 1) for which constraining as well as enabling influences can be expected deserve further attention. To this end, multiple teams within more organisations have to be investigated. Within a structurationist framework quantitative and qualitative methods of data-gathering and longitudinal analysis can be employed. On the one hand, a quantitative analysis can be performed of the correlation between the degree of team learning and the properties and the appropriation of the workflow system (outcome oriented analysis). On the other hand, a qualitative analysis can be made based on the subjective experiences the teams have during learning processes considering the enabling and/or constraining influences issuing from using the workflow system (process oriented analysis).

Besides workflow systems, there is a more general need for design criteria and development guidelines from a learning perspective. Nowadays, in service, trade and industry, ERP packages (such as the German SAP and the Dutch TRITON) are being used world-wide to an ever-increasing extent. Their modular or for some part even component based structure and the parametering provide great flexibility in application, but only to a certain extent. Such a technical-administrative approach may be leading to knowledge of 'organising' being increasingly systemised and homogenised. The trend towards the development of generally applicable business reference models for certain branches of industry is a clear example. This trend may be harmful for the mixing of order and disorder that learning asks for. Therefore, it is necessary that organisational scientists formulate explicit diagnostic and design criteria as a counterweight.

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