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Problem Oriented Project Pedagogy

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Designing Virtual Learning Environments based on Problem Oriented Project Pedagogy

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Abstract

This chapter reports on the design and practice of virtual learning environments based on the pedagogical approach of Problem Oriented Project Pedagogy (POPP). Problem Oriented Project Pedagogy is situated within the field of Computer Supported Collaborative Learning and the differences between POPP and the more well-known Problem Based Learning (PBL) is discussed. Furthermore, the chapter presents and discusses the learning theory heritage and the key concepts. The principal aim is to discuss problems and possibilities in design and practice of virtual learning communities based on Problem Oriented Project Pedagogy.

Introduction

Problem Oriented Project Pedagogy (POPP) has been the pedagogical foundation for establishing Aalborg University (1974) and Roskilde University Center (1972) in Denmark. The approach represented a radical change in the teaching and study methods applied at that time. The emphasis shifted from a model based on delivery of information and knowledge towards a critical, experientially based pedagogy favoring learning as knowledge construction through genuine collaboration. In the late 1980s, open education programs and research within the field of virtual learning environments also became based on the POPP-approach.

The POPP-approach offers great potentials in designing and practicing virtual learning environments. It enables genuine collaboration among students; the possibility to work with real-life problems; the possibility to integrate work experiences with theoretical and methodological reflections. However, the approach also face obstacles and problems. The overall objective of this chapter is to introduce and discuss virtual learning environments based on Problem-Oriented Project Pedagogy and to analyze some of the experiences related to this approach.

First, POPP is situated in the context of "Computer Supported Collaborative Learning" (CSCL). Second, the article describes POPP, its didactical principles, the learning theory heritage, and discusses some of the key concepts. Third, the article describes prototype organizations in virtual learning environments, which rely on the pedagogical approach. Finally, the possibilities of enhancing such environments through Information and Communication Technology (ICT) are discussed.

The field of Computer Supported Collaborative Learning

The academic field of Computer Supported Collaborative Learning (CSCL) has emerged during the 1990'ies. The first scientific workshop was held in Acquafredaa di Maratea, Italia resulting in the book, *Computer Supported Collaborative Learning* (O'Malley, 1995). Subsequently, an International Conference has been held every second year (CSCL 95, 97 & 99). In Europe, a research network within the European Science Foundation (ESF) worked with collaborative learning from 1994 – 1998 (see Dillenbourg, 1999, and Dillenbourg, Baker, Blaye and O'Malley (1996). In March 2001, the first Euro-CSCL took place in Maastricht (Euro-CSCL 2001).

The focus of the academic field is information and communication technology within collaborative learning. The overall aim of CSCL is to analyze and design collaborative situations so that active construction of knowledge takes place (Koshmann, 1994). A general understanding of CSCL is that it departs from a view of teaching and learning as a transfer of knowledge. Instead, learning is viewed as a social construction and negotiation process mediated by artifacts between humans. Therefore, theories stressing constructivist, cultural historical and shared cognition approaches to learning have received renewed interest and have been adopted (CSCL'95, '97 & '99). The importance of collaboration between students, and between students and teachers, during the learning process has directed the design perspective from solely focusing on the teacher-student transfer to the design of learning environments that support social construction and collaboration.

Approaches within Computer Supported Collaborative Learning

There are two main approaches within CSCL, which are of importance to the practice of ICT-based POPP. The first approach has its roots in distance education. The other has its roots in institution-based collaborative learning situations. The first approach, which is mainly practiced within *distance education*, focus on the mediated *communication processes* between distance learners and between distance learners and teachers (e.g. Mason and Kaye, 1989; Harasim, 1990; Kaye, 1992). The key concept in distance education is *flexibility* in terms of *where* to study and *when* to study accompanied by *democratic ideals*, such as peoples' rights and opportunities to take part in higher education or continued competence development. In agreement with the basic concept of flexibility, students are offered the opportunity to participate in educational programs from locations of their own choice - typically at home or at work - and at hours that are convenient to them. This flexibility has been radically supported by asynchronous and textual communication, such as computer conferencing systems, bulletin board systems, and more recent Internet services like the World Wide Web and email.

The theoretical arguments for using ICT in learning are related to text-based communication and learning benefits from writing. Based on the notion (Vygotsky, 1978) that detailed written speech requires deliberate semantics to structure the web of meaning, has influenced the design of virtual learning environments (Sorensen, 1997; Mason, 1992). The argument behind the distance learning approach has been that text-based communication offers certain learning advantages compared to face-to-face learning in terms of the externalization and internalization of explicit knowledge as students may read, reflect, write and revise their arguments and comments before they answer questions or share knowledge with each other (Harasim, 1990).

The other approach to CSCL derives from on-campus collaborative learning situations. The role of the computer systems in such situations is not solely aimed at communication but should rather be regarded as a tool for qualifying learning processes through design of systems focusing on mutually dependent activities and task solving among students, for example so-called micro worlds (Schank,

1995). Theoretically, the approach is partly based on the cultural-historical tradition with roots in the work of Vygotsky, (1978), especially the concept of the *zone of proximal development*. The zone of proximal development is "*the distance between the actual development level as determined by independent problem solving and the level of potential developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers*" (Vygotsky, 1978, p. 86). Moreover, the approach stresses the benefits of the mediated nature of learning through artifacts and language, because this may help in the deliberation process of knowledge and in gaining experiences with the scientific principles of a phenomenon. The approach has its point of departure in formal learning processes for children and young people, i.e. school education (Rochelle & Teasley (1989), O'Malley (1989).

ICT-based POPP has its roots in both of the above-mentioned approaches. It shares areas of study with the distance learning approach as it focuses on the design of flexible and distributed learning environments, as well as it shares areas of study with the on-campus approach as it also focuses on collaboration and stresses the benefit of mediated nature of learning through learning technologies. Therefore, Fjuk and Dirckinck-Holmfeld (1999) named the approach Computer Supported distributed Collaborative Learning (CSdCL), stressing the *distributed* nature of the collaborative learning situation.

Furthermore, the approach has also been characterized as a Scandinavian approach to CSCL (Heeren, 1996). This characterization is valid if compared to the Scandinavian approach to participatory design within the scientific community of Computer Supported Co-operative Work (CSCW). Both POPP and Scandinavian participatory design (Ehn, 1989) stress the emancipatory and participatory perspectives of learning.

Problem-Oriented Project Pedagogy

Problem-Oriented Project Pedagogy is thoroughly described in the Danish pedagogical literature (Illeris, 1984; Adolfsen, 1985; Dirckinck-Holmfeld, 1990; Christiansen & Dirckinck-Holmfeld,1995; Olesen & Jensen, 1999) and is therefore only briefly introduced below.

In Denmark, the pedagogical approach traces back to 1970'ies when Aalborg University and Roskilde University Center were established. The universities were established in a period of radical change. University educations were seen as a mean to establish social equality. Moreover, the ideas aimed at increasing the interaction between the private sector, the public sector, and the universities regarding research and education. At the same time, the student movement fought for the idea of universities as platforms for radical, social and scientific critique, and as forays for doing action research together with underprivileged groups and the working class. The pedagogical compromise which unified these strong and partly antagonistic interests became Problem-Oriented Project Pedagogy (POPP). These pedagogical principles were original inspired by the work of Oscar Negt and his work for the German trade unions where he formulated the principles for the educational program as the development of "Sociological imagination and exemplary learning" (Negt, 1977).

To-day Problem-Oriented Project Pedagogy (POPP) can to some extent be compared to problem-based learning (PBL) and case-based learning which both are internationally applied pedagogical approaches. To a certain degree, these approaches build on the same constructivist learning principles as Problem-Oriented Project Pedagogy. However, there is a fundamental difference related to the point of departure for the learning process. PBL takes its point of departure in the solution of a pre-defined task or problem set by the teacher or the textbook (Pettersen, 1997). Therefore, this learning process is more gov-

erning than the POPP-approach, which emphasizes learning as principally ungovernable. We can design for optimal learning environments. However, we cannot control when learning occurs.

Siggaard (2000) who is inspired by the educational philosopher Dewey describes learning as a transformation filled with energy, which takes place in jumps and leaps. A transformation where the learner is moving from the known towards the unknown in a movement, which transforms the unknown, confused situation filled with doubt to a (momentarily) clarified situation. In other words, we are not able to design learning but we can work on the design of optimal learning environments so that genuine learning may take place. As a consequence, POPP includes a series of integrated didactical principles as a basis for the learning environment: problem formulation, enquiry of exemplary problems, participant control, joined projects, interdisciplinary approach, and action learning

Didactical principles

The most important principles are *problem formulation* and *enquiry of exemplary problems* (anomalies). In other words something, which makes the student wonder and makes them want to find an answer. The entire educational process is built up upon the student's enquiry of scientific and social problems and is the focal center of the student's engagement in the learning process. In order to understand the problem and find a solution to the problem, the students have to go through different stages of systematic investigations: preliminary enquiry, problem formulation, theoretical and methodological considerations and investigations, experimentation and reflection.

According to Illeris (1981), *enquiry,* on its own, does not constitute the basis for an active process of acquiring knowledge through critical reflection: *"A problem is not a problem in a psychological sense if the person who has to work with it does not experience it as a problem."* (p. 83, our translation, Fjuk & Dirckinck-Holmfeld, 1999). Therefore, *participant control* is an interrelated principle. When students themselves define and formulate the enquiry, they have a conscious relation of ownership to it, and they experience it as a problem (anomaly), which implicitly encourages involvement and motivation. Participant control and the ownership of the problem setting are therefore seen as fundamental for the students' engagement in the learning process.

Participant control implies that the institution or the teacher cannot fully guide or control the learning process. Problem setting is always a leap in the dark. It is the subsequent theoretical and empirical enquiry that really displays the results of the collaborative learning situation. However, teachers can help promote exemplary problems in relation to an overall evaluation (cognitive, psychodynamic, social/societal and scientific) through negotiations, dialogues and enquiries about the problem area. At university level, this evaluation has to be particularly focused on what is important, interesting and exemplary with respect to the subject area in a balance between historical, present and future considerations and between different theoretical and methodological positions. This enquiry and negotiation between students and teachers set the curriculum.

The success of the pedagogical approach strongly depends on that preliminary negotiation process. If too little effort is put into this phase, the students may focus on surface problems without much relevance for the subject area. Therefore, the preliminary phase of problem setting is very important and must be supported by materials, lectures, preliminary investigations and review of former work in order for students to focus on exemplary and principle problems. As a sort of related tacit knowledge, the POPP-approach supports the development of competencies and skills of interdisciplinary thinking and

problem solving, but also – and very importantly - the competencies to identify essential problems and see problem areas in new ways.

Joint projects and action learning

Another central didactic principle of POPP is collaboration in *joint projects*. The project organization builds on a social-constructivist perspective that underlines the integration of individual construction of knowledge and the students' *mutual responsibility* for creating and conducting a joint project. According to constructivist conceptions of learning, the learner constructs knowledge by assimilating experience to prior knowledge or by accommodating existing knowledge to new experiences (Piaget, 1969; Kolb, 1984). Common understandings among peer-students result from confrontations and negotiations of perspectives and beliefs. This negotiation of perspectives implies inner contradictions viewed as the prerequisite for new learning.

Our experiences show that joint, collaborative projects, where students (on the same intellectual level) are mutually engaged in the problem area and in the enquiry, gain the best results with respect to learning from each other, negotiating the problem area, and establishing synergy in the group (see Dirckinck-Holmfeld, 1990)[1]. Moreover, the joint project work ensures that the learning process is not purely cognitive. In a very informal and unstructured manner, most groups' use a lot of time and energy to discuss broader issues of psychodynamic and social character related to the learning process.

Within open educations, students often make projects in relation to own work practice and they have to implement the acquired learning in their organization. On that basis, project work is a sort of *action learning* that integrate experiences from practice with theoretical and methodological knowledge from the university.

Collaboration, flexibility and students' mutual responsibility for learning

In pedagogical literature and discussion, concepts like collaboration (O'Malley, 1995), flexibility (Andreasen, 1999)**,** and student's "own responsibility for learning" (Bjørgen, 1995) are central concepts. In the following section, I will very briefly point to the ways in which POPP deals with these concepts.

Collaboration

POPP is a *collaborative* pedagogy[2]. Following the didactical principles, the pedagogy requires and supports strong interdependence between the participants in the learning situation. An interdependence that requests that:

- Competent students and teachers guide the less competent. (Cf. the principle of zone for proximal development by Vygotsky (1978)).

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[1] In a study of students practice in a virtual learning environment based on POPP (Dirckinck-Holmfeld, 1990), we studied two different models of working together. That of *genuine collaboration*, where participants really worked together, shared the problem formulation, and were mutual responsible for the project and the outcome, and the "umbrella"-project, where the students were loosely coupled around a problem area, but without sharing the problem formulation and the overall responsibility for the project. The investigation documented, that the collaborative group had radical much more interaction and negotiation with each other on the problem area, than the "umbrella" group, which primarily used the networking possibilities for social interaction.

[2] Cf. the concept of genine collaboration as "pooling of minds" in Salomon (CSCL95).

- Learning takes place through confrontations and negotiations of perspectives and beliefs among peers with the same intellectual capacity. (Cf. the principle of constructing knowledge by Piaget (1969)).
- The group establishes synergy in the learning process so that the participants in the group constellation learn and become more competent than the individual participant would be on their own. (Cf. the principle of person-plus within the tradition of distributed cognition and learning (Perkins, 1993, Salomon, 1993).

Flexibility

POPP is a *flexible* pedagogy. The flexibility relates to the *curriculum.* Together with the teachers, the students define the curriculum, the theories and methods to use in order to make the exemplary enquiry. However, as it is a collaborative pedagogy where the participants are interdependent and have to collaborate, the organization of POPP requires, that time, space and a common ground are established between the participants. Compared to the more traditional arguments for flexible learning, such as just-in-time learning and the flexible study conditions (place, time and learning modules), POPP adds a new interpretation of "flexibility". That is the flexibility regard the participant's deep engagement with the problem to be studied and to the student's participation in the formulation and definition of the enquiry and in setting the curriculum.

Mutual responsibility

In POPP, the learning process is a *mutual responsibility* between the learners and between the learners and the teacher/tutor. Knowledge cannot be transmitted to the learner, and therefore, the individual learner is responsible for his or her own learning. However, because the study is organized as joint projects, the learners have to feel a *mutual responsibility* for each other. They have to make sure that all members of the group progress in their construction of knowledge through their commitment and activities. However, the learners are not the only responsible. The teachers and tutors are responsible for the establishment of a stimulating learning environment and for engaging in social practices with the students. In general, the teachers and tutors are responsible for challenging, facilitating and stimulating the student's progress – both in the project groups and as individuals. We do not use the very popular Scandinavian phrase, "ansvar for egen læring (AFEL)" (responsibility for own learning) (Bjørgen, 1995), but prefer the phrase "gensidig ansvar for egen og fælles læring" (GAFEL) (Mutual responsibility for individual and collaborative learning).

The collaborative learning principles for Problem-Oriented Project Pedagogy, which I will label *genuine collaboration* may be summarized as follows: Participants have a joint project and a shared enterprise, participants are inter-dependent, participants owe and share the enquiry, participants have mutual responsibility for learning, and the collaboration among the participants is a long term process.

Design of Computer Supported distributed Collaborative Learning

The collaborative nature of POPP makes it challenging to adapt it to virtual learning environments. Information and communication technology offers great potential for flexibility in learning in terms of time and space. However, until recently, there has been less potential when it comes to co-ordination which is the heart of collaboration.

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The *first generation* of virtual learning environments was, from a technological view, based on computer conferencing – that is an asynchronous, text-based, written mode of communication and learning. *The second generation* of virtual learning environments is based on web-based communication. Communication is still asynchronous, however, texts are now potentially multi modal and hyper textual. *The third generation*, of which we only see the contours, will much more strongly integrate synchronous communication. And the *fourth generation*, which only exists at research level, will integrate "virtual reality techniques".

The following describes how we have been dealing with the POPP-approach within first- and second-generation virtual learning environments. The next section presents ideas for improving the virtual learning environment with regards to the potentials of third generation tools such as net-meetings and an increased use of multi modal and hyper textual tools.

At Aalborg University the virtual learning environment has been especially developed in relation to the open education activities. More than 15 programs are offered as virtual learning[3]. Many of the programmes focus on informatics, e.g. health informatics, informatics for priests, ICT & learning. However, in other programmes such as Master in Technical Language, information and communication technology is solely a tool for the participants to communicate and collaborate.

The open education programs (offered in Danish) have students from all over Denmark, few students from abroad (Danes working abroad), and some students from the rest of Scandinavia. The students are typically professionals, who take the education simultaneously with full-time work, families, hobbies, etc. Due to the flexibility offered by the virtual learning environment, they are able to participate despite of physical distance to the university as well as they are able to handle the obligations from work and every day life. The open learning programs are organized as part time studies (20 hours a week).

The project based learning environment.

A semester is organized around a *theme*. The themes ensure both the extension of the subject area as well as the focus and depth within the subject area. The themes are often formulated quite openly, however, over time, practice will assist the process of determining which problem areas are core issues and which issues are more peripheral.

Within a semester, there are typically two sets of activities: course work (50%) and project-work (50 %). Within distributed learning environments, both course-work and project-work takes place via a conference system or a web-system supplemented by four to five face-to-face seminars held at the university during a given year.

There is a dialectic relation between courses and project work. Courses introduce and provide an overview of the disciplines or central topics within the theme, while project-work offers the students the possibility of enquiring an exemplary problem. The courses are related to the theme and obligatory and therefore shared by all the students. Through the course work, the students build up common references and some shared academic tools, which they use in the joint project-work. The courses are of basic importance in order for the students to build up a common ground of references, theoretical and methodological for use in the projects. In other words, the courses enable the students to share a scientific context in order to communicate and interact with each other and the teachers.

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[3] The series of educations can be seen at http://www.auc.dk/aaben

The joint projects are made in groups of four to five students on average. In the projects, students work in-depth with a problem area. Here, they struggle with theories and methods related to their problem area which has been presented during the courses. Moreover, students work independently acquiring new theoretical and methodological approaches as well as findings about the problem areas.

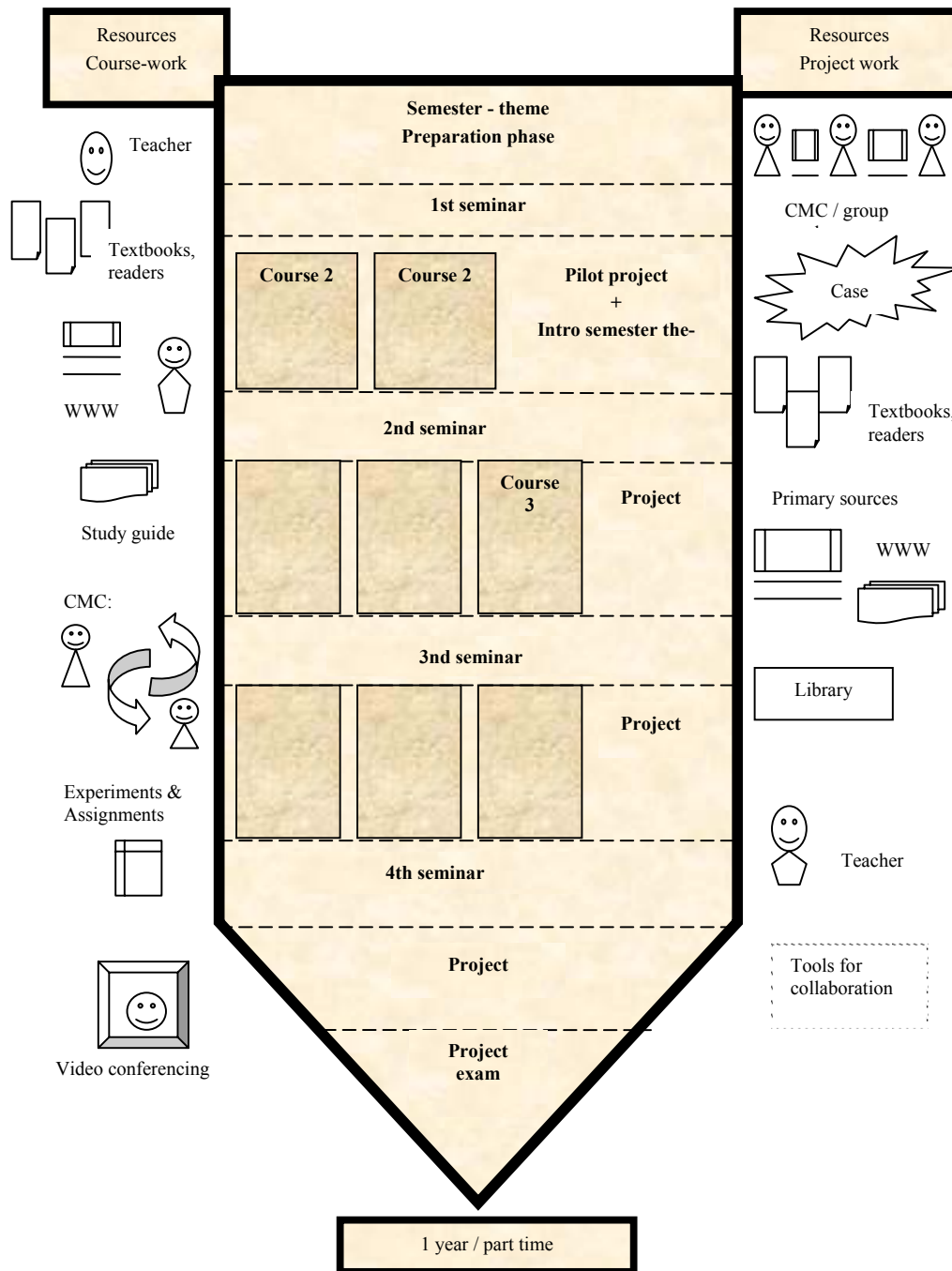The overall organization of the learning environment is shown below (see fig. 1).

Fig. 1. ICT and Problem Oriented Project Pedagogy

As long as POPP has existed, there have been problems with the balance and dialectic between course-work and projects. Teachers seem to favor course-work where they are in control, while students seem to favor projects, where they are in control. Sometimes courses are offered too late for the students to be used in the projects. Other times, the students do not know how to relate the courses to the problem area because they are inexperienced.

Until now, this hurdle has been dealt with as displayed in Figure 1. Course work dominates in the beginning, and project work intensifies towards the end of a semester. In other words, course-work has a more introductory and guiding character for the projects, while the actual work takes place in the projects. Figure 1 lists the resources, which are available in the virtual environment today. The list distinguishes between resources for course-work and for project-work.

Resources for course work

The typical course-work resources are (prioritized):

- The teacher as the organizer – often as a traditional "lecturer"
- The teaching material: textbooks, readers, primary sources, encyclopedias, articles
- A study guide and supporting materials
- Exercises: Fieldwork, assignments, experiments, etc.
- Conference tools, through which the participants may discuss, ask questions and deliver assignments.
- A guest teacher, perhaps participating through video conferencing
- WWW – for search of more information

There are different ways of organizing course-work. When adopting metaphors from on-campus teaching we find the following:

- The *lecture*, where the teacher writes a presentation in the conference system and the students ask questions and participate in a written discourse on the topics.
- The *seminar*, where the teacher is an organizer of a set of activities and experiments for the students and a proactive facilitator of the written discourse in the conference system.
- The *assignment driven course*, where the teacher makes presentations and organize assignments for the students to solve.
- *Case-work*, in which the virtual learning environment is used to get involved in a real case, maybe in other part of the world
- The *study-circle*, where the teacher organize that groups of students or single students present theories for the other students. The students or the teacher facilitate the discussions. The teacher may participate in the academic discourse and stimulate the students to meta-reflect on the study.

It is important to be aware that there are many different ways to organize course-work in the virtual learning environment as well as in the traditional on-campus setting. And there are many opportunities to abandon the more traditional transfer and control approach and to put more emphasis on construction and participation. However, even though we are heading for new potentials in the virtual learning envi-

ronment, it seems that teachers are reproducing their traditional behavior in the virtual learning environment. The teachers who like to give lectures transform their lecture to the virtual environment e.g. as a sort of written lecture, while the teachers who prefer seminars tend to reproduce that behavior. I have used metaphors from the traditional teaching area. However, in line with the fact that we get more and more experiences within the virtual environment, new practices will occur and the above-mentioned metaphors will become too limiting.

Resources for project-work

Project work is often initiated by a pilot project phase in order for the students to acquire the appropriate methods. The pilot project phase is succeeded by the actual project-work. The project work is typically organized in phases: 1. problem-formulation and problem analysis, 2. research, investigations and empirical fieldwork, 3. writing the report, presenting, comparing, discussing theory and empirical findings as well as producing analyses and conclusion, and 4. evaluation and examination. The phases are organized around the face-to-face seminars. The seminars mark shared activities in the transition to a new phase.

Principally, the resources for the project-work are the same as in course-work, however they are prioritized differently. The typical resources for project-work are**:**

- The conference system (communication and collaboration with the other students)
- A case for empirical work
- Textbooks, articles, readers, encyclopedias, books on methodology, theories, www-resources, etc.
- The library
- Friends, colleagues and other resource persons and informants
- Tools for annotating, organizing, writing and analyzing (computer-based and conventional)
- The teacher
- Tools for collaboration – are sparsely used now but will move up-front, when the tools are more widely spread

Compared to course-work, the teacher is further down the hierarchy of prioritizations. Not to say, that the teacher is not important. As guidance he or she is very important – in relation to identifying the core problem (anomaly), to select the case-study, decide on the theories and methods to use, discussing the interpretation and the findings with the students and stimulate meta reflection on the enquiry and the learning process. In Vygotsky (1978) words as the more experienced representative of scientific understandings. However, the students organize the learning process and use a variety of resources besides the teacher to seek information and material, which may assist them in their enquiry process.

The conference system plays a much more crucial role than in most course work[4], since the students must communicate with each other through the conference system in order to coordinate their work, their comprehensions and interpretations, the structure of the project, their uncertainties, etc., and to

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[4] This can be documented by looking at number of messages in a group conference versus a course conference and the number of turns related to the message. Even in virtual learning environments where the course work is based on a seminar model, we will find the same tendency that the project group conferences contain more messages and more interactivity than the courses. (See Dirckinck-Holmfeld, 1990; and http://www.hum.auc.dk/mil (password required))

produce a project together. The asynchronous written communication is regarding certain phases and certain tasks difficult and bring-about extra-work on the students and teachers. Especially coordination and articulation work on the establishment of shared understandings of the problem area may cause extra work (see Fjuk and Dirckinck-Holmfeld, 1999; Bygholm, 2001; Rattlef and Mathiesen, 2001).To overcome some of the shortages of asynchronous communication synchronous work-tools are going to be used much more (see Fig. 1). Until now, there have not been many attempts to explore how these tools influence the students' learning process because the tools have not been used widely. However, we experience a growing need for tools like MERCI and NetMeeting: shared whiteboard, shared audio and video, shared applications and shared desktop in order to support the many types of coordination processes in the joint project-work (see the article of Georgsen and Raudaskoski, 2001). We will, therefore, have to put much more emphasis on what I have labeled the third generation of tools.

WWW-resources are prioritized together with books even though this will change in the near future. Students still turn to books for deeper readings. However, WWW-resources play a more and more important role as a medium for accessing information and texts immediately. Additionally, students and teachers can benefit particularly from browsing the Web in the phase of getting an overview of the problem area. Here, they have direct access to enormous amounts of information and resource banks and, in many cases they have the possibility of downloading the material directly, which means that they can evaluate the text "just-in-time" and immediately share the material with each other.[5] (Jensen, 2000).

Enhancing CSdCL through information and communication technology

There is no doubt that information and communication technology has brought substantial resources to the development of POPP-methods in distance learning. Without such tools it is difficult to practice collaborative learning in geographically dispersed groups– if not impossible. Therefore, information- and communication technology per se opens for new ways of organizing formal education and lifelong learning.

Seen in the perspective of lifelong learning, the independence of "place" has very important implications. Despite of physical distance, ICT may promote the process of *integrating* scientific knowledge and workplace experiences. Through ICT, learners from different parts of a country or different parts of the world are linked together in a structured, virtual learning environment in which they can exploit each other's experiences and competencies as well as establish a dialectic liaison between the experiences of everyday life and the world of theories. Indeed, didactical principles such as Problem-Oriented Project Pedagogy offer a basis for the participant's opportunity to confront experiences within a reflective and theoretical context.

When it comes to the ways in which ICT may enhance POPP, there are many challenges and possibilities. Now, the technology is so robust and advanced that many new forms of collaborative practice can occur. ICT is no longer only compensating for the loss of face-to-face possibilities but is providing new

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[5] A common critique of Internet resources is that the students get an overload of information. This may be true if the students have not learned how to use the Internet resources. However, if the students have the right links to academic sites, they can get a much broader and substantial overview of the problem than before, when they were only using traditional library resources. When only depending on library resources, the students often faced the problem that the central books and journals were taken by others or were only available within another library. Through virtual libraries the students can access the information "just-in-time" and from everywhere, which is of great importance within distance learning programmes.

tools (third generation distance learning tools), which enhance the prospects of collaboration – even though the participants are dispersed.

The tools may help to solve the POPP-conflict between course-work and project-work through more elaborated understandings of resources for project-work. Instead of using relatively many teaching resources on lecturing, more emphasis can be put on the development of self-instructional course components. This will support and to some extent take over the presentation of a subject area[6]. The result may be that teaching resources can be moved from *presentation and instruction* to *discussion* a discipline. This discussion may then be linked directly to the project work. As described by Tolsby's (2001) article on teacher portfolios in this volume, the Web will, moreover, make it easier for teachers to share course components. Course components may therefore establish flexibility about when a course is available.

The fundamental advantages of ICT-based POPP are the *permanence, retrievability and the accumulation of "materialized" explicit knowledge* as well as the *flexibility* regarding time. As Harasim (1990) and Sorensen (1997) have stressed, text-based communication and collaboration require deliberate semantics to structure the web of meaning. As such, the text-based communication mode may help both the reflection and the externalization phases of the learning process. In addition, the permanent nature and retrievability may furthermore promote the development of a more transparent learning community (Lave & Wenger, 1991; Dirckinck-Holmfeld & Sorensen, 1999) where the newcomers can learn from the old timers – in fact by imitating the work of others. It is easy "to browse" into another project group and to follow the progression, get new ideas and so on. Discussions on relevant topics are stored; prototypical assignments are available, and projects worked out by other students are easily stored in a library. In that respect, ICT may help the process of designing a transparent learning environment where the students more easily can learn from each other, from older students and from the practice of the teachers and researchers.

Furthermore, other activities which rely on the use of all human senses may to some extent also be supported by semi-virtual activities, such as digital photos and sounds, e.g. photos of the experience of being in a rain-forest or of the waste-disposal-system in a neighborhood. Having to document experiences may in fact strengthen the sensitivity related to the sensory appearance.

Nevertheless, even though the ICT-tools add to the virtual process of POPP, they do not render superfluous the need for "face-to face" work. Synergetic dialogues and negotiations are essential in project pedagogy – both in courses and in project-work in order to confront ideas and perspectives of each student and to build a common understanding in the group. The conference system can to some extent be used for the collaboration, however the lower intensity of the interactions and the speech actions implies that it is rather difficult to practice a deep and complex discussion.

In addition, some learning activities are difficult to implement in the virtual learning environment. These are activities that imply use of physical means and expensive tools, which are only available in laboratories on-campus. On the other hand, we see more and more examples of physical laboratories going virtually, so these possibilities will also change the future. But there is another reason for meeting face-to-face, and that is the need for socializing in order to strengthen the tacit knowledge building and to establish and maintain trust and strong social relations and understandings among the project members. Our experiences point to the fact that in order to engage in collaborative project work, the participants have to build up a sort of social capital to draw on within the more "narrow" bandwidth of

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[6] Eugene Tackle exploits this in his course designs for on-campus teaching, where the confrontation time with students is, reduced to the time for discussing the problem area (http://www.public.iastate.edu/~wxintro/faculty/takle.html)

ICT-based communication. So, instead of regarding ICT as taking over all communication, it is better to look at ICT as an integrated part of the learning environment and to rethink the value of the different media for communication, for instance "face-to-face" work, asynchronous tools and synchronous tools, interactive multimedia materials within the field of Computer Supported distributed Collaborative Learning.

Concluding remarks

POPP is an existential pedagogical approach (Colaizzi, 1998). It is based on the aspect that people are social beings and that learning is acquired and developed through genuine interdependence. POPP is furthermore a basic democratic pedagogy where the participants learn to take responsibility, to probe the obvious and to engage in the fellow students and societal problem issues. POPP may not be seen as contemporary due to the focus on collaboration. But it contains an ambivalence which makes it contemporary appropriate. On the surface, POPP considers all demands of the business community for flexibility, readjustment ability, method awareness, problem setting and solving at the same time, as it contributes to the social development of the genuine human being through the participant's mutual engagement in building 'communities of practice' (cf. Lave & Wenger, 1991).

Fundamentally, ICT offers new potentials for POPP in distance learning. POPP is basically a text-based pedagogy, where the students have to produce a shared text (the project). On this basis, it corresponds very well with computer-mediated learning. In addition, computer mediation offers flexibility in the communication so that the participants are able to negotiate the different aspects of the project. However, our research also shows (Dirckinck-Holmfeld, 1990; Fjuk & Dirckinck-Holmfeld, 1999; Dirckinck-Holmfeld, 1999) that asynchronous communication, as the communicative infrastructure for POPP is too limited. In order to negotiate and truly confront each other's construction of meaning, the participants need other tools. In some situations, they need "the face-to-face meetings"; while in other cases they may use synchronous work tools such as whiteboard, chat rooms, shared applications, and multi modal communication facilities. With the implementation of these facilities, the possibilities of a further development of the POPP-concept within distance learning are growing substantially. In addition, interactive multimedia materials are progressing. Already now, the Internet has become a very important source of information due to the accessibility of information and the low costs. In the future, we will see advanced interactive tools. This may change our understandings of course-work and the relations between courses and projects as the tools may support all levels of the enquiry process: tools which help the student's problem formulation and problem analysis; portfolios[7] which promote the reflection process; simulation programs which assist experimentation; digital photos which materialize and give permanence to experiences; and dynamic models which assist the conceptualization process. In the future, more technologies from the two approaches within CSCL - distance learning and institution-based collaborative learning may merge and be used in POPP with the problem formulation to guide which tools to use.

Until now, focus has been on the development and implementation of some basic first- and second generation ICT-tools. In the near future[8], focus will be on a better understanding of the third generation

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[7] See Sørensen (2001) and Tolsby (2001) in this volume.

[8] The project Virtual Learning and Learning Environments (ViLL) is going to explore the use of third generation tools from a technical, pedagogical and didactical point of view (http:www.iti.auc/vill

tools. Additionally, the tailoring of the specific tools and the didactical design of virtual learning environments will become very important in order to reflect the pedagogical approach. However, as more technical tools are implemented in the learning environment, the more we have to stress the need for the development of a new communicative and collaborative competencies among the participants (teachers and students) which integrate ICT-operative skills, human communication and didactical competencies.

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