Changing Tools, Changing Attitudes: Effects of introducing a CSCL system to promote learning at work

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Abstract

The use of computer-supported collaborative learning (CSCL) tools to manage and support learning at work offers a lot of advantages, such as the increase in the availability and access to knowledge. However, computer systems also introduce new ways of doing things, which may impact on their acceptability and usage in an organisation. The study considers the issue of re-mediating human activity through the introduction of a CSCL system to support collaborative organisational learning (COL) activities as a way of promoting learning at work. A comparative study into the effects of re-mediating work practices in an organisation was conducted 'before' and 'after' the introduction of a CSCL system using three selected constitutive elements of COL namely: collaboration, knowledge sharing and interactivity. The study used activity theory as a framework for examining the support mechanisms for the selected elements of COL from a social and cultural perspective in terms of how they occur, and how they are supported in context. Findings highlighted the importance of accounting for social and cultural issues relating to the tool user, prior to the introduction of a CSCL system to support learning at work, as these could impact on the usage and acceptability of such a tool.

Keywords

Computer-Supported Collaborative Learning, Collaborative Organisational Learning, Activity Theory, Tool Mediation

1 Introduction

Many organisations have recognised the importance of integrating learning within their work structures and procedures so as to promote collaborative learning at work. The effort to promote learning at work is usually undertaken because of the perceived benefits of sharing knowledge as well as experiences about work amongst employees. However, learning at work tends to already exist naturally within the organisation's work processes. Perhaps the challenge is not about promoting learning at work, but to employ appropriate CSCL tools to enhance and sustain already existing collaborative learning activities for the benefit of the whole organisation (McDermott, 1999). In addition, managing and supporting learning at work can prove to be a very complex endeavour because organisational learning tends to be social and cultural in nature (Argris and Schön, 1996).

This paper discusses findings of an investigation into the effects of re-mediating work practices through the introduction of a CSCL system to support and manage knowledge acquisition and distribution processes. A study was carried out over a period of two years in an organisation that was about to introduce the use of a computer system to support and manage work practices so as to promote collaborative learning at work. Work practices in this organisation were analysed using the activity theory (Nardi, 1996; Leont'ev, 1981) framework in order to establish the impact of re-mediating their support mechanisms. Three constitutive elements of COL namely: collaboration, knowledge sharing and interactivity were identified and selected for focus during the investigation. The study was conducted in two parts. Part one used management's views about work practices in this organisation to analyse the support mechanisms for the three identified elements of COL prior to the introduction of a computer system. This approach was found useful in shaping initial perceptions about the organisation and its operations so as to obtain insights into the means by which pedagogical processes are nurtured in their natural environment. Part two of the study conducted a more detailed and focused investigation of work practices at team level once a computer system had been introduced. This enabled the investigator to obtain a detailed understanding of work practices from people who actually carry out these operations in order to establish how they occur, and how they are supported naturally as well as could be supported through the use of a computer system. Results of this analysis highlighted the importance of accounting for social and cultural issues of the prospective tool user in context prior to the introduction of a CSCL system to support COL. Social, cultural and contextual issues of the user act as vehicles for collaboration, knowledge sharing and interactivity, all of which are vital elements of

learning at work. Hence re-mediating their support mechanism using a CSCL tool could impact on the usage and acceptability of that tool.

The paper begins by introducing collaborative organisational learning or simply organisational learning. (Organisational learning is not necessarily always collaborative. The author has chosen to use the term collaborative organisational learning to emphasise the collaborative aspect of the type of organisational learning that is under discussion). A discussion into the relevance of using a CSCL system to support COL is then presented. Thereafter a brief introduction to activity theory is given together with background information about its origins. This is followed by an outline of the relevance of using activity theory to analyse collaborative organisational learning. The section that follows presents the case study by introducing the organisation used during the investigation. This is followed by part one of the study, which gives an interpretation of the organisation's activity system. Part two analyses the workers' perception of work practices in the organisation. Finally, the two studies are comparatively analysed in terms of the identified elements of COL with results presented in the findings section, which is followed by a conclusion.

2 Collaborative Organisational Learning

Collaborative Organisational Learning (COL) can be described as an activity that occurs mainly in a community of practice (Brown and Duguid, 1991) whereby objects are directly linked to the work activity. It tends to be informal and responsive in nature, whilst drawing from the social and cultural settings of the community in which activity occurs (Argris and Schön, 1996). These social and cultural aspects are exhibited when carrying out activity, and are evident through the mutual bonding that takes place whilst engaging in collective and collaborative activity. Organisational learning is usually informal and unstructured, an aspect that raises the need to address the consequences of formalising this kind of learning through the introduction of a CSCL system. The introduction of such a tool usually transforms human activity, thereby introducing new ways of carrying out duties (Orlikowski, 1992). Changes in the methods for performing work practices do not only affect the work activity being carried out but also transforms the work culture of the subjects involved in carrying out those practices.

2.1 Supporting COL using a CSCL system

The informal and unstructured nature of COL or learning at work makes it difficult to introduce effective mechanisms for managing and supporting this kind of learning. This is mainly due to social, cultural and contextual aspects of organisational learning that are usually obscured in work structures and procedures of the organisation. These social and cultural aspects are usually embedded in conversational practices and relationships that exist within the work culture of the organisation. In order to alleviate this problem, several advocates of learning in organisations have offered different visions and prescriptions about how organisations learn, and also how this learning can be supported and nurtured using various media (Nonaka and Takeuchi, 1995). In addition, more and more organisations are currently employing the use of CSCL systems to support knowledge acquisition and distribution processes as a way of promoting learning at work. This is done in the hope that organisations may be able to unveil tacit knowledge and share it amongst employees, thereby use it for the benefit of the whole organisation. Whilst the use of a CSCL system to support these processes could bring about a lot of advantages in relation to the flexibility in access and increased availability of information, computer systems usually fail to account for social and cultural issues of the user. The success of any knowledge management system heavily relies on the willingness of the end-users to actually use the system in their day to day duties to support collaborations, knowledge sharing, and interactive activities associated with learning at work. These concerns highlight the need to examine work practices in an organisation so as to understand the social and cultural issues that impact on COL in context before embarking on the introduction of a CSCL system to promote learning at work. Activity theory can help to understand these social and cultural issues of the user, by providing a language for describing what people do in context (Nardi, 1996).

3 Activity Theory – A brief introduction

Activity theory is a theoretical framework for analysing human practices in context. Activity or 'what people do' is reflected through actions as people interact with their environment. Therefore, this framework uses activity as the basic unit for studying human practices. Activity theory has its origins in the Vygotskian concept of tool mediation and Leont'ev's notion of activity. Vygotsky (1978) originally introduced the view that human beings' interactions with their environment are not direct ones but are instead mediated through the use of tools and signs. This notion is usually portrayed by

what is commonly known as the *basic mediational model* or simply the *activity triangle model* (see figure 1 below).

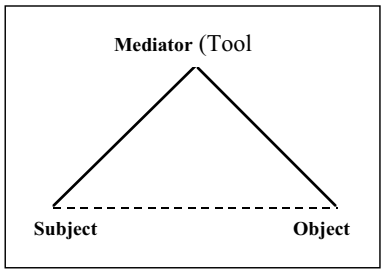

Figure 1. Basic Mediational Model (Vygotsky, 1978).

The model highlights the idea that the relationship between the *Subject* and the *Object* is not direct but instead mediated through the use of a *Tool.* A tool could be something physical, for example a spanner or a computer keyboard; it could also be psychological as in a sign or software application. Physical tools are used to handle or manipulate objects whilst psychological tools can be used to influence behaviour in one way or another. Leont'ev (1981) on the other hand further developed Vygotsky's ideas about the social and cultural mediation of human activity by developing a hierarchical model for analysing human activity. Leont'ev had recognised the importance of human activity in establishing people's understanding of the activity that they are carrying out. Inspired by this thinking, Engeström (1987) extended Vygotsky's original conceptualisation for the mediated relationship between the subject and the object by introducing an expanded version of the activity triangle model so as to incorporate Leont'ev's social and cultural mediational aspects of human activity.

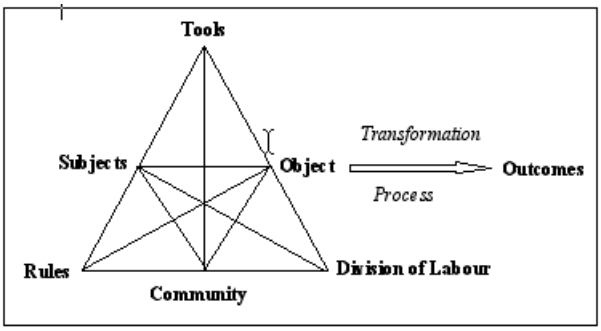

Figure 2. Expanded Activity Triangle Model (Engeström, 1987).

Engeström therefore, offers a general model of human activity in the way of the *expanded activity triangle model* or simply the *activity triangle system*, which reflects the collective and collaborative nature of human activity. The expanded activity triangle model incorporates the *subject*, *object*, *community* and other mediators of human activity, namely *tools, rules* and *division of labour*. Engeström's expanded activity triangle model was used in this study as a heuristic model that captures and unifies concepts from activity theory that are relevant to the analysis of work practices and learning (Mwanza, 2000). The study began by interpreting the various components of Engeström's expanded activity triangle model in terms of the situation being examined. This involved the use of the *Eight-Step-Model* (shown below) that incorporates open-ended questions based on Engeström's expanded activity triangle components so as to identify the: -

1. *Activity* of interest - What sort of activity am I interested in?
2. *Object*-ive of activity - Why is this activity taking place?
3. *Subjects* in this activity - Who is involved in carrying out this activity?
4. *Tools* mediating the activity - By what means are the subjects performing this activity?
5. *Rules* and regulations - Are there any cultural norms, rules and regulations governing the performance of this activity?
6. *Division of labour* - Who is responsible for what, when carrying out this activity and how are the roles organised?
7. *Community* - What is the environment in which this activity is carried out?
8. What is the desired *Outcome* from carrying out this activity?

3.1 Activity Theory and Collaborative Organisational Learning

Several researchers including Engeström (2000) and also Blackler et al (2000) have demonstrated the relevance of applying the activity theory framework to the analysis of work practices and learning in an organisation. Engeström (1987) particularly emphasises the idea of analysing breakdowns or contradictions in the operations and support mechanisms of an activity system. Through his notion of *learning by expanding*, he argues that breakdowns or contradictions are the means by which new understanding or learning comes about. During this study, the identification of contradictions between the natural support mechanisms for work practices and through the use of a computer system was focused on in order to obtain new understanding of the effects of re-mediating the means by which learning activities were supported at work.

The rationale behind the use of this framework to analyse work practices in this organisation draws from the need to investigate the support mechanisms for collaborative learning as continuously developing processes that transform human activity. Activity theory's notion of *tool mediation* was central to this analysis due to its emphasis on the idea that human capacities develop in collaboration with other individuals, by interacting with their environment. This interaction involves the use of tools whose development and usage is influenced by the social and cultural settings of the environment in which activity is carried out (Vygotsky, 1978; Leont'ev, 1981).

4 Case study

The case study introduces the organisation and the two studies conducted during the investigation.

About the Organisation

The organisation used in this study was part of a consortium of three academic institutions and three industrial partners working on the ENRICH project (http://kmi.open.ac.uk/projects/enrich/). The ENRICH project was funded by the European Union under ESPRIT to develop computer tools and methodologies for integrating working and learning within knowledge intensive organisations (Sumner, Domingue and Zdrahal, 1998).

The organisation in question operates in the aerospace industry. It manufactures aeroplanes and body parts for both commercial and military purposes. The company employs thousands of people at its manufacturing sites or what is usually referred to as 'plants' all over the UK. Manufacturing operations at these plants are organised in team structure. Team operations tend to be product oriented with team members working in various areas including engineering and assembling plane body parts, etc. Each team consists of a minimum of fifteen workers. In terms of division of labour, a team usually has a leader who is responsible for directing work operations within a team. The team leader reports to the line leader who in turn reports to the production manager and the hierarchy goes on. In addition to carrying out their normal duties workers were required to continuously reflect on their work practices by holding team planning meetings in order to assess or rate their performances against targets set by management. The key idea behind these team-planning meetings was to encourage workers to evaluate their work practices during the team planning process so as to learn from each other's experiences. Management later introduced the use of a paper based company workbook as tool to guide the team planning process and provide a means for recording team-planning activities.

The company workbook incorporates the team planning sheets and team scoring matrices. The team planning sheet was used for setting new objectives to be satisfied as well as recording decisions made in relation to actions to be taken in order to achieve targeted objectives. The team scoring matrices on the other hand were used to assess whether or not the objective set had been met. This was established by rating and recording scores on each target. During the team planning exercise, a team would normally hold a meeting to measure its performance against any of the targets by indicating the current level of performance, thereafter, to set future targets to be met.

Management's decision to introduce the use of a company workbook to guide the team planning process was an attempt to standardise the performance assessment procedure across all teams in the whole organisation. This standardisation initiated the process of formalising work procedures in this organisation. Management had hoped that formalising work procedures in this way would encourage the sharing of knowledge about work across all teams throughout the organisation. The sharing of knowledge about work took the form of the accumulation of lessons learnt or what was referred to as 'best practices'. These best practices mainly consisted of work experiences of other teams at different plants within the organisation. In the meanwhile, management had also realised the benefits of using a computer system to support the management and nurturing of knowledge sharing activities as a way of

promoting collaborative learning at work. They commissioned the development of a computer system – ENRICH-, as an enhanced and enriched version of the company workbook.

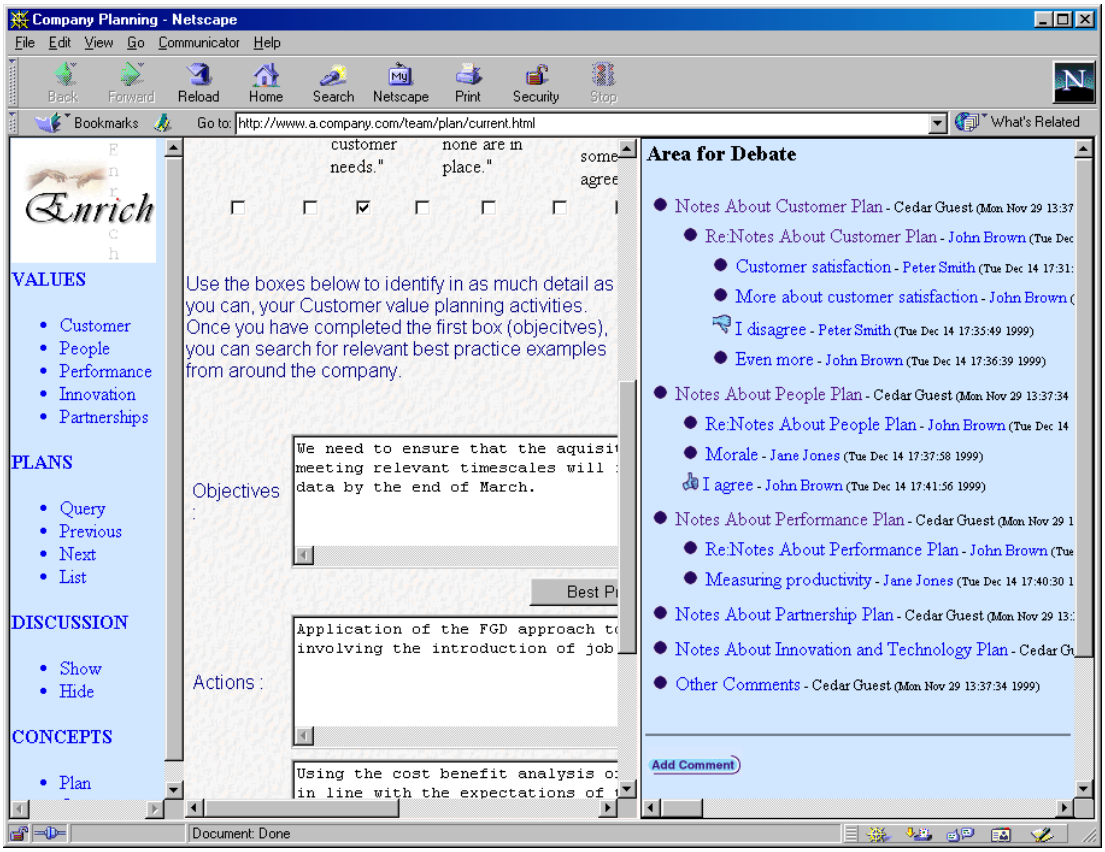

Figure 3: The ENRICH tool

Figure 3 above shows a snapshot of interface features of the ENRICH computer system introduced to support work practices in this organisation. The interface features include a 'discussion space' marked as 'Area for Debate'. Workers were encouraged to conduct their consultations and collaborations online using this discussion space so that these could be captured, stored and consulted by all workers. The discussion space included an option to submit anonymously as a way of encouraging nervous workers to make contributions. The middle part of the tool shows an interactive form based interface to replace the paper based company workbook's team planning sheets for setting new objectives to be met. The form also incorporates scoring matrices for indicating current levels of performance and setting future targets, as well as recording actions to be carried out. The form had a link to a searchable database of 'best practices' for workers to consult and learn from experiences of other workers at other plants within the same organisation. Despite the hierarchical structure of the organisation, management were keen to encourage interactivity across levels of operations. They requested that the computer system be built with links up and down the various levels of operations from top management level right down to team level. Workers at each level including management were required to put content of their work operations and plans online so that all employees can universally access these. Generally, the design and implementation of the ENRICH system was mainly based on the structure of the company workbook and also on information provided by management regarding the operations of this organisation and how these were supported.

4.1 Part One Study - Interpreting the Organisation's Activity System

Using the Eight-Step-Model whilst answering questions in relation to the situation being examined enabled the investigator to acquire some basic understanding about the organisation. Using this approach, it was also possible to decide on what resources would be necessary to analyse during the investigation. The Eight-Step-Model together with the associated open-ended questions were then used as triggers or reminders on what to look for during observational studies, open-ended questionnaires and also during interviews to help in deciding on what questionnaires to ask.

The paper based company workbook acted as the main source of information about the organisation during the initial investigation because it was presented by management as the official version of what happens in this organisation. Nonetheless, the investigator also shadowed several ENRICH project meetings and also obtained information informally through casual discussions with company representatives during coffee breaks and project lunches. This was done to obtain a general understanding of the organisation's work practices and support mechanisms in an informal setting. A review of the organisation's company web site together with other company publicity materials that were already in the public domain e.g. company financial reports, and products promotional magazines was conducted. There were two individuals representing the organisation on the ENRICH project, one of whom kindly agreed to act as the researcher's proxy (Plowman 1996) for the purpose of accessing information that the researcher could not obtain easily due to restrictions from within the organisation. The proxy was also found to be helpful in clarifying and interpreting issues arising from the study so as to transform information gathered into knowledge. Finally a detailed evaluation of the paper based company workbook was conducted since it was the main guiding tool for the co-ordination and execution of collaborative knowledge sharing activities during the team planning process. The information gathered from this investigation was used to produce an activity triangle system of the organisation so as to structure the analysis by outlining the various components and mediators of work activity in this organisation. See Figure 4.

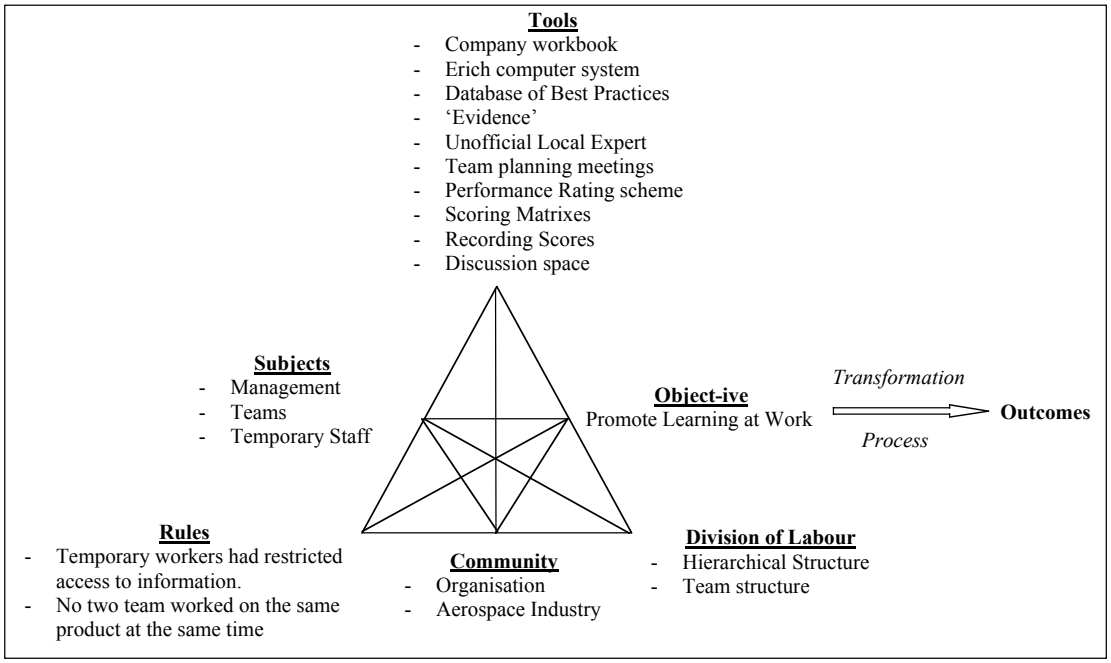

Figure 4. Organisation's Activity System.

4.2 Part Two Study – Analysing the Workers Perspective

The second part of the study was focused on analysing team based work practices in order to obtain detailed information about how these were carried out and also establish their support mechanisms from people who actually carried out these operations. The information gathered from part two investigation was then analysed and compared with the information obtained from part one investigation in relation to the three identified elements of COL. The outcome of this analysis and comparison is presented in the findings section below.

5 Findings

Contrary to the information presented by management about work practices and how they were supported in this organisation, this study reveals the following observations in relation to the three identified elements of COL.

In terms of collaboration, social and cultural practices of workers at team level were not appropriately supported by the computer system, an aspect that affected the usage and acceptability of this tool. For example, team members had developed a local cultural habit of discussing work related problems collaboratively by consulting a local unofficial expert within the team in a face to face arrangement if

the problem was urgent. If the problem were not urgent, they would wait and raise the problem for discussion during the next team meeting. A local unofficial expert in this context usually referred to a fellow worker recognised by others to be more knowledgeable about manufacturing operations in this organisation and also willing to help others once a problem emerged. The kind of collaborations and consultations that normally took place amongst team workers in this organisation were mainly informal and unstructured. The ENRICH computer system tried to emulate this process by introducing a discussion space to support similar discussions and collaborations, so that these could be captured, stored and accessed by all employees in the organisation. This effort resulted into a mis-representation of established local cultural habits of by formalising discussion and collaboration procedures that were normally informal and conducted in confidence. Team members were therefore not keen to use the system because they did not like the idea of discussing online when they could see each other and hold discussions face to face. The fact that the computer permanently captured discussions for future reference also contributed to its lack of usage because workers were worried about exposing their views, as they did not know who else was going to read their contributions outside the team.

Another issue that affected the usage of the ENRICH computer tool in relation to supporting collaborations amongst team workers was the fact that the system's interface mirrored the layout and presentation style of the paper based company workbook. Detailed investigations of team based work practices revealed that workers at team level did not use the paper based company workbook systematically during their team planning process as intended by management. As a matter of fact, some teams did not even use the workbook at all. Teams that used the company workbook used it as a reference manual from which they could generate ideas on how to produce their own team planning strategies. Since ENRICH was developed and implemented based on the company workbook, employees were reluctant to use it because they viewed it as management's way of controlling not only what they did but also how they did it. They argued that, just like the paper based company workbook, the new computer system did not take into consideration local established methods of doing things.

In terms of knowledge sharing, the use of a computer system introduced uncertainties as to who should access what information due the organisation's use of temporary staff. The second investigation discovered that the organisation engaged the services of temporary staff from employment agencies from time to time. Temporary staff had no fixed duration of employment therefore management decided to restrict their access to classified information. Their duties were also heavily monitored and controlled. Even though it was possible to control access to classified information by requiring users to log-in and using passwords, this strategy could not have worked because knowledge sharing tends to succeed where it is inclusive. In this case, workers did not have equal access to resources.

There was also a misrepresentation of team local culture in the way the CSCL system supported knowledge sharing amongst team members. Management's version of how teams shared knowledge in this organisation presented 'best practices' as the main source of knowledge that workers consulted during work practices. The computer system was therefore implemented with a link to a database of best practices so team members could access and refer to them during their team planning process. However, findings from the analysis of team based work practices revealed that teams never consulted these best practices at all. They had instead what they referred to as 'evidence'. The idea of 'evidence' in this context refers to an individual or a document containing facts about how to go about carrying out a particular task. Team members did not find the best practices particularly useful because they did not include the context and process by which these lessons were learnt. The idea of 'evidence' was much preferred because it incorporates the methods and explanations of how the knowledge came about. Workers at team level could easily identify and relate to the notion of 'evidence' because it incorporated local practical ideas that developed from team members' experiences.

In terms of interactivity, management held the view that since all teams worked regularly on similar products this strategy would also facilitate ease of interaction. In contrast, findings of team based work analysis revealed that there were limited or no cross-team interactions when carrying out work practices in this organisation. This was due to the fact that even though teams did work on similar products from time to time, no two teams worked on the same product at the same time.

Finally, regarding management's idea to introduce a hyperlink from the form based interface in the ENRICH system so as to link all levels of operation, team workers were keen to use this feature because they wanted to establish how their activities at team level feeds into management's overall objectives. However, this feature was also under used due to management's failure to put content on their part of the tool.

6 Conclusion

Findings of this study have raised many issues relating to learning at work and how the introduction of a CSCL system can disturb the established social and cultural habits of workers in terms of collaboration, knowledge sharing and interaction patterns. Whilst it is possible to change the work culture of an organisation, by formalising work procedures and support mechanisms, this formalisation cannot enforce a new work culture to be accepted by workers. Many organisations and CSCL system developers usually under play or treat these social and cultural aspects of the user as secondary matters. However, the impact these have on the usage and acceptability of the CSCL tool can be high. The value of using an activity theory approach to analyse work practices lies in the fact that this framework represents such social and cultural issues as part and parcel of the underlying representation. By focusing on the relationships between the tool and work, rather than considering social and cultural issues as additional factors to be taken into account at some point in the future.

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