Ibrugtagning af ikt i universitetsuddannelse

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Ibrugtagning af ikt i universitetsuddannelse – Bind II

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Indholdsfortegnelse

Oversigt over artikler

Pilotprojekt som metode (Nyvang, 2008a[1]). I artiklen præsenteres en række overvejelser, man må gøre sig, når målet for en undersøgelse både er forandring i forhold til en konkret case og mere generel viden, der kan anvendes i fremtidige forandringsprojekter og i andre kontekster. Der argumenteres for, at pilotprojekter kan bibringe viden, der er central for at få denne type udviklingsprojekter til at fungere i praksis. De metodiske problemstillinger diskuteres desuden i forhold til en konkret case, hvor formålet er forandring af universitetsundervisning. Herunder diskuteres målformulering for forskning og forandring, forskerrollen samt balancen mellem intervention, konflikt og udvikling.

E-læringssystemer og projektpædagogik - pædagogikkens krav til systemdesign og funktionalitet (Nyvang et al., 2004). Artiklen udvikler en teoretisk baseret analysemodel, der kan vise et e-læringssystems potentiale for understøttelse af problemorienteret projektpædagogik. Teorien om gruppers læring i samarbejde hentes fra Wenger. Analysemodellen fokuserer på systemers potentialer inden for tre hovedområder: meningsforhandling, koordinationsarbejde samt ressourcehåndtering. Analysemodellen testes på tre forskellige systemer og systemtyper.

Students designing ict support for collaborative learning in practice (Nyvang & Tolsby, 2004). Artiklen analyserer, de studerendes praksis i forbindelse med valg af ikt-støtte til problemorienteret projektarbejde. Det teoretiske grundlag er Wengers teori om lærings i praksisfællesskaber (Wenger, 1998). Artiklen identificerer på baggrund af et casestudie koordinering af aktiviteter, koordinering af videnkonstruktion samt konstruktion af fælles videnbilleder som centrale aktiviteter for de studerende i arbejdet med deres projekt. Artiklen viser desuden, at de studerende ønsker fleksible værktøjer, der kan tilpasses igennem projektprocessen i takt med, at behovene ændrer sig. Endelig er det tydeligt, at de studerende føler stort ejerskab for systemer, de selv har udvalgt og tilpasset.

Using activity theory framework (atf) to build an analytic bridge across the Atlantic: Two cases of information and communication technology (ict) integration (Nyvang & Johnson, 2004). Hensigten med artiklen er at vise, at virksomhedsteorien kan bruges til at afdække og forstå udfordringer og modsætninger i forbindelse med integration af ikt i videregående uddannelsesinstitutioner. Hensigten er desuden at liste nogle af de udfordringer, virksomhedsteorien har kunnet bruges til at påvise i to cases, dels ibrugtagning ved Humanistisk Informatik og dels ibrugtagning på et universitet i USA. I begge tilfælde viste virksomhedsteorien sig brugbar til at forstå vanskelighederne ved ibrugtagning og omstilling med ikt. Det viste sig også i begge tilfælde, at ledelsens støtte og facilitering af omstillingsprocesserne er nødvendig, primært fordi omstillingen kræver

[1] Oprindeligt 2003.

ressourcer af forskellig art. Samtidig understreges det, at ledelsen med fordel kan give plads til, at organisationens medlemmer selv arbejder innovativt og fører egne ideer ud i livet. Endelig viste det sig også, at ibrugtagning af ikt i udstrakt grad påvirkes af den kultur ibrugtagningen finder sted i.

Teachers implementing ict in higher education (Nyvang, 2008b[2]). Artiklen analyserer ibrugtagning af ikt på Humanistisk Informatik med særlig fokus på undervisernes ibrugtagning. Det teoretiske grundlag for analysen er virksomhedsteorien. Det udledes, at ibrugtagningen for undervisernes vedkommende består af tre delprocesser, nemlig valg af ikt, tilpasning af ikt og ændring af praksis med ikt. Det vises desuden, at undervisernes overordnede motivation for ibrugtagning af ikt, er forbedring af kvaliteten af de studerendes udbytte af undervisning og studie. Ibrugtagningen fremstår desuden som en læreproces for lærerne selv.

Creating an educational infrastructure -experiences, challenges and lessons learned (Bygholm & Nyvang, 2004). Artiklen analyserer ibrugtagningen af infrastrukturer til støtte af kommunikation og samarbejde på Humanistisk Informatik. Det teoretiske grundlag for analysen er infrastrukturbegrebet, som det udvikles og anvendes af Star og Ruhleder samt Batesons teori og læring og udvikling, som også Star og Ruhleder anvender. En række udfordringer, der opstod i forbindelse med ibrugtagningen, beskrives og kategoriseres med henblik på at informere fremtidige ibrugtagningsprojekter. Kategoriseringen sker i en matrix, der horisontalt ordner problemer efter om de vedrører adgang, proces og kontekst eller mål og værdier. Vertikalt ordnes problemerne efter, om de vedrører kommunikation og medie, design om support eller teknologi. Konklusionen er, at det ikke er muligt at undgå alle problemer og modsætninger, men samtidig også, at kendskab til udfordringer og barrierer kan bruges konstruktivt.

Bygholm, A., & Nyvang, T. (2004). *Creating an educational infrastructure -experiences, challenges and lessons learned.* Paper presented at the ICT and learning in regions, Aalborg.

Nyvang, T. (2008a). Pilotprojekt som metode. In M. Georgsen & H. Tolsby (Eds.), *Forskning i praksis - mennesker, teknologi og forandring (in press)*. Aalborg: Aalborg Universitetsforlag (udkommer 2008).

Nyvang, T. (2008b). Teachers implementing ict in higher education. In L. Dirckinck-Holmfeld & A. Lorentsen (Eds.), *Virtual learning environments. New ways of learning in higher education.* Aalborg: Aalborg Universitetsforlag (udkommer 2008).

Nyvang, T., & Johnson, N. A. (2004). *Using activity theory framework (atf) to build an analytic bridge across the atlantic: Two cases of information and communication technology (ict) integration.* Paper presented at the SITE 2004, Atlanta.

Nyvang, T., & Tolsby, H. (2004). *Students designing ict support for collaborative learning in practice.* Paper presented at the Networked Learning 2004.

[2] Oprindeligt 2003.

Nyvang, T., Tolsby, H., & Dirckinck-Holmfeld, L. (2004). E-læringssystemer og projektpædagogik - pædagogikkens krav til systemdesign og funktionalitet. In M. Georgsen & J. Bennedsen (Eds.), *Fleksibel læring og undervisning - erfaringer, konsekvenser og muligheder med ikt*. Aalborg: Aalborg Universitetsforlag.

Pilotprojekt som metode

Abstract

Når forskning og forandring går hånd i hånd stiller det særlige krav til metodevalget. I artiklen præsenteres en række overvejelser, man må gøre sig, når målet for en undersøgelse både er forandring i forhold til en konkret case og mere generel viden, der kan anvendes i fremtidige forandringsprojekter og i andre kontekster. Der argumenteres for, at pilotprojekter kan bibringe viden, der er central for at få denne type udviklingsprojekter til at fungere i praksis. De metodiske problemstillinger diskuteres desuden i forhold til en konkret case, hvor formålet er forandring af universitetsundervisning. Herunder diskuteres målformulering for forskning og forandring, forskerrollen samt balancen mellem intervention, konflikt og udvikling.

Introduktion af problemområde

Undervisningsinstitutioner, herunder universiteter, står midt i et særdeles omfattende omstillingsprojekt. Internt på universiteterne såvel som i det omgivende samfund stiger forventningen om, at man udnytter ny teknologi til at øge kvalitet og fleksibilitet i uddannelserne. I lyset af teknologiens hastige udvikling og samfundets stigende behov for uddannelse kan omstillingsprojektet i stedet for at finde sted i et afgrænset tidsrum forventes at blive en kontinuert proces. Pædagogiske og teknologiske nyudviklinger vil gradvist ændre praksis. Kilder som Bygholm og Dirckinck-Holmfeld (1997), Lorentsen (2000) samt Collis og Moonen (2001) behandler alle forskellige aspekter af udvikling af universitetsundervisning med ikt, hvor det fremgår, at ikt indtil nu og også fremover vil være anledning til at ændre de organisatoriske, pædagogiske og teknologiske rammer omkring læringsmiljøet. Et andet afledt vigtigt aspekt er, at omstillingen må forventes over tid at være særdeles gennemgribende. Derfor er der et stort behov for at forstå forandringsprocesserne, blandt andet hvordan de faciliteres, og hvilke udfordringer det i øvrigt giver undervisningsinstitutionen at være under konstant forandring. Derfor er det vigtigt at identificere metoder både til omstilling af uddannelser og til opbygning af den nødvendige viden om omstillingsprocessen.

Kombinationen af metoder til omstilling og forståelse af omstilling er udgangspunktet for denne artikel. Målet er at vise konkrete eksempler på, hvordan en aktiv forsknings- og udviklingsindsats kombineres på baggrund af et konkret projekt, hvor formålet er dels at sætte forandringsprocessen i gang og dels at etablere et bæredygtigt grundlag for fremtidige forandringsprocesser. Det ontologiske grundlag for artiklen er, at undervisning med teknologi er udtryk for en social praksis, der former og formes af teknologi og læringsforståelse. Derfor må studier af forandring af undervisningsinstitutioner tage udgangspunkt i undervisningspraksis og involvere både de personer, der direkte og indirekte har betydning for undervisningen. Desuden må de genstande og processer, undervisningen berører og berøres af, også inddrages. Den grundforståelse af problemfeltet er gennem artiklen styrende for valget af teoretisk og empirisk perspektiv på problemfeltet.

Artiklen falder i to hoveddele, hvor første del udpeger og diskuterer pilotprojektet som en relevant metodisk tilgang på baggrund af projektets mål. Pilotprojektet kan anvendes som afsæt for et større forandringsprojekt, men er i sig selv af kortere varighed og mindre omfattende samtidig med, at kravet om konkret forandring fastholdes. Pilotprojektet defineres således senere i artiklen mere præcist som en dialogorienteret forandringsorienteret metode, der bygger på syv principper: Afgrænsning, udvikling med konkrete resultater, involvering af de berørte aktører, synlige og konkrete aktiviteter, forskningsbaseret indsigt i praksis, fremadrettet udviklingspraksis samt ledelse og koordination.

Anden del er en præsentation af et konkret udviklings- og forskningsprojekt samt diskussion af anvendelse af et pilotprojekt som metodologisk ramme for etablering af et større udviklingsprojekt under studienævnet for Humanistisk Informatik på Aalborg Universitet. Uddannelsen er placeret under det Humanistiske Fakultet og består af 2 års fællesforløb efterfulgt af tre grenspecialiseringer, hvor de studerende kan vælge bachelor- og kandidatniveau inden for henholdsvis Kommunikation, Humanistisk Datalogi og Multimedier. Udviklingsprojektet er del af ViLL projektet (Virtuelle læringsmiljøer og Læringsformer) under Det Digitale Nordjylland[3].

Forandringsorienterede metoder

Metodevalg på baggrund af de skitserede mål med undersøgelsen vil naturligt koncentrere sig om metoder, der i en eller anden forstand fokuserer på forandring og udvikling i kombination med forskning. Der er imidlertid inden for denne afgrænsede ramme forskellige perspektiver, der gør sig vidt forskellige antagelser om forandringens betingelser og karakter. Den klassiske aktionsforskning ser således udvikling som strid mellem forskellige interesser og forskeren som aktiv medspiller på den svage parts side i eksempelvis konflikter mellem arbejdsgiver og arbejdstager. Nyere metoder ser i højere grad forskeren som facilitator i dialogen mellem forskellige involverede i et udviklingsprojekt. I de følgende afsnit redegøres kort for disse hovedstrømninger med henblik på at beskrive og argumentere for pilotprojektet som metodologisk ramme i den aktuelle case.

Aktionsforskning – forskeren som deltagende og indgribende ekspert

Aktionsforskning føres normalt tilbage til første halvdel af det 20. århundrede (Nielsen, Dirckinck-Holmfeld & Danielsen, 2001). Kurt Lewins forskning i USA under 2. verdenskrig er et af de tidligere eksempler på aktionsforskning, som ofte fremhæves (Smith, 2001). Lewin var oprindeligt gestaltpsykolog, men bevægede sig også ind på det socialpsykologiske område og gjorde det til en del af målet for sin forskning at forbedre leveforholdene for de sociale grupper, han studerede. Derfor måtte han også i sin forskning udvikle et perspektiv på, hvad forbedrede forhold kunne bestå i, og involvere de interessenter, herunder politikere, uden hvilke forandringerne ikke

[3] Se http://www.ell.aau.dk.

kunne gennemføres. Specielt i 60'erne og 70'erne bredte, der sig også blandt forskellige forskningsretninger i blandt andet Skandinavien et ønske om med udgangspunkt i deres forskning at tage aktiv del i udviklingen af de nye velfærdssamfund, ofte som støtte for sociale grupper, der af den ene eller anden grund ikke nød godt af de forbedrede forhold, den brede befolkning havde fået (Ibid). Blandingen af forskning og politik var og er imidlertid ikke uproblematisk. Når aktionsforskning overhovedet tages op i denne sammenhæng skyldes det imidlertid, at feltet rummer begreber om forandring og metoder, der kan anvendes til at belyse det forandringsprojekt, der behandles i denne artikel. Det drejer sig hovedsageligt om begreber vedrørende ophævelse af strukturer, værktøjer, der kan anvendes til at ophæve strukturer og forståelsen af forandring.

Det ufærdige anvendes af den norske sociolog Thomas Mathiesen som et generelt mål for aktionsforskningsprojekter (Mathiesen, 1973). Aktioner har til formål at nedbryde eksisterende strukturerer samtidig med, at det skal forebygges, at der etableres nye faste og konserverende strukturer. I nedenstående figur skitseres det hvilke kræfter, der ifølge Mathiesen trækker væk fra det ufærdige:

Budskabet er	Fremmed	Innvevd
Antydet	Konkurrerende motsigelse (alternativ)	Konkurrerende enighet
Utformet	Ikke-konkurrerende modsigelse	Ikke-konkurrerende enighet

Figur 1: Hvis budskabet er tydeligt formuleret og allerede indvævet i de eksisterende strukturer eksisterer ikke nogen reel åbenhed for udvikling baseret på nytænkning. Er målet derimod kun antydet og samtidig fremmed for de eksisterende strukturer eksisterer en reel mulighed for innovation (Mathiesen, 1973, s. 16).

Thomas Mathiesen vil med modellen i figur 1. fremhæve at er målsætningen med et forandringsprojekt tydeligt formuleret og allerede afspejlet i de eksisterende strukturer, så vil projektet blive præget af en uhensigtsmæssig enighed og fastholdelse af det eksisterende blandt de involverede. Kun hvis målsætningen er fremmed for de eksisterende strukturer og ikke endelig, frigøres de spændinger mellem forskellige synspunkter, der karakteriserer det ufærdige og muliggør reel innovation.

Frasigelsen af de eksisterende strukturer, som Mathiesen udtrykker, kan virke stærkt begrænsende for såvel udviklings- og forskningsprojektet. Den meget radikale afstandstagen fra det eksisterende vil nok kunne skabe forandring. Om det vil give en reel og positiv udvikling, hvor de berørte aktører selv oplever, de er med, er mere tvivlsomt. En så markant afstandstagen fra de eksisterende strukturer giver meget let voldsom modstand, ligesom forskeren let kommer til at fremstå som den eneste ekspert i projektet. Derved er der også fare for ikke at opfylde den oprindelige hensigt om, at aktørerne i et givet felt sammen med forskeren skaber en ny fremtid. I det lys an-

vendes det ufærdige herefter i denne artikel i en mindre radikal form. Det indgår som argument for, at man i udviklingsprojekter må være parat til at udvikle projektets mål undervejs og må konstruere projektet således, at det faktisk understøtter en løbende evaluering og tilpasning af mål. Desuden er det ufærdige en påmindelse om, at udviklingsprojekter løbende må forholde sig til den balance det er at bygge på noget eksisterende og samtidig skabe noget nyt.

Inden for systemudvikling har specielt den skandinaviske tradition (Bansler, 1987) udviklet sig væk fra en konfliktsøgende aktionsforskning over mod forsknings- og udviklingsprojekter, hvor forskeren indgår som partner i en dialog, og målet er at involvere den ekspertise, de forskellige interessenter i et udviklingsprojekt besidder.

Dialogbaseret forskning og udvikling – forskeren som aktiv medspiller (n3)

Dialogbaserede forskning- og udviklingsmetoder foreslås af Nielsen et al. (2000) sammensat af flere elementer:

- Etnografiske og kvalitative metoder for at forstå praksis
- Designmetoder for at producere en vision om (ny) praksis
- Forhandling af designmuligheder for at nå beslutninger om (ny) praksis

Forskeren bidrager i forhold til alle tre processer som facilitator i en dialog mellem ligeværdige partnere. Den eksisterende organisations eget bidrag til opnåelse af større indsigt i egen praksis og udvikling er mere udtalt end i den traditionelle aktionsforskning.

Samspillet mellem begrebet om det ufærdige og de mere konsensussøgende dialogbaserede metoder kan diskuteres med udgangspunkt i Karen S. Christensen (1985), der fra sit udgangspunkt i fysisk planlægning beskæftiger sig med den varierende grad af usikkerhed, der er knyttet til enhver planlægning. Selvom fysisk planlægning vedrører design og placering af fysiske omgivelser som veje, bygninger og lignende tilbydes en forståelsesramme, der er meningsfuld inden for det aktuelle domæne. I nedenstående matrix ses således hendes bud på strategi knyttet til forskellige grader af usikkerhed om kombinationen af mål og middel i planlægning:

	Enighed om mål	Ikke enighed om mål
Teknologi kendt	Planlægning/programmering	Forhandling
Teknologi ukendt	Eksperimenteren	Håndtering af kaos – elementer af forhandling og eksperimenteren

Figur 2: Udviklingsprojekter kan vælge forskellige strategier afhængig af i hvilket omfang mål og teknologi er kendt (Christensen 1985).

Det aktuelle udviklingsprojekt kan ikke entydigt placeres i en af de fire kasser. Lone Dirckinck-Holmfeld og Annette Lorentsen (2000) peger da også i forhold til institutionsomstilling på, at de fire forskellige forandringsstrategier kan bruges til at belyse forskellige dele af det samme omstillingsprojekt og udpege overordnede strategier. Ved forandring af uddannelseskontekster er det således ikke ualmindeligt at starte med en generel enighed om de faglige og pædagogiske mål, hvorimod man gennem eksperimenter ønsker at identificere relevante teknologier til opnåelse af de kendte mål. Det er imidlertid også realistisk, at anvendelse af en ny teknologi vil medføre ny erkendelse, der har potentiale til at rokke ved de eksisterende mål, hvorved forhandlinger om revurdering og præcisering af de faglige og pædagogiske mål iværksættes. Udviklingsprojekter bliver således i sig selv kilde til den erkendelse, der er med til at udvikle projektets mål. Der er med andre ord også i dette perspektiv i en positiv og udviklingsfremmende forstand noget ufærdigt over et udviklingsprojekts formulering og mål, når det sættes i værk. Med indikationen af, at en del værdifuld erkendelse om udviklingsprojektet kun kan opnås ved at iværksætte selve projektet, står det også endnu en gang klart, at refleksion undervejs i forløbet og reel mulighed for at justere udviklingsplanerne er afgørende for at gennemføre et succesfuldt udviklingsprojekt.

Pilotprojekt som ramme for forandring og forskning

Opdelingen af udviklingsprojekter i en række faser eller iterationer, som hver især munder ud i en række konklusioner af betydning for projektets videre forløb, ændrer ikke behovet for en etablerings- eller opstartsfase. Her argumenteres for anvendelsen af et pilotprojekt som ramme for etableringen af et større forandringsprojekt, der kombinerer udvikling og forskning i udvikling. Det skal dog allerede her fremhæves, at pilotprojektet, som det diskuteres på de følgende sider, indeholder kvaliteter og principper, der er anvendelige langt ud over selve etableringen af et udviklingsprojekt. Det falder imidlertid uden for rammerne af denne artikel og det empiriske grundlag den bygger på at gå i dybden med faser uden for pilotprojektet.

De overordnede argumenter for anvendelsen af pilotprojekter bygger i udstrakt grad på de principper, der er identificeret i aktions- og dialogforskning. Pilotprojekter er således:

- Afgrænsede til dele af organisationen
- Udvikling med konkrete resultater
- Involvering af de berørte aktører
- Synlige og konkrete aktiviteter (der virker engagerende)
- Forskningsbaseret indsigt i praksis, herunder forandringens processer og resultater
- Fremadrettet udviklingspraksis, pilotprojektet er kun første skridt
- Ledelse og koordination

Listen er ikke prioriteret, da alle syv principper er nært forbundne og i udstrakt grad hinandens forudsætninger i praksis. Konkrete resultater kan i sig selv være et mål, men er også med til at

skabe synlige aktiviteter, der kan fastholde og udvide engagementet blandt de berørte aktører. Det er på en gang grundlaget for den aktuelle fase i udviklingsprojektet og med til at etablere grundlaget for en fremadrettet udviklingspraksis med en række udviklingstrin. Desuden kan synlige aktiviteter i forhold til de dele af organisationen, der ikke umiddelbart tager aktiv del i pilotprojektet, være med til at øge opmærksomheden på udviklingsprojektet og afmystificere det. Afgrænsningen til dele af organisationen er desuden centralt for hele ideen med pilotprojektet som første skridt i en gensidig lære- og udviklingsproces. Kompleksiteten reduceres ved at afgrænse projektet, og det bliver muligt i praksis at følge de andre seks principper. Omvendt må pilotprojektet også afgrænses under hensyntagen til de andre mål. Resultaterne skal have en tilstrækkelig synlighed og rækkevidde, ligesom den forskningsbaserede indsigt skal have større rækkevidde end det aktuelle projekt. Sidst men ikke mindst er ledelse og koordination med til at sikre kvalitet og en hensigtsmæssig udnyttelse af ressourcer i projektet.

Pilotprojektet må udover de direkte involverede aktører, f.eks. de lærere, der udvikler deres undervisning med ikt, have deltagelse af en eller flere personer, der fungere som forskere og eksperter med ansvar for facilitering, inspiration og evaluering af projektets forskellige dele. Om forskeren hentes udefra eller udpeges internt i den organisation, der gennemfører pilotprojektet, må naturligvis afhænge af hvilke kompetencer, der er til stede i organisationen, samt i hvilket omfang man ønsker helt friske øjne på udviklingsarbejdet til at supplere organisationens egne medlemmer og kompetencer.

Forskeren har som i de dialogorienterede udviklingsmetoder forskellige opgaver i pilotprojektet, der i sig selv består af flere faser. I første fase er forskeren med til at udpege, hvilke dele af organisationen det vil være relevant og muligt at involvere direkte i pilotprojektet. I næste fase er forskeren sparringspartner for de lærere, der har brug for inspiration til udviklingen og afviklingen af deres undervisning. Mod slutningen af pilotprojektet færdiggør forskeren en evaluering på tværs af hele projektet, hvor fokus er rettet mod forståelse af processer og produkt – på den baggrund udpeges desuden relevante proces- og indholdsmæssige tiltag for udviklingsprojektets følgende fase.

På de følgende sider beskrives og diskuteres et konkret pilotprojekt med henblik på at vise metoden i anvendelse i praksis og give et mere nuanceret billede af dens styrker og svagheder.

Udvikling af undervisningen på Humanistisk Informatik

Uddannelsen i Humanistisk Informatik ved Aalborg Universitet er genstand for det udviklings- og forskningsprojekt, der her betragtes fra et modetodeperspektiv. Uddannelsen er placeret under det Humanistiske Fakultet og består af 2 års fællesforløb, hvorefter de studerende har mulighed for at vælge bachelor- og kandidat niveau inden for henholdsvis Kommunikation, Humanistisk Datalogi og Multimedier. Der er cirka 500 studerende tilknyttet Humanistisk Informatik. Uddan-

nelserne anvender allerede i et vist omfang ikt-støttede læreprocesser, men hovedsageligt i forbindelse med uddannelser, hvor aktiviteterne primært er placeret off-campus, mens dette projekt primært beskæftiger sig med uddannelser, der i udgangspunktet har de fleste aktiviteter on-campus.

Målet for projektet er flersidet – dels drejer det sig om at afdække og konkretisere fordele og udfordringer knyttet til at anvende ikt til at skabe større sammenhæng, fleksibilitet, gennemsigtighed og kvalitet for alle aktiviteter på en uddannelse med mange studerende og dels om at forstå forandringsprocesserne knyttet til ibrugtagning af ny teknologi i undervisningen. Disse mål er imidlertid meget abstrakte i forhold til gennemførelsen af konkrete udviklingsaktiviteter. Derfor er der i projektet gennemført et pilotprojekt, der har til formål at konkretisere de abstrakte mål såvel som målene vedrørende udvikling af uddannelsen yderligere.

Valg af pilotprojekt som metode

For en nærmere afklaring af den indholdsmæssige side såvel som den metodemæssige side af udviklingsprojektet gennemførtes et pilotprojekt. Udgangspunktet for det valg var den antagelse, at en eksperimenterende og reflekterende tilgang med udgangspunkt i praksis giver det bedste grundlag for en fortsat udvikling af uddannelsens faglige indhold og pædagogiske form. Herunder gennemgås projektet med udgangspunkt i de syv kriterier i pilotprojektet: Afgrænsning, udvikling med konkrete resultater, involvering af de berørte aktører, synlige og konkrete aktiviteter, forskningsbaseret indsigt i praksis, fremadrettet udviklingspraksis samt ledelse og koordination.

Afgrænsning

Pilotprojektet har som et af sine overordnede mål at skabe viden, der kan danne grundlag for et større forandringsprojekt. For i praksis at kunne afsøge, hvordan forandringer gennemføres og opleves i en given organisation afgrænses pilotprojektet såvel tids- som indholdsmæssigt. Afgrænsningerne har til formål at reducere kompleksiteten i projektet. Her spiller det også ind, at forandringer i undervisningsorganisationer ofte kun kan gennemføres som del af en driftssituation. Nye læringsformer og læringsmiljøer kan bedst udvikles og afprøves med lærere, der faktisk forbereder undervisning og underviser studerende, studerende, som studerer og supportfunktioner, der i praksis supporterer en uddannelse. Med afgrænsningen sikres plads til at såvel projektledelsen som de øvrige deltagere kan gennemgå den læreproces, der er hensigten med pilotprojektet og samtidig kan have overskud til at reagere på udfordringer og uhensigtsmæssigheder, der opstår undervejs.

I det konkrete pilotprojekt betød den tids- og indholdsmæssige afgrænsning, at pilotprojektet omfattede lærere og studerende på ét semester. Den tidsmæssige afgrænsnings tilpasning i forhold til et semesters varighed er valgt, fordi semestre er den mindste naturlige afgrænsning for undervisningsforløb i den aktuelle organisation. Semesteret var udvalgt dels på baggrund af et relativt lavt

antal studerende (21) og lærere (6 fordelt på 4 kurser) og dels på baggrund af semestrets indhold og placering i uddannelsen (5. semester Humanistisk Datalogi). Denne del af uddannelsen blev udvalgt, fordi flere af lærerne allerede har erfaringer fra lignende udviklingsprojekter, ligesom de studerende på dette tidspunkt af deres studie selv skal opnå erfaring med deltagelse og ledelse af udviklingsprojekter. Disse forhold, der havde til formål at sikre en forholdsvis let opstart af projektet, må naturligvis også tages i betragtning, når det skal vurderes i hvilket omfang, resultaterne kan overføres til andre dele af uddannelsen og udvikling i større skala.

Udvikling med konkrete resultater

Den synlige forandring inden for organisationens produkt undervisning blev opnået ved at udvikle konkrete kursusforløb med ikt. Det gav såvel for de involverede lærere som studerende en meget synlig forandring, der også kunne mærkes i dagligdagens undervisning og studie. Pilotprojektet involverede primært to kurser, hvor lærerne under indflydelse af det aktuelle udviklingsprojekt har valgt at omlægge deres kurser til i langt højere grad end tidligere at anvende internetbaserede teknologier i undervisningen. I begge tilfælde eksperimenterede lærerne med kursusformen. I kurset 'Menneske-maskine interaktion' valgte lærerne at supplere de traditionelle forelæsninger med forskellige øvelser, der krævede at de studerende kommunikerede asynkront i et konferencesystem i perioden mellem forelæsningerne. Derved fik både lærere og studerende mulighed for at forberede sig bedre på selve forelæsningerne, fordi lærerne bedre kunne følge de studerendes behov og ønsker samtidig med, at de studerende fik nye muligheder for at prøve stoffet af i samspil med lærerne. I kurset 'Kunstig intelligens' valgte lærerne at fokusere på udvikling af et elektronisk kursusmateriale, der også udvidede de studerendes muligheder for at forberede sig inden forelæsningerne eller vende tilbage til stoffet efter kurset. Materialet indeholdt desuden en række øvelser og selvtests, der satte den enkelte studerende i stand til at vurdere sin egen indsigt i kursusstoffet (Schärfe, Petersen & Øhrstrøm, 2002).

Da fokus var udvikling med ikt involveredes også kurset 'Multimedieproduktion', hvor læreren gennem flere år har udviklet sit kursus med ikt i forløbet og den efterfølgende erfaringsopsamling for på den måde at integrere erfaringerne i dette kursus i pilotprojektets forløb og konklusioner.

Involvering af de berørte aktører

Antallet af deltagende studerende og lærere i pilotprojektet var, som beskrevet, afgrænset ved kun at fokusere på kursusaktiviteterne på et semester med ca. 25 studerende og 6 lærere fordelt på 3 kurser. Lærerne tilknyttet de enkelte kurser har hver især udviklet ikt-anvendelsen i deres eget kursus med udgangspunkt i netop dette kursus og lærernes eget kendskab til de teknologiske og pædagogiske udviklingsmuligheder som den primære drivkraft. Her skal det dog også bemærkes, at lærerne i pilotprojektet i forskelligt omfang også forsker i anvendelse af ikt i læringsmiljøer og netop har valgt at trække på denne forskning i forhold til deres egen undervisning. Derfor har der

ikke som sådan været gennemført særlige aktiviteter med henblik på at inspirere den enkelte lærer i udvikling af egen undervisning.

Der er derimod gennemført forskellige aktiviteter, som har haft til formål, at hjælpe lærerne med at gennemføre ikt-udviklingen i form af støtte til drift af systemer samt design- og programmeringsopgaver. Det er således tilstræbt, at pilotprojektet helt eller delvist skulle stille de ekstra ressourcer til rådighed, som har været nødvendige for at udvikle og gennemføre kurserne i den nye form. Hensigten med støtten er også at spænde et sikkerhedsnet ud under lærere, der ønsker at kaste sig ud i en kursusudvikling, de ikke føler sig sikre på at kunne føre til ende på grund af tekniske og organisatoriske udfordringer.

De studerende har ikke været involveret direkte i selve udviklingen af kurserne, men har naturligvis studeret inden for de rammer pilotprojektet har været medvirkende til at forandre i forhold til tidligere. Lærerne har dog løbende anvendt de studerendes reaktioner i deres egne evalueringer og justeringer af forløbet. Dermed vil de studerendes involvering i pilotprojekt primært være synlig i dets konklusioner og anbefalinger vedrørende fremtidige udviklingsaktiviteter.

Administrative funktioner, herunder den eksisterende ikt-drift og -support i organisationen, har kun i begrænset grad været involveret i pilotprojektet af hensyn til ønsket om kompleksitetsreduktion. Den eksisterende ikt-organisation har dog været involveret med henblik på at sikre, at de valgte tekniske løsninger kan anvendes, drives og supporteres i det eksisterende tekniske miljø. Det afgørende er således, at der ikke i pilotprojektet truffet valg vedrørende tekniske løsninger, som ikke kan udbredes i senere faser af projektet.

Synlige konkrete aktiviteter

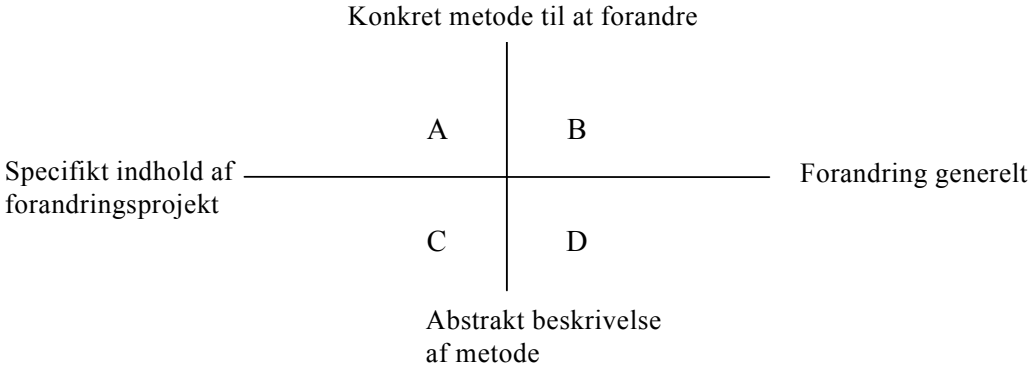
Synligheden af udviklingsaktiviteterne i pilotprojektet var nært forbundet med de konkrete resultater i form af konkret forandring af kurserne. Internt i pilotprojektet har de mest synlige tværgående aktiviteter set fra lærernes perspektiv været diskussioner på lærernes faste møder i løbet af semestret og i et vist omfang også løbende diskussioner med de studerende. Her har man gensidigt orienteret hinanden om de planlagte aktiviteter. I forhold til de involverede lærere og studerende har evaluerings- og forskningsaktiviteterne været synlige i form af dataindsamling gennem en interviewundersøgelse, hvor alle deltog. Specielt de studerende udtrykte glæde over, at de på den måde blev taget alvorligt, og deres forslag og kritik kom til at indgå i projektet.

I udgangspunktet var hensigten med at gennemføre synlige aktiviteter i pilotprojektet også at sprede kendskabet til udviklingsaktiviteterne til den øvrige del af organisationen på Humanistisk Informatik. Udover et web-sted, hvor pilotprojektet kunne følges har der imidlertid ikke været en særlig indsats med henblik på et gøre pilotprojektet synligt. Udviklingsaktiviteterne vurderes primært relevante for den øvrige organisation i kraft af de resultater i form af nyudviklede kursuskoncepter og forskningsresultater, der foreligger ved pilotprojektets afslutning. Tanken om

løbende synliggørelse på tværs af organisationen er imidlertid ikke opgivet og forventes videreudviklet i projektets følgende faser.

Forskningsbaseret indsigt i praksis, herunder forandringens processer og resultater

Pilotprojektets forskellige forskningsmål behandles med udgangspunkt i spændingsfeltet mellem viden om et specifikt indhold i et udviklingsprojekt og viden om udviklingsmuligheder i uddannelse generelt. Desuden inddrages spændingsfeltet mellem metode som konkret værktøj til forandring og en mere abstrakt forståelse af forandringsmetoder. Denne opdeling kan synes kunstig og anvendes da også her primært som en måde, hvorpå variationen i målene træder tydeligt frem.
I figur 3 nedenfor sammentænkes de to spændingsfelter:



Figur 3. Erkendelsesinteresser i pilotprojektet på Humanistisk Informatik. Distinktionen mellem teori og empiri placeres på henholdsvis en metode- og indholdsakse.

Pilotprojektet har erkendelsesmål knyttet til alle fire kvadranter; det vil sige målet er at opnå viden om, hvordan forandring gennemføres i det konkrete tilfælde med det specifikke indhold (A), hvordan konkrete metoder til udvikling kan bruges til at designe udviklingsprojekter generelt (B), forholdet mellem det specifikke forandringsprojekt og det teoretiske og videnskabsteoretiske grundlag for den anvendte metode (C) og endelig forholdet mellem forandringsmetoder og deres teoretiske og videnskabsteoretiske grundlag generelt (D). Det skal endnu en gang fremhæves, at der er tale om et gennemgående forsøg på at forstå, hvad forandring og ibrugtagning af ny teknologi faktisk er, og hvordan denne forandring kan gennemføres i praksis.

Mål A: Gennemførsel af forandring i pilotprojektet. Undervisningen skal i det aktuelle projekt udvikles gennem større anvendelse af de muligheder ikt tilbyder. Herunder opstår behov for at udvikle en mere præcis definition af, hvad formålet med at anvende ikt er samt en forståelse i

organisationen af implikationerne ved at arbejde med udvikling af ikt-anvendelsen. Her anvendes metoder, der understøtter dialogen mellem parterne i udviklingsprojektet, samt sikrer at mål og strategi knyttet til forandringerne er forankret i den aktuelle organisation. I det aktuelle pilotprojekt er den indholdsmæssige afgrænsning foretaget af projektledelsen efter gennemgang af uddannelsens forskellige elementer i forhold til pilotprojektets mål. Udviklingen af de enkelte kurser er gennemført på baggrund af lærernes egen formulering af mål og ønsker i dialog med projektledelse og ikt-driftsorganisationen.

Mål B: Gennemførsel af forandring på Humanistisk Informatik. I forlængelse af pilotprojektet udvælges metoder til bæredygtig forandring af hele uddannelsen. Dermed må de første skridt tages til at afklare, hvordan bæredygtighed defineres i den konkrete kontekst. På baggrund af pilotprojektet er identificeret en række problemstillinger knyttet til ibrugtagning af ikt, som har betydning for det videre udviklingsarbejde, da ibrugtagningen er knyttet nært sammen med tilstedeværelsen af såvel negative som positive effekter i organisationen (Nyvang, 2008). En central metode er her således evaluering af såvel form som indhold i pilotprojektet og på den baggrund er det besluttet at arbejde videre efter en model, der minder meget om pilotprojektet. Undervisningen på endnu et af uddannelsens semestre udvikles med ikt. Med henblik på at udvide projektets perspektiv fokuseres på et semester med langt flere studerende, flere kurser og flere lærere. Indholdsmæssigt fokuseres på at skabe en samlet ikt-baseret indgang til semestrets undervisning, hvilket også stiller større krav om central ledelse og koordinering end tilfældet har været i pilotprojektet. Samtidig er der parallelt iværksat et større arbejde med at udvikle organisationens ikt-strategi under inspiration af de konkrete resultater, der er nået gennem pilotprojektet. I Christensens (1985) terminologi kan det fremstilles som en bevægelse fra håndtering af kaos i pilotprojektet, hvor mål og mulige teknologivalg har været uklare til i højere grad at dreje sig om en forhandling, hvor teknologi og mulige mål i højere grad er kendte.

Mål C: Forståelse af forandringsprocesserne i det konkrete pilotprojekt. Forståelsen af forandringens betydning i det aktuelle projekt har to hovedformål. Dels er der tale om første skridt i en mere generel forståelse af ibrugtagning, og dels er der tale om et redskab for de involverede parter, hvor det både drejer sig om at udvide forståelsen af de udviklingsskridt der allerede er taget og forberede de næste skridt. Som beskrevet under mål B er dele af denne forståelse allerede omsat til konkrete anvisninger for udviklingsprojektets næste fase.

Mål D: Viden på et generelt og teoretisk niveau om forandring knyttet til ibrugtagning af ikt. Den generelle forståelse af ibrugtagningen skal være af en karakter, der gør det muligt at arbejde videre med ibrugtagning i en bredere sammenhæng. Dette mål kan ikke nås gennem et enkelt pilotprojekt, men i det aktuelle tilfælde fungerer det som pilotstudie for en større undersøgelse, hvor den umiddelbare forståelse af ibrugtagningen kan kvalificeres gennem yderligere undersøgelser.

Pilotprojektets fokus er primært første (A), andet (B) og tredje mål (C); dvs. at gennemføre en konkret forandring og skabe grundlaget for yderlige forandring gennem opsamling af konkrete erfaring og etablering af en teoretisk funderet forståelse af forløbet. Det sidste mål er mere langsigtet, men må ikke tabes af syne – det vil på et helt praktisk plan sige aktiviteter, dataindsamling og analysearbejde allerede fra starten må være rettet mod alle fire mål. Samtidig flyder behandlingen af de fire mål sammen, da vekselvirkningen mellem teoretiske betragtninger og konkrete erfaringer står centralt i forhold til alle fire delmål.

Dataindsamlingen i forhold til forskningsdelen af pilotprojektet på Humanistisk Informatik har været sammensat af tre aktiviteter: Referater fra lærermøder, kursusmaterialer og -strukturer samt semistrukturerede interviews med alle involverede lærere og studerende i slutningen af forløbet. I behandlingen af data, bl.a. med henblik på nærværende artikel, har de afsluttende interviews været den største datakilde, mens kursusmaterialer og referater fra lærermøder primært er anvendt, hvor de supplerer interviews – det er for eksempel, hvor lærere eller studerende henviser til detaljer i et bestemt kursusmateriale eller hvor lærere referer til bestemte diskussioner i lærergruppen. Det er oplagt, at en række andre metoder kan være relevante at inddrage i fremtidige projekter. Eksempelvis kan dagbogsmetoder, hvor studerende, lærere og projektledelse fører dagbog under et ibrugtagningsforløb forventes at nuancere forståelsen af forløbet (Hansen, 2002).

Fremadrettet udviklingspraksis - pilotprojektet som første skridt

Det fremadrettede, ufærdige om man vil, i pilotprojektet er på forskellig måde tilstede, men mest tydeligt i de forsknings- og evalueringsmæssige interesser. Til belysning af pilotprojektets værdi i denne henseende præsenteres her et udsnit af de afledte konklusioner med fokus på anbefalinger vedrørende indholdet af de kommende faser.

Udvikling af undervisningen med udgangspunkt i det enkelte kursus og den enkelte lærer kan med succes gennemføres som i det aktuelle pilotprojekt (Schärfe et al., 2002; Nyvang, 2002 & Tolsby et al., 2002). Selv mindre forandringer, hvor et eksisterende pædagogisk koncept primært udvides ved at gøre en del af de eksisterende aktiviteter webbaserede, kan give kvalitetsforbedringer i undervisningen. Det ses i det aktuelle pilotprojekt. Lærere og studerende får med nye kommunikations- og materialeformer et læringsmiljø, der i højere grad and tidligere involverer den enkelte studerendes eget arbejde med stoffet i undervisningen. De små udviklingsskridt kan også udgøre et værdifuldt grundlag for den videre udvikling, idet de kan betragtes som en lære- og søgeproces, hvor alle involverede parter trinvist kan udvikle deres praksis samt visionen om den fremtidige udvikling. Her spiller det også ind, at undervisningsorganisationer, der ønsker at udvikle sig, mens de er i normal drift, må have en høj grad af sikkerhed for, at uddannelsens kvalitet som minimum fastholdes. Netop små skridt gør udviklingen i hvert skridt overskuelig og resultatet forudsigeligt i tilstrækkelig grad. De involverede lærere får overskuelige og håndterbare mål at arbejde frem mod, og de studerende skal ikke fra semester til semester gennemgå radikale omvæltninger i måden at lære og studere på. Selvom der arbejdes med et til stadighed ufærdigt

produkt, må der således findes en balance mellem forandring og konservering i form af en vis stabilitet indenfor den enkelte iteration i en løbende udvikling. Formuleret på en lidt anden måde kan man sige, at de kortsigtede mål såvel som teknologiske muligheder må være kendt, hvorimod den fortsatte udvikling afhænger af, at langsigtede mål og valg af teknologi er under stadig forhandlinger i lyset af de indhøstede erfaringer.

Vedligeholdelse af sammenhængen mellem uddannelsens forskellige læringsaktiviteter fremstår som den største udfordring på baggrund af pilotprojektet. Den eksisterende metodefrihed sammenholdt med kravet om, at undervisningen skal være forskningsbaseret betyder, at udvikling af undervisningen ikke er fremmed for den enkelte lærer, hvilket udtrykkes klart af både de lærere og studerende, der har indgået i pilotprojektet. Det er dog også tydeligt, at udvikling af undervisningen med specielt netbaseret ikt kalder på overvejelser vedrørende integration eller mangel på integration mellem uddannelsens forskellige pædagogiske og organisatoriske elementer. I pilotprojektet gør lærerne selv opmærksom på denne problemstilling samtidig med, at de studerende efterlyser større koordinering af såvel fagligt indhold som metoder i undervisning og iktanvendelse. Det må i projektets næste faser overvejes, hvordan en hensigtsmæssig grad af koordinering fastholdes uden, at det virker konserverende og for begrænsede for den enkelte lærer og det enkelte kursus. Der er en udfordring at bevare et handlerum for lærere, der ønsker at være helt i front med afprøvning af nye teknologier og metoder inden for en ramme, der af hensyn til sammenhængen mellem enkeltaktiviteter, håndhæver en vis ensartethed i metode- og teknologimæssig forstand. Der er dog næppe nogen endelig metode til at slippe fri af dette paradoks. Man kan med andre ord sige, at løsningen også her kan og bør forblive ufærdig.

Udviklingen af overordnede visioner for ikt-anvendelsen på Humanistisk Informatik må også intensiveres i de følgende faser. Uden en fælles overordnet vision for udviklingen af læringsmiljøet og ikt's rolle i den forbindelse forbliver grundlaget for at træffe en række valg i udviklingsprojektet uklart. Dermed bliver det også tydeligt, at udviklingsprojektet i de følgende skridt må unytte den viden, der er opnået i pilotprojektet. Erfaringerne kan danne grundlag for fælles beslutninger og eventuelt ledelsesinitiativer, der på samme tid sikrer en løsning, der er tilstrækkelig færdig til, at den med fordel kan indgå som en naturlig del af daglig praksis og samtidig er så ufærdig, at den ikke blokerer for fortsat udvikling. Idet teknologier og mål gennem forhandling baseret på erfaringerne fra blandt andet pilotprojektet bliver kendt åbnes også for at højere grad af planlægning og mindre behov for eksperimenter i den fremtidige udvikling.

Ledelse og koordination

Ledelse koordination og inspiration på tværs af de enkelte aktiviteter i et pilotprojekt fremhæves som et selvstændigt princip for at understrege disse elementers betydning i denne form for aktionsforskning. Overordnet set er det tre hovedformål med ledelse og koordination: 1. at undgå sammenfaldende erfaringer opnås flere steder i organisationen, hvor det ikke er nødvendigt 2. at undgå, at der i forskellige dele af projektet udvikles i retninger, der tilsammen giver en uhen-

sigtsmæssig helhed og 3. at sikre fremdriften i projektet. Specielt i pilotprojektet som det aktuelle, hvor flere lærere parallelt har arbejdet med udvikling af deres undervisning er det vigtigt at sikre, at erfaringer spredes på tværs af projektet.

Det skal dog også fremhæves, at ledelse og koordination kan spille forskellige roller i forskellige faser af et udviklingsprojekt. I pilotprojektet har hensigten været at eksperimentere og at understøtte den enkelte lærers egne ideer for på den måde at kunne komme mere generelle anbefalinger for mål med brugen af ikt og valg af teknologi. I den forbindelse har projektledelsens hovedopgave været at skaffe den nødvendige tekniske støtte og fungere som sparringspartner i forhold til indholdet. Som nævnt ovenfor er det i den proces blevet tydeligt, at der i projektets næste fase er brug for en større grad af koordination. Det er nødvendigt at finde en balance mellem den enkelte læreres frihed og en fælles struktur. Den fælles struktur er nødvendig for at vedligeholde en vis sammenhæng mellem uddannelsens forskellige aktiviteter og faglige elementer. Uddannelsens ledelse og lærere arbejder allerede med at udvikle den faglige og pædagogiske sammenhæng, men der er også behov for at arbejde med sammenhæng i ikt-anvendelsen for at sikre en sammenhængende indgang til uddannelsens virtuelle elementer samt en konsistent formulering af mål og strategi for anvendelse af ikt. Her er det således en opgave for uddannelsens ledelse eller udviklingsprojektets ledelse at formulere fælles retningslinier for eksempelvis valg af ikt-system således, der ikke opstår en uhensigtsmæssig diversitet.

Konklusion

Pilotprojektet har i den aktuelle case fungeret som en hensigtsmæssig ramme for etableringen af et forandringsprojekt. Fokus på afgrænsning af projektet, konkrete synlige resultater, involvering af de aktører forandringen berører, synlige aktiviteter i udviklingsprocessen, forskningsbaseret indsigt og en fremadrettet udviklingspraksis samt ledelse og koordination synes tilsammen at danne basis for reel udvikling. Organisationens eksisterende kompetencemæssige ressourcer udnyttes samtidig med, at forskeren får mulighed for dels at tilføre det aktuelle udviklingsprojekt større kvalitet og dels stille en mere generel forståelse til rådighed for andre projekter. Erfaringerne fra casen rejser imidlertid også nye spørgsmål til forståelsen af de syv principper. Det er på nuværende tidspunkt uafklaret i hvilket omfang, hvert enkelt af de syv principper skal anvendes i forhold til forskellige dele af den undervisningsorganisation, der forandres i forskellige faser af pilotprojektet og det samlede udviklingsprojekt. Det er naturligt, at den enkelte lærer har en betydelig indsigt i udviklingen af egen undervisning og udbredt kendskab til de ressourcer, der er relevante for eget udviklingsarbejde. Derimod er det i forhold til den aktuelle case uklart i hvilket omfang synliggørelse af udviklingsaktiviteter og resultater faktisk virker motiverende og udviklingsfremmende i de dele af organisationen, der ikke er direkte involveret i pilotprojektet. Lærernes tilbagemeldinger tyder på, at forskeren i samspil med lederen af projektet i høj grad skal fungere som det Von Krogh, Ichijo og Nonaka (2000) kalder *knowledge activist* (Ibid, s. 147-175). En *knowledge activist* faciliterer og kvalificerer innovation, typisk hvor den allerede finder sted,

ved aktivt at bringe relevant viden, der allerede findes i organisationen frem til nye steder, hvor den kan anvendes. Denne just-in-time synliggørelse af aktiviteter og hidtidige resultater vil kun i begrænset omfang i sig selv motivere udvikling, da den typisk finder sted, efter beslutningen om at udvikle er truffet.

Metoden i følgende faser i udviklingsprojektet inden for Humanistisk Informatik vil i udstrakt grad kunne bygge på de syv principper fra pilotprojektet med de præciseringer, der er omtalt ovenfor. At der er foretaget præciseringer er som ønsket på forhånd en styrke ved pilotprojektet. På den ene side udgør de syv principper metodologisk ramme, der er tilstrækkelig færdig til at kunne sætte udvikling og forståelse af udvikling i gang, mens de på den anden side er tilstrækkeligt ufærdige til naturligt at kunne tilpasses de faktiske forhold i et konkret projekt. Det er dog stadig en stående udfordring at formidle forskningen, der finder sted inden for rammerne af et pilotprojekt i en form, som gør den let at relatere til andre projekter. Med den viden, der er opnået gennem pilotprojektet åbnes dog også for nye strategier, når det kommer til at lede, koordinere og fokusere udviklingen. Studiet ledelse har således fået et bedre grundlag for at udpege særlige indsatsområder og dermed tilføre flere udviklingsprojektet flere fælles retningslinier på tværs af studiets enkelte delelementer. Et muligt indsatsområde, der nævnes af deltagere i pilotprojektet, er digitale materialer. Pilotprojektet har ligeledes tilvejebragt mere sikker viden om kravene til nye webbaserede infrastrukturer til støtte for studiets administration og læringsmiljø. Denne viden kunne danne basis for en udpegning af hvilke infrastrukturer, der fremover skal være obligatoriske, og dermed også danne baggrund for at fokusering af den videre udvikling.

Tak til

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E-læringssystemer og projektpædagogik - pædagogikkens krav til systemdesign og funktionalitet

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Abstrakt

Denne artikel fokuserer på at udvikle en analysemodel for e-læringssystemer, der kan vise forskellige systemers styrker og svagheder i forhold til nogle pædagogisk begrundede parametre. Artiklen vil således kunne bruges til at skærpe opmærksomheden på en række funktioner, man skal være bevidst om, når man ønsker at vælge e-læringssystemer. Det er artiklens udgangspunkt, at en analysemodel skal begrundes i forhold til den pædagogiske praksis, som e-læringssystemerne skal understøtte.

Indledning

Det pædagogiske grundlag for denne artikel er problem- og projektorienterede læreprocesser; åbne læreprocesser, der tilrettelægges i et samspil mellem lærere og studerende. Udgangspunktet er et problem eller et fænomen, som de studerende ønsker at udfordre og et fagligt indhold, som institutionen ønsker, de studerende anvender i den forbindelse. Artiklens teoretiske ståsted ligger i forlængelse af det det pædagogiske udgangspunkt og uddyber fra en socialkonstruktivistisk position den teoretiske baggrund for de pædagogiske principper. Empirien er hentet fra to forskellige typer af virtuelle læringsmiljøer[4] tilrettelagt på et projektpædagogisk grundlag: masteruddannelsen i Ikt og Læring samt bachelor- og kandidatuddannelserne under studienævnet for Humanistisk Informatik med særlig vægt på uddannelserne i Humanistisk Datalogi. Ikt og Læring udbydes under it-vest samarbejdet i samarbejde mellem Aalborg Universitet, Aarhus Universitet, Danmarks Pædagogiske Universitet, Handelshøjskolen i København og Roskilde Universitet. Humanistisk Datalogi udbydes af Aalborg Universitet. En mere udførlig karakteristik af uddannelserne følger senere. Udgangspunktet for denne artikel er, at e-læring kan bidrage positivt til udviklingen af projektbaseret problemorienteret læring på flere måder (Dirckinck-Holmfeld, 2002).

E-læring kan for det første bidrage til at gøre undervisningen og adgangen til læringsmiljøet mere fleksibel – både i forhold til hvornår undervisningen og samarbejdet med medstuderende og lærere finder sted, og hvor den finder sted. Der gives allerede i dag mange eksempler på, at e-læring anvendes til at udvikle mere fleksible læringsformer. I stedet for at finde sted i en begrænset koncentreret periode på for eksempel 14 dage udstrækkes undervisningen over en

[4] Med virtuelle læringsmiljøer mener vi den mentale konstruktion af at arbejde sammen uden at være fysisk til stede. Meningskonstruktion og læreprocesserne sker gennem deltagelse i aktiviteter medieret af informations- og kommunikationsteknologier (ikt).

længere periode, men med en mindre daglig belastning. Mere og mere af undervisningen og samarbejdet med medstuderende og lærere finder sted i computer-medierede virtuelle læringsmiljøer, hvilket muliggør fleksibilitet i forhold til hvor man er, og hvornår man kobler sig på læringsmiljøet. Den nye fleksibilitet gælder både studerende og lærere. Man har naturligvis altid haft en betydelig fleksibilitet ved valg af tid og sted for forberedelse af undervisning, formulering af bidrag eller efterbehandling af andres bidrag til et projekt, men med adgangen til det virtuelle læringsmiljø bliver selve samarbejdsprocesserne med de øvrige deltagere også allestedsnærværende.

E-læring kan for det andet bidrage til kvalitetsudvikling ved at muliggøre nye og procesorienterede undervisningsmetoder, hvor deltagernes motiver, behov og interesser fra deres fritids-, studie- eller arbejdsliv kan danne udgangspunkt for undervisnings- og læreprocesserne, som f.eks. i virtuelt projektarbejde. Det nye er, at i og med alle arbejdsprocesser og samarbejder fastholdes i det virtuelle læringsmiljø, så bliver det nemmere at dele information og arbejdspapirer med hinanden og bygge videre på hinandens arbejde. Endvidere indbyder fastholdelsen til refleksion både for den enkelte og i forhold til det fælles arbejde. Derudover kan e-læring også bidrage til udviklingen af nye former for undervisnings- og læringsmaterialer til støtte for kursusarbejdet i forbindelse med projektarbejdet, hvor man i større omfang lader forskellige medier spille sammen.

Den tredje begrundelse for at inddrage e-læring, der bygger på ikt som teknologisk platform er desuden, at ikt i bred forstand er en basisteknologi, som gennemsyrer arbejds-, organisations- og samfundsprocesser. Projektorganiseret problemorienteret læring må for både masteruddannelser samt bachelor- og kandidatuddannelser bidrage til, at de studerende bliver aktive, konstruktive og kritiske brugere af den nye teknologi.

E-læring rummer således et potentiale, men der er samtidig en række forudsætninger, der skal opfyldes for, at e-læring faktisk bidrager positivt til udviklingen af nye læringsformer præget af kvalitet og fleksibilitet.

E-læring skal for det første baseres på et bevidst pædagogisk grundlag f.eks. i form af virtuel projektpædagogik, og designet af teknologien og læringsmiljøet skal støtte det pædagogiske grundlag for at sikre kvalitet og sammenhæng. For det andet skal lærere, studerende og andre involverede i form af administration, studievejledning o.a. være parate til at involvere sig i en ny arbejds- og studieform. Denne parathed omfatter (men er ikke begrænset til) lyst og evne til at arbejde i virtuelle miljøer, der stiller nye krav til kommunikativ kompetence og samarbejdsformer samt specielt for lærere og studerende evne til at omstille sig til at udnytte den nyvundne fleksibilitet aktivt og positivt. For det tredje er der en række krav til teknologien – deltagerne skal have nem adgang og systemerne skal være designet til at understøtte effektiv brug i lyset af de pædagogiske og faglige målsætninger og brugergruppen.

E-læringssystemer er ikke neutrale

E-læringssystemer til støtte for undervisnings- og læreprocesser er ikke neutrale, men reflekterer bestemte forståelser af kommunikation og læring, som udtrykkes i systemernes funktionalitet og i deres brugergrænsefladedesign. Ligesom fysiske bygninger, kan systemerne være designet mere eller mindre optimalt i forhold til at understøtte de læreprocesser, som skal finde sted. Et auditorium med faste stole kan vanskeliggøre gruppearbejde, fordi rummets indretning fra udgangspunktet har været tiltænkt en anden funktion. Derudover kan rummet endvidere være designet uhensigtsmæssigt i forhold til dets intenderede brug. Tager vi igen auditoriet som eksempel kan det være indrettet så der er for stor afstand mellem talere og lyttere, hvilket mindsker oplevelsen af nærvær og vanskeliggør deltagelse i diskussion. Det er den samme problematik, som gør sig gældende i forhold til design af e-læringssystemer.

Det er derfor nødvendigt at gøre sig overvejelser om, hvilke undervisningshandlinger og læringsaktiviteter, som systemerne skal understøtte, det vil sige hvilken funktionalitet skal være til stede, og hvorledes skal disse funktioner designes for at støtte den brug, som skal finde sted.

Inden for forskning og udvikling tales der om nogle forskellige e-læringstraditioner, som netop repræsenterer forskellige underliggende syn på, hvad læring er og dermed, hvordan ikt bedst muligt kan støtte læringen (Koshmann & O´Malley, 1994). Computerbaseret træning kom som det første markante eksempel frem allerede i 1960'erne og bygger på en tradition for programmeret undervisning (Skinner, 1968). Det læringsteoretiske grundlag, behaviorismen, opfatter viden som et objekt, der kan overføres fra en lærer til en elev eller fra et system til en elev. Ved systematisk at tilrettelægge information kan denne overføres til eleven, som betragtes som et tomt kar, der skal fyldes med information. Denne grundforståelse udgør også grundlaget for "intelligente tutoring systemer", der kom til i 1970'erne og dog sofistikeres ved at modellere forskellige brugerprofiler, som programmerne kan tilpasse sig.

Mikroverdener kom frem i 1980erne og er baseret på konstruktivistiske læringsprincipper inspireret af Bruner (1966) og Piaget (1969). Her lægges vægt på, at den studerende konstruerer forståelsen af sig selv og verden gennem aktive eksperimenter (Papert, 1983). Viden kan ikke overføres, men viden skabes af den enkelte gennem interaktion og forhandling med omgivelserne. Vægten på det interaktive og forhandlende aspekt videreudvikles i den socialkonstruktivistiske forståelse af læreprocesser, som kommer til udtryk i forsknings- og praksisområdet omkring Computer Supported Collaborative Learning (CSCL). Her i begyndelsen af det 21. århundrede udvider e-læringsbegrebet sig til ikke kun at omhandle de formelle læreprocesser uddannelsesinstitutioner tilrettelægger, men også de uformelle, som opstår i sociale fællesskaber. Der er også en stigende opmærksomhed på, at forskellige vidensformer - handlingsviden og eksplicit viden - spiller sammen og må udnyttes i læringsøjemed. Derudover frigøres læreprocesserne også fra deres binding til tid og sted. Forskningen begynder derfor at tale om virtuelle læringsmiljøer og læringsformer, og det læringsteoretiske grundlag udvides med teorier om "læring i praksisfællesskaber"(Wenger, 1998).

I denne artikel interesserer vi os især for e-læringssystemer til at støtte udviklingen af virtuelle læringsmiljøer på et projektpædagogisk grundlag, da de mest radikalt tilbyder nye måder at organisere og tilrettelægge læring på. Der er således tale om både et brud med udbredte undervisningsformer og tidligere kendte former for e-læring.

Metode

En analyse af teknologier til støtte af læring kan have forskelligt udgangspunkt og forskellige mål: 1. Teknologien som udgangspunkt med henblik på at udpege nødvendige tekniske funktioner, 2. Bred læringsteoretisk og pædagogisk kortlægning som udgangspunkt for at opstille krav til teknologien på tværs af tilrettelæggelsesformer og 3. Fokus på en specifik læringsstrategi med henblik på at udpege relevant teknologistøtte for netop denne tilrettelæggelse.

Det teknologisk motiverede udgangspunkt findes hos Wenger (2001). I en analyse af teknologier, der skal støtte dannelsen af praksisfællesskaber, opstiller han et sæt funktionelle krav, som grundlag for evalueringen. Problemet med en sådan evaluering er, at den kun giver en teknisk forståelse af, hvad praksisfællesskaber i virtuelle rum er. Den bygger på forventninger til teknologien i stedet for at tage udgangspunkt i praktiske erfaringer med tilrettelæggelse af læringsmiljøer. Som eksempel kan nævnes sms-beskeder, der er en primitiv teknologi, og som ville komme dårligt ud i Wengers analyse, men som alligevel kan være en vigtig teknologi til støtte af visse funktioner i et praksisfællesskab.

Den brede læringsteoretiske kortlægning findes hos Reeves (1997), der har beskrevet det, han kalder for fjorten pædagogiske dimensioner for ikt-støttet læring. De universelle dimensioner skal bruges til at evaluere ikt-støttet læring og til at gennemføre komparative undersøgelser. Problemet med universelle dimensioner er, at de kun undtagelsesvis vil indfange de specifikke aspekter ved forskellige læringssystemer og læringsformer. De bliver for generelle og overfladiske, og Reeves' opstilling vil for eksempel have begrænset værdi ved evaluering af teknologisk støtte til projektarbejde.

Denne artikel tager det tredje udgangspunkt, hvor fokus rettes mod en bestemt læringsstrategi, det problemorienterede projektarbejde, og hvor evalueringen tager udgangspunkt i de forskellige processer og aktiviteter, der indgår i projektarbejdsformen. Argumentet er, at en adækvat evaluering af virtuelle læringsomgivelser må tage udgangspunkt i, hvordan læringsaktiviteterne kan udfolde sig i teknologien. Det er læringsaktiviteterne, som er det centrale, og det er læringsaktiviteter, man designer for i udviklingen af virtuelle læringsomgivelser.

Det betyder også, at en analysemodel både bør være funderet i nogle faktiske erfaringer og teoretisk indsigt i de læreprocesser analysen forholder sig til. I den resterende del af denne artikel vil vi præsentere vores erfaringsbase samt diskutere en læringsteoretisk forståelse af virtuel projektpædagogik. Endelig vil vi kombinere det teoretiske perspektiv og de konkrete erfaringer i en analysemodel og anvende den i analyse af tre forskellige e-læringssystemer.

Virtuel projektpædagogik som analysegrundlagDen virtuelle projektpædagogik, som specielt er udviklet ved Aalborg Universitet (Dirckinck-Holmfeld, 1990; Dirckinck-Holmfeld, 2002; Bygholm, 2002) og i mindre omfang ved Roskilde Universitetscenter (Jensen, 2000), giver grundlæggende nogle meget spændende muligheder for fleksibel tilrettelæggelse af kvalitetslæringsmiljøer.

Den virtuelle projektpædagogik bygger på en integration af følgende didaktiske principper: problemorientering, deltagerstyring, fælles projektarbejde, tværfaglighed, og aktionslæring (for en uddybning, se Dirckinck-Holmfeld, 2002). På den måde ligner den virtuelle projektpædagogik, som her anvendes på masteruddannelsen i Ikt og Læring meget den projektpædagogik, som anvendes på de fysiske institutioner, herunder uddannelserne i Humanistisk Datalogi. Den væsentligste forskel udgøres af læringsmiljøet, som primært er et virtuelt læringsmiljø medieret af computere og internet. For at give et indtryk af de to miljøer vores erfaringsgrundlag stammer fra gennemgås her kort deres rekrutteringsgrundlag, faglige indhold, tilrettelæggelse inklusiv anvendelse af virtuelle læringsmiljøer samt kilderne til de problemstillinger, som de studerende arbejder med.

Masteruddannelsen Ikt og Læring er en to-årig uddannelse på halv tid tilrettelagt for voksne, professionelle. Uddannelsen er tilrettelagt som web-baseret læring med fire to-dages seminarer pr. år. Læringsmiljøet designes som et samspil mellem kursusarbejde og projektarbejde inden for et givet tema. Kursusarbejdet giver en indføring i de forskellige fag og discipliner, som knytter sig til temaet, medens projektarbejdet sikrer de studerendes egen forskningsinteresse og fordybelse herindenfor. De studerende opfordres til at arbejde med læringsprojekter med udgangspunkt i problemer og fænomener fra deres arbejde i lyset af de teorier og metoder, de gennem uddannelsen har fået kendskab til. Det er tilsyneladende ikke noget problem at få studerende, der til dagligt arbejder i forskellige virksomheder og organisationer, til at arbejde sammen. Nogle grupper vælger at arbejde sammen med udgangspunkt i en enkelt studerendes arbejdsplads, men på en principiel måde således at læringsprojektet også kan gavne i deres egen organisation. Andre vælger at arbejde med en problemstilling, som går på tværs af flere virksomheder og organisationer, men således at empirien udgøres af deres "egen" virksomhed. Det interessante er, at de studerende vitterligt arbejder sammen, og noget kan tyde på, anvendelsen af e-læring har en positiv indflydelse her. I sidste ende er det universitetet, der vurderer læringsudbyttet, som skal respektere de akademiske krav, der er til uddannelser på dette niveau.

Bachelor- (3 årig) og kandidatuddannelserne (2 årig) i Humanistisk Datalogi på Aalborg Universitet er traditionelle fuldtidsuddannelser tilrettelagt for (unge) studerende med en gymnasial uddannelse og uden krav om særlig erhvervserfaring. De fleste uddannelsesaktiviteter tilrettelagt af universitetet foregår på universitetet suppleret med web-baserede aktiviteter. Dertil kommer omfattende brug af blandt andet web-baserede aktiviteter, som de studerende selv tilrettelægger, herunder deres projektarbejde.

Læringsmiljøet på uddannelserne i Humanistisk Datalogi har indholds- og tilrettelæggelsesmæssige overlap med masteruddannelsen i Ikt og Læring. Projektpædagogikken er i højsædet; undervisningen søges tilrettelagt, så der kan opstå et frugtbart samspil mellem kursusundervisning og projekter, hvor de studerende selvstændigt og under eget ansvar behandler reelle problemstillinger. På Humanistisk Datalogi er det naturligvis centralt for læringsmiljøet, at uddannelserne er forankret on-campus. Det vil i det aktuelle tilfælde sige, at de studerende jævnligt går til forelæsninger, workshops og værkstedsøvelser i universitetets fysiske bygninger og har mulighed for også at placere dele af deres projektsamarbejde som synkrone møder i universitetets bygninger. For nylig har man samlet viften af lærer- og studenterdrevne initiativer under en fælles paraply og indført en officiel ikt-baseret læringsomgivelse (baseret på Lotus Quickplace), der tilføjer kursusundervisningen en samlet virtuel platform. Samme omgivelse giver også de studerende mulighed for at oprette projektrum, der kan bruges til at støtte samarbejdet i projektgrupperne. Lærerne har eksperimenteret med undervisningsformerne, fordi de her så en mulighed for at udvikle kvaliteten af de studerendes læring ved f.eks. at gå fra traditionelle forelæsninger til en mere dialogbaseret og fleksibel form. De studerende har eksperimenteret med ikt-støttet samarbejde i projektgrupperne, fordi de ønskede større fleksibilitet i forhold til valg af arbejdssted og -tid. Dermed er en særlig on-campus version af den virtuelle projektpædagogik og det virtuelle projektarbejde under etablering[5]. Grænserne mellem masteruddannelsens distribuerede læringsmiljø og de traditionelle bachelor- og kandidatuddannelsers læringsmiljø er med andre ord på dette punkt ikke længere så tydelige, som man måske umiddelbart ville forvente.

For at kunne vurdere funktionaliteten i forskellige e-læringssystemer i forhold til det virtuelle projektarbejde, vil vi i det følgende identificere nogle af grundprincipperne i det læringsteoretiske grundlag bag projektpædagogikken. Vi vil her tage fat i tre forhold, der tilsammen udgør vores analysemodel: *meningsforhandling*, *koordinationsarbejde* og *ressourcehåndtering*. Begrundelsen for, at vi fokuserer på disse tre forhold er dels teoretisk begrundet ud fra de elementer, der konstituerer samarbejde i et praksisfællesskab (Wenger, 1998; Schmidt, 1994; Strauss, 1985; Strauss, 1988 samt Fjuk og Dirckinck-Holmfeld, 1999), og dels erfaringsmæssigt og empirisk begrundet gennem vores arbejde med udviklingen af virtuelle læringsfællesskaber.

Meningsforhandling

Etienne Wenger beskæftiger sig i bogen: Communities of Practice – Learning, Meaning and Identity (Wenger, 1998) med fænomenet meningsforhandling:

" The negotiation of meaning is a productive process, but negotiating meaning is not constructing it from scratch. Meaning is not pre-existing, but neither is it simply made up. Negotiated meaning is at once both historical and dynamic, contextual and unique (...) meaning is always the product of its negotiation, by which I mean that it exists in this process of negotia-

[5] For yderligere indsigt i udviklingsarbejdet henvises til afrapportering fra projektet Virtuelle Læringsformer og Læringsmiljøer (ViLL). Offentliggøres på http://www.ell.aau.dk foråret 2004.

tion. Meaning exists neither in us, nor in the world, but in the dynamic relation of living in the world" (ibid., s. 54).

Wenger beskriver meningsforhandling som en dualitet mellem deltagelse og reifikation (tingsliggørelse)[6]. Deltagelse og tingsliggørelse er ifølge Wenger sammenhængende processer, som interagerer og forudsætter hinanden uden at erstatte hinanden. Deltagelse er en aktiv proces, som Wenger reserverer for aktører, som er medlemmer af sociale praksisfællesskaber. Deltagelse implicerer gensidighed mellem aktører i en fælles proces af genkendelse og anerkendelse. Deltagelse er samtidig et bredere og dybere begreb end interaktion. Vi er således også deltagere i et virtuelt læringsmiljø, selv om vi i perioder ikke interagerer.

Reifikation beskriver ifølge Wenger vores engagement med verden som produktion af mening. Webster definerer reifikation således: "To treat (an abstraction) as substantially existing, or as a concrete material object" (her efter Wenger 1998, s. 58). Etymologisk betyder begrebet "at gøre noget til en ting". I den oprindelige marxistiske betydning af ordet betød det også fremmedgørelse, hvilket ikke er tilfældet i Wengers brug. Wenger bruger begrebet bredt til at dække alle de processer, hvor man gør noget, designer, repræsenterer, giver navn til, institutionaliserer etc. I den forstand er reifikationen ikke værdifri; den er udtryk for værdiladede valg. Samtidig gør han et stort nummer ud af at fastholde, at der er tale om et dynamisk forhold mellem proces og produkt. Reifikation er således ikke blot et produkt, idet man ikke kan tale om et produkt uafhængig af den fortolkning af produktet, som samtidig finder sted. Reifikationer kan antage mange former: et røgsignal eller en gammel pyramide, en formel eller en konkret lagerhal, et lille logo eller et stort informationssystem. Det væsentlige er, at reifikationer fastholder og udtrykker mening, som hjælper til at organisere den sociale praksis og fortsatte meningsforhandling.

En udfordring til det virtuelle fleksible læringsmiljø bliver således, hvorledes dette understøtter meningsforhandling som et samspil mellem deltagelse og skabelse af læringsprodukter? Og på hvilke måder muliggøres deltagelse? På hvilke måder synliggøres deltagelse? På hvilke måder muliggøres, at meningskonstruktionen fastholdes?

Koordinationsarbejde

Både empirisk og teoretisk ved vi, at koordinationsarbejde spiller en meget central rolle i gensidigt forpligtende læreprocesser (Fjuk & Dirckinck-Holmfeld, 1999) og i fælles arbejdsprocesser (Schmidt 1994; Strauss 1985; Strauss 1988). Der er tale om nogle forskellige typer af koordinationsarbejde: *Fælles afhængighed* i betydningen fælles forståelse, hvor den enkeltes bidrag til helheden er afgørende, og helheden på den anden side er nødvendig for den enkelte; *Sekventiel afhængighed*, hvor den enkeltes eller gruppens bidrag til processen er nødvendig for at projektet kommer videre og endelig *gensidig afhængighed*, som refererer til den situati-

[6] Tingsliggørelse har for læsere med en marxistisk baggrund medbetydningen af fremmedgørelse. I vores brug, som bygger på Wengers brug af det engelske begreb reification, betyder det alene tingsliggørelse i betydningen af fastholdelse, institutionalisering, repræsentation, struktur etc. Det er dog vigtigt at holde fast i, at reifikationsprocesser aldrig er neutrale, men at de altid udtrykker et værdiforhold – bevidst som ubevidst.

on, hvor den enkeltes resultat bliver input for de andre og vice versa (se Thompson 1967, s. 54-55, her efter Schmidt (1994, s. 13) (vores oversættelse)).

Koordinationsarbejde er centralt for at forstå, hvorledes samarbejdet mellem studerende udspiller sig i projektarbejdet og kan betragtes som en særlig genre af meningsforhandling, der har til formål at sikre at gruppen faktisk eksisterer og samarbejder som en gruppe. Sammenlignet med koordinationsarbejde i en arbejdsproces har studiearbejde det tillægsaspekt, at projekt- og kursusarbejdet er den væsentligste arena for fælles meningskonstruktion og skal føre til udvikling af erkendelse, kritisk refleksion, konfrontation og tilpas gensidig forståelse for at de fælles læreprocesser og det fælles projektarbejde kan tage form.

Koordinationsarbejdets og specielt den fælles afhængigheds store betydning er også synlig i Wengers perspektiv på meningsforhandling i praksisfællesskaber. Praksisfællesskaberne udgør som nævnt ovenfor rammen for meningsforhandling ligesom de også vedligeholdes og udvikles gennem dualiteten af deltagelse og reifikation. Ifølge Wenger (1998, s. 73) defineres praksisfællesskaber ved tre forhold: delt repertoire (shared repertoire), gensidigt engagement (mutual engagement) og fælles projekt (joint enterprise) blandt praksisfællesskabets medlemmer. Behovet for et delt repertoire udtrykkes i problemorienteret projektpædagogik blandt andet ved, at deltagerne må have et fælles grundlag for meningsforhandlingen. Samtidig må deltagerne dog også bringe forskellige forudsætninger for at bidrage positivt til meningsforhandling og opbygning af et nyt fælles repertoire.

Gensidigt engagement og ikke mindst forhandling og udbygning af det gennem et projektforløb er afgørende for at en projektgruppe faktisk kan gennemføre læringsforløbet tilfredsstillende og som gruppe konstruere viden og udtrykke den i sammenhængende form i projektrapporten. Fælles projekt eller fælles mission, som man måske også kan oversætte Wengers begreb til, forhandles også gennem projektforløbet og hænger nært sammen med det gensidige engagement.

Praksisfællesskabet kan være specielt vanskeligt at etablere og vedligeholde i et virtuelt læringsmiljø, som baserer sig på asynkron kommunikation. I et asynkront miljø kan det således være svært at vedligeholde et fælles repertoire, gensidigt engagement og fælles mission, fordi adgangen til løbende at koordinere medlemmernes parallelle arbejde er dårligere, end hvis gruppemedlemmerne arbejdede samtidigt i samme fysiske rum.

En udfordring til det virtuelle læringsmiljø bliver således, hvordan dette understøtter deltagelse og reifikation i den del af meningsforhandlingen, der har med koordinationsarbejdet at gøre. På hvilke måder understøttes koordinationsarbejde? På hvilke måder synliggøres koordinationsarbejde?

Ressourcer og ressourcehåndtering

Begrebet ressourcer dækker over materialer og værktøjer, som stilles til rådighed for den lærende; i det aktuelle tilfælde den universitetsstuderende. Problemstillingerne vedrørende res-

sourcer og ressourcehåndtering har imidlertid ændret sig med de forskellige generationer af e-læring, fordi synet på, hvad læring er og dermed hvad ressourcer er har ændret sig tilsvarende. I "computer-baseret træning" blev træningssystemet designet med henblik på at præsentere et nøje tilrettelagt stofområde og overtage undervisningsforløbet. Den håndgribelige ressource blev synonym med undervisningsforløbet, og den studerendes eneste ressourcehåndtering bestod i at finde systemet og interagere med enkeltelementerne, efterhånden som de præsenterede sig. Med udviklingen af mikroverdener ændrer perspektivet sig, og e-læringssystemerne bliver nu i højere grad en ressource og en ressourcecontainer for de studerende, hvor de kan gå på opdagelse. I stedet for de styrende systemer, hvor problemformuleringen så at sige er bygget ind i e-læring systemet, får vi nu nogle systemer, som skal *støtte* undervisning og læring.

I den virtuelle projektpædagogik benyttes begrebet ressource som en betegnelse for:

1) Materialer og værktøjer, som stilles til rådighed for at skabe rammer omkring og struktur i processen.
2) Ressourcer som de studerende selv finder frem til.
3) Ressourcer som de studerende producerer undervejs i processen og dermed kan bygge videre på.

Til forskel fra de styrede forløb, men også til forskel fra traditionen omkring mikroverdener betragtes læringsressourcerne i læringsmiljøet som åbne, og det er i høj grad de studerendes ansvar i samarbejde med lærerne til stadighed at inddrage nye ressourcer, både i form af nye teorier og metoder, som kan antage alle dataformer, for eksempel bøger, web-baserede digitale materialer og i form af værktøjer til at støtte forskellige dele af processen, for eksempel tekstbehandling, billedbehandling og fildeling. Der kan også være tale om ressourcepersoner, for eksempel venner og bekendte eller formelt tilknyttede faglige ressourcepersoner i form af vejledere og bibliotekarer. Dertil kommer de ressourcer, som medstuderende eller tidligere studerende udgør i form af projekter, fastholdte dialoger og adgang til virtuelle rum for andre projekter.

Ressourcer er således et meget omfattende begreb som både indikerer noget som skal *støtte* de studerende i deres læreproces og *produkter* eller *delprodukter* af denne proces. Ressourcer kan antage mange former – og der er allerede udviklet mange ressourcer, som kan genbruges i vidt forskellige projekter. Ofte handler det mere om at tage ressourcerne i brug eller at skaffe adgang til ressourcerne end om at designe helt nye ressourcer. Spørgsmålet er hvordan denne ressourcehåndtering og –produktion kan støttes af et e-læringssystem?

Sammenfatning af analysemodellen

E-læringssystemer til brug i problemorienteret projektpædagogik vurderes ud fra følgende paratmetre:

- Meningsforhandling
    - Hvordan understøttes deltagelse og reifikation?
- Koordinationsarbejde

    - Hvordan håndteres fælles afhængighed i praksisfællesskabet: delt repertoire (shared repertoire), gensidigt engagement (mutual engagement) og fælles projekt?
- Ressourcer og ressourcehåndtering
    - Hvordan støttes anvendelse, produktion og deling af ressourcer i projektgruppen?

Hvilke e-læringsfaciliteter, der kan støtte henholdsvis meningsforhandling, koordinationsarbejde og ressourcehåndtering diskuteres i analysen. Først vil vi dog foretage en kategorisering af e-læringssystemer, da det giver et overordnet perspektiv på forskellige typer af funktionalitet.

Kategorisering af e-læringssystemer

Der udvikles og markedsføres en række e-læringssystemer til udvikling, vedligeholdelse, administration og leverance af e-læring. Dette område er ganske uoverskueligt. E-læringssystemerne bygger på forskellige teknologier, og de lægger op til forskellige læringsstrategier. Ingen systemer er pædagogisk neutrale og valget af system giver, sammen med indretningen naturligvis, en klar indikation af, hvilken praksis der forventes af brugerne (jf. diskussion ovenfor).

Afhængig af hvilken funktionalitet e-læringssystemerne tilbyder, kan man dele dem ind i forskellige kategorier. Centrale kategorier vil være:

- Indholdsleverancesystemer (undervisningssystemer)
- Konferencesystemer (kommunikationssystemer)
- Groupware (samarbejdssystemer)

Indholdsleverance- og læringsadministrationssystemer er systemer, hvor de centrale funktioner er tilrettelæggelse og publicering af undervisningsmateriale samt administration af de studerendes tilgang til materialerne. Disse systemer omtales også Learning Management Systems (LMS). Eksempler på systemer i denne kategori er:

- Lotus Learningspace og Lotus LMS (http://www.lotus.com)
- WebCT (http://www.webct.com)
- Blackboard (http://blackboard.com)

I **konferencesystemer** er det dialog i asynkrone fora, som er den grundlæggende, men ikke nødvendigvis eneste funktion. Eksempler på systemer i den kategori er:

- Virtual-U (http://www.vlei.com/)[7]
- FirstClass (http://www.softarc.com/)

[7] Virtual-U beskrives af VLEI som værende til leverance af on-line kurser, men vi fokuserer her på aktiviteter centreret omkring Vgroups modulet til støtte af asynkron dialog.

Groupware er systemer, hvor målsætningen er at støtte samarbejdet i større og mindre grupper. Det gøres med asynkron dialog, fildeling, versionsstyring af dokumenter og en række andre funktioner. Disse systemer er ofte ikke udviklet med e-læring for øje, men er med deres fokus på samarbejde interessante i denne sammenhæng. Eksempler på systemer i den kategori er:

- QuickPlace (http://www.lotus.com)[8]
- Groupcare (http://www.groupcare.com)[9]
- Igroups (http://www.igroups.dk/)

Disse kategorier er ikke absolutte beskrivelser, og mange systemer har funktioner som går på tværs af kategorierne. Alligevel har de fleste systemer en dominerende funktionalitet, som retfærdiggør deres placering.

For at diskutere hvilke muligheder, der ligger i de forskellige kategorier, har vi valgt at se på et system fra hver kategori: Lotus Learningspace (indholdsleverancesystem), Virtual-U (konferencesystem) og Lotus Quickplace (groupware). Som nævnt har vi vægtet at diskutere systemer vi i forvejen har konkrete erfaringer med at anvende. Det betyder blandt andet, at analysen ser på en version af Lotus Learningspace, der senere har fået grænsefladen opdateret en smule, ligesom Lotus LMS fra samme leverandør også er kommet på markedet senere.

Virtual-U

Virtual-U blev udviklet ved Simon Fraser universitetet i Canada som en del af et forskningsprojekt om socialkonstruktivistisk funderet e-læring, men i 1999 blev udvikling og markedsføring placeret i et eget selskab. Virtual-U markedsføres i dag af Virtual Learning Environments Inc.

Pædagogikken

Der ligger den udtalte pædagogiske erkendelse bag Virtual-U, at online læring ikke alene kan baseres på publicering af forelæsningsnotater på nettet. Det centrale værktøj i Virtual-U er derfor asynkrone konferencer, hvor fokus er interaktion og dialog mellem studerende og mellem studerende og lærere. Det er i konferencerne, man skal lære gennem meningsudveksling med andre og gennem skriftlig eksplicitering. Forskning i brugen af asynkrone konferencer (Sorensen, 1997) viser netop, at asynkrone dialoger fremmer refleksion, fordi de studerende må udtrykke sig skriftligt, og fordi det asynkrone medie giver rum for eftertanke. De studerende kan gennemlæse det, de skriver før det sendes, og de kan ændre i det. Derimod er det

[8] Lotus er i færd med at omdøbe Quickplace til Lotus Team Workplace. Vi overlader markedsføringen af det nye navn til Lotus og holder her fast i det mere kendte Quickplace.

[9] Groupcare og Igroups er begge internetbaserede tjenester, der tilbyder adgang gratis eller mod betaling. Betaling giver ekstra services..

vanskeligere at gennemføre samtidige, spontane dialoger som er vigtige for idégenerering og meningsforhandling.

Den pædagogiske organisering i Virtual-U baserer sig på en *kursusmodel*, hvor strukturen er prædefineret af systemet. Et kursus struktureres efter en færdig template, som rummer: tidsstrukturering, temaer, ressourcer, konferencer og aktiviteter (deriblandt afleveringer og prøver).

For at bruge Virtual-U som en læringsomgivelse for projektarbejdet, må vi tilpasse aktiviteterne i projektarbejdet til kursusmodellen. Det kan i udgangspunktet virke som en selvmodsigelse, men det er ikke en traditionel kursusmodel med forelæsninger og test som Virtual-U lægger op til. Kursmodellen med temaer, ressourcer, konferencer og aktiviteter harmonerer godt med organiseringen af projektarbejde. Projektarbejde kan også deles op i temaer, det bygger på nogle ressourcer (teorier og metoder), det skal forhandles gennem diskussion, og det består af nogle opgaver, som skal udføres (produkter som skal laves, og rapporter som skal skrives).

Erfaringer med Virtual-U

Ved Aalborg Universitet har man lang erfaring med at bruge Virtual-U som læringsomgivelse til både fjernundervisning og i traditionelle kurser på universitetet. Den mest omfattende brug af Virtual-U er i den tidligere omtalte masteruddannelse i Ikt og Læring. Virtual-U anvendes også i afgrænsede dele af uddannelserne i Humanistisk Datalogi.

Meningsforhandling

I Virtual-U støttes meningsforhandling først og fremmest af de asynkrone konferencer, som kan oprettes efter behov. Asynkrone konferencer har den egenskab, at de er gode til at vise deltagelse i en forhandlingsproces. Man kan se, hvor mange indlæg hver enkelt har leveret, indhold og omfang af hvert bidrag, samt hvor det har placeret sig i processen. Fordi dette er synligt for alle, også for vejlederen, der er tilknyttet projektgruppen, skaber det en forpligtelse til at deltage og et krav om, at man må redegøre for, hvorfor man eventuelt er fraværende.

Problemet med konferencer er, at de kan blive vældig lange, og et projekt kan nemt omfatte flere hundrede indlæg. Da bliver det en udfordring at samle op og skabe orden og at fastholde mening (reifikation) sådan, at forhandlingsprocessen ikke går i ring eller flyder ud, og man mister fokus i projektet.

En måde at skabe mere struktur i projektkonferencerne er, som det fremgår af figur 1 at benytte underkonferencer for at organisere projektarbejdets forskellige processer.

Figur 1. Brug af underkonferencer for at strukturere projektarbejde.

Eksemplet ovenfor viser, hvordan en projektgruppe har indrettet sig i Virtual-U, og hvordan de bevidst bruger underkonferencer til at skabe forskellige forhandlingsrum og for at give mere mening og struktur til projektarbejdet. Projektgruppen har lavet fem underkonferencer, som omhandler: litteratur, meddelelser, projektvejledning, projektstyring og projektcasen. Totalt produceres der 866 indlæg i dette projektforløb, men ved at organisere projektet i forskellige forhandlingsrum bliver processerne tydeligere, og det bliver enklere at fastholde den viden, som produceres. Alligevel er fastholdelse af viden en udfordring i asynkrone konferencer, når indlæggene og konferencerne bliver mange. Selv hvis man er påpasselig med at skrive opsamlinger, der sammenfatter indholdet i en konference forsvinder opsamlingen let som endnu et indlæg blandt tusind andre. Desuden er det vanskelig at gøre opsummeringen til en fælles proces i en konference, fordi man ikke kan editere i hinandens indlæg.

Asynkrone konferencer fremstår som velegnede til forhandlingsprocesser og til at synliggøre deltagelse, men det kan være vanskelig at fastholde, videreudvikle og dele en fælles mening. I Virtual-U mangler artefakter, hvormed man kan tingsliggøre og synliggøre den fælles viden, som forhandles frem i konferencerne. Der mangler artefakter som kan samle, strukturere og synliggøre de erfaringer som projektgruppen bygger op.

Vejledning er også en form for meningsforhandling, og med en problemorienteret tilgang er det et mål, at vejledningen skal opretholde de studerendes kontrol over problemet samtidig med, at perspektiverne for behandling af problemet udvides eller præciseres i forhold til de faglige mål. Ideelt set betyder det, at de studerende skal være med til at sætte dagsordenen, og med vejlederens støtte udvikle deres egen erkendelse. Dette er ikke mindre udfordrende, når vejledningen lægges i konferencer. Vejlederen ønsker at beskytte sin egen tid og afsætter derfor bestemte tidspunkter eller perioder til vejledning. Desuden skaber skriftligheden en yderligere formalisering af vejledning. Den er eksplicit i sin form og kan fremstå som mere autoritær og vanskeligere at opponere mod. Det som kendetegner "vejledningsmøderne" er, at de er adskilte, uafhængige hændelser, og at der er få indlæg og kun lidt virkelig dialog.

Vejlederens tilbagemelding er ofte koblet direkte til teksten, som de studerende har afleveret. Tilbagemeldingen får først sin egentlige betydning i den efterfølgende meningsforhandling

internt i gruppen. Da er der begrænset mulighed for kommentarer, afklaringer og nye spørgsmål til vejlederen, hvilket vejlederen må tage højde for i formuleringen af sin vejledning således, at den både forholder sig til konkrete tekster og til projektet og dets fremdrift som helhed.

Koordinering

Konferencer er som nævnt gode til at eksplicitere og synliggøre meningsforhandlingen, det vil sige støtte selve koordineringen og udviklingen af en fælles forståelse, men det kan være vanskeligt at fastholde koordineringen som en delt erfaring i et konferenceindlæg. Desuden er det vigtigt at være opmærksom på rollefordelingen i gruppen, således at den eller de gruppemedlemmer, der føler sig bedst tilpas i tekstbaserede asynkrone konferencer ikke overtager styringen af projektet.

Til at fastholde koordinering i Virtual-U kan kursustemplaten bruges som en projektplan, der for deltagerne synliggør det fælles projekt. Den kan bruges til at organisere projektets forskellige faser og koble vigtige ressourcer til processen. Problemet er, at man er henvist til en færdig struktur, som ikke nødvendigvis dækker det enkelte projektarbejde. Virtual-U kan også generere en kalender på baggrund af datoer knyttet til aktiviteterne, men datoer kan kun ændres ved at ændre i kursustemplaten. Noget reelt kalenderværktøj er der således ikke tale om

Ressourcehåndtering

Ressourcehåndtering i Virtual-U foregår sædvanligvis i en egen konference, hvor projektmedlemmer kan sende indlæg med aktuelle ressourcer; dokumenter, links, forslag til litteratur og lignende. Fordelen ved at bruge konferencer er, at man kan koble en diskussion direkte til valget af ressource, og man kan få en meningsudveksling om ressourcens indhold, fortolkninger og hvorvidt den er egnet til projektproblemet. Ulempen er igen, at det er vanskeligt at finde frem til indhold i en konference. Konferencestrukturen skaber ikke oversigt, og det er umuligt at omgruppere og organisere konferenceindlæggene for at skabe orden i ressourcerne.

Opsummering af Virtual-U

Fordelen ved at bruge konferencesystemer som Virtual-U og FirstClass er, at de fokuserer på læring gennem dialog, refleksion og meningsudveksling i stedet for præsentation og overføring af undervisningsmateriale. Denne læringsstrategi er i overensstemmelse med projektpædagogikkens grundtanke.

Udfordringen er at fastholde den mening, som konstrueres i konferencerne, gøre den synlig og gøre den til en del af projektgruppens delte repertoire (Wenger, 1998). Mening og viden har let ved at forsvinde i konferencens uoverstigelige mængder af information.

Lotus Learningspace

Lotus Learningspace er udviklet af Lotus som også står bag det meget udbredte intranetsystem Lotus Notes. Notes anvendes ofte internt i virksomheder til publicering og deling af information i enkelte grupper eller på tværs af organisationen. Tidligere versioner af Lotus

Learningspace har været en direkte udvidelse til Lotus Notes, hvilket dog fra og med version 4 af Learningspace, som vi her ser på, ikke længere er tilfældet.

Pædagogikken

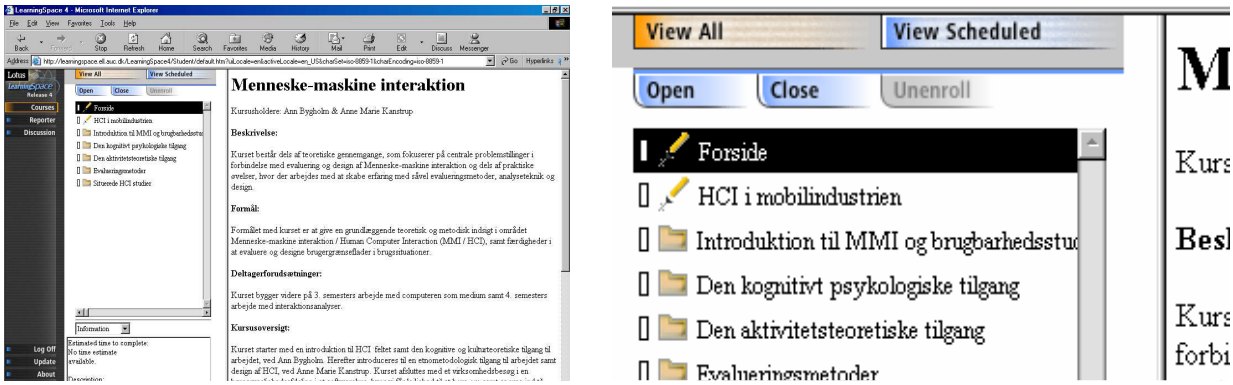
Learningspace udtrykker med sin funktionalitet og sit interface en pædagogik, der kan betegnes som traditionel klasseundervisning oversat til e-læring. Systemet lægger op til, at en lærer planlægger et kursusforløb, udarbejder materiale, publicerer det i Learningspace for derefter at sætte afviklingen af kurset i værk, afvikle det og eventuelt slutte af med en test. Læreren og de studerende kan kombinere arbejdet med stoffet, ofte i form af læsning, med synkron eller asynkron kommunikation og dermed også tilføre læringen et kollaborativt element.

Erfaringer med Learningspace

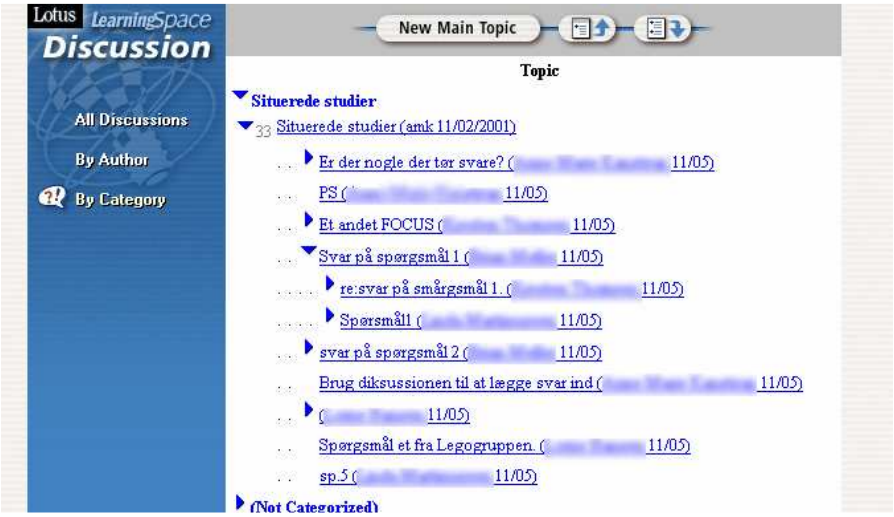
Nærværende analyse af Learningspace bygger på erfaringer opnået gennem et semesters brug af systemet på 5. semester af uddannelsen i Humanistisk Datalogi. Analysen bygger på interviews med lærere og studerende på det omtalte semester samt observationer af den konkrete brug af systemet.

Beskrivelse af Learningspace

Learningspace består af de to hovedmoduler ”*Core”* og ”*Collaboration”*. Core udgør systemets kerne og anvendes til at levere kurser asynkront. Derfor hører Learningspace til den kategori, der normalt betegnes ”*indholdsleverencesystemer”*. Kursusmaterialerne produceres uden for Learningspace og tilgås via kursusstrukturen, der oprettes i Learningspace.



Figur 2. Her ses skærmbilledet den studerende møder ved indgangen til et kursus til venstre og selve kursustrukturen forstørret til højre. Når det enkelte punkt i strukturen åbnes bliver det tilknyttede indhold synligt for den studerende.



Figur 3. Asynkron diskussion i Learningspace.

Eneste tekniske krav til kursusmaterialerne er, at de skal kunne vises i en web-browser. Learningspace giver desuden mulighed for at føre en log over, hvornår den enkelte studerende tilgår de forskellige dele af materialet, så man som lærer kan følge forløbet. Der er også mulighed for at teste de studerende gennem anvendelse af multiple-choice formularer.

Collaboration-modulet anvendes til synkron og asynkron kommunikation. Den asynkrone kommunikation er skriftlig og finder sted i diskussionsfora, mens den synkrone bygger på skriftlig kommunikation (chat), fælles whiteboard, samt udveksling af video og lyd.

Meningsforhandling

I samarbejdet mellem de studerende kan den enkelte som beskrevet ovenfor deltage på flere måder. Det kan dels være ved at læse eller bearbejde indhold leveret gennem kursusleverancedelen og dels ved at indgå i diskussionsfora eller synkrone møder med andre studerende.

Ønsker man som studerende at deltage aktivt, er det mest oplagt at gøre det i diskussionsfora og synkrone møder. En lærers eller studerendes læsning af indlæg i diskussionen bliver ikke synlig for andre, medmindre vedkommende skriver et svar. Mangel på automatisk reifikation øger kompleksiteten i meningsforhandlingen unødigt, da alene synliggørelsen af, at man har læst et indlæg, ofte kan være tilstrækkeligt svar. Reaktion i form af ændringer i eller tilføjelser til kursusmaterialerne er også problematisk, da det kræver adgang til administrationsmodulet, der er forskelligt fra det modul, hvor lærere og studerende normalt arbejder i meningsforhandlingssituationen.

Den primære kritik mod indholdsleverancesystemer som Lotus Learningspace set i lyset af en problemorienteret projektpædagogik er således, at funktionalitet og interface primært er rettet mod en lineær proces, hvor læreren planlægger et forløb og derefter afvikler det på baggrund af en foruddefineret struktur. Arbejdes der problemorienteret med projekter, er det ikke bare læreren eller vejlederen, men bestemt også de studerende, der har behov for at kunne tilføje en struktur nye elementer som det manifeste produkt af deres egen lærings- og arbejdsproces.

Vurderingen af mulighederne for meningsforhandling i Learningspace må dog også berøre det kollaborative modul, hvor synkront arbejde på fælles ressourcer i en distribueret gruppe muliggøres. Man kan samtidig diskutere en fælles ressource og arbejde på den sådan at en mødedeltagers rettelse straks bliver synlig hos de andre, der kan vælge at lave nye tilføjelser og ændringer. Dermed er såvel reifikation som deltagelse i meningsforhandlingen ganske klar, og i forhold til visse dele af projektet kan gruppen arbejde ganske hurtigt og effektivt i det synkrone miljø. En del af de problemer, der i Virtual-U er knyttet til vejledningsmøder, vil formentlig også kunne afhjælpes ved at anvende det kollaborative modul fra Learningspace. På den anden side er det vigtigt at holde sig for øje, at det synkrone miljø ikke giver samme rum for refleksion, som det asynkrone tekstbaserede.

Koordinering

Lotus Learningspace indeholder ingen egentlig kalender, hvilket i et koordineringsperspektiv er en mangel. Planen for det enkelte kursus kan dog aflæses i forbindelse med kurset. Modulet til facilitering af synkront samarbejde tilbyder også en kalenderlignende funktion til annoncering af planlagte synkrone sessioner, hvilket også er særdeles vigtigt. Synkront samarbejde inden for et stærkt afgrænset tidsrum kræver netop en del planlægning for at sikre, at alle deltagere er til stede, og at de nødvendige ressourcer er til rådighed.

Koordinering kan desuden ske gennem annoncering på den første webside studerende møder, når de logger på systemet eller på websider under det enkelte kursus. En anden mulighed er at anvende diskussionsmodulet til at oprette en tråd eller et særskilt forum til kommunikation, der har med koordinering af gruppens arbejde at gøre. Her gælder dog de samme muligheder og forbehold, som blev diskuteret i forbindelse med Virtual-U. Disse løsninger støder dog alle på det problem, at oversigten over planlagte aktiviteter enten bliver svært tilgængelig, fordi den skal stykkes sammen af forskellige kilder eller bliver besværlig at opdatere, fordi indholdet af en webside med oversigten skal opdateres manuelt uden for systemet.

Opbygningen af et delt repertoire, gensidigt engagement og fælles projekt er i Learningspace ramt af de samme vanskeligheder som i Virtual-U. Asynkrone diskussioner fremstår som det primære medium for disse aktiviteter, fordi materialehåndteringen bygger på leverance og ikke på interaktion.

Ressourcehåndtering

Lotus Learningspace tilbyder som allerede antydet forskellige muligheder for håndtering af forskellige former for elektroniske ressourcer. I Core-delen, som er det primære værktøj til distribution af materialer er der dog ikke gode muligheder for at reifikere udviklingen i et delt repertoire. Dertil er adgangen til publikation og revision af materialer alt for besværlig, og der er heller ikke det systemet er bygget til. Risikoen for forvirring omkring hvem, der har rettet en tekst hvornår er også betydelig, fordi der ikke er noget god versionsstyring knyttet til materialehåndteringen.

I synkrone møder kan nogle ressourcetyper bearbejdes direkte idet systemet for eksempel giver adgang til et delt whiteboard, hvorved muligheden for at forhandle og reifikere et delt repertoire forbedres markant.

Opsummering af Learningspace

Lotus Learningspace er som kursusleverancesystem bedst egnet til at støtte de traditionelle former for kursusaktivitet i forbindelse med projektarbejdet, hvor man ønsker at præsentere et stofområde for de studerende. Meningsforhandling med medstuderende og lærere om stoffet kompliceres dog ved, at denne må finde sted i et særskilt diskussionsforum meget lig Virtual-U eller i et synkront mødeforum, sammenlignet med Virtual-U er sidstnævnte dog en styrke ved Learningspace. Det vanskeliggør desuden samarbejdet, at meningsforhandling relateret til koordinering og ressourcehåndtering også må placeres i diskussionsforummet, der ikke i nævneværdig grad understøtter disse processers særkender.

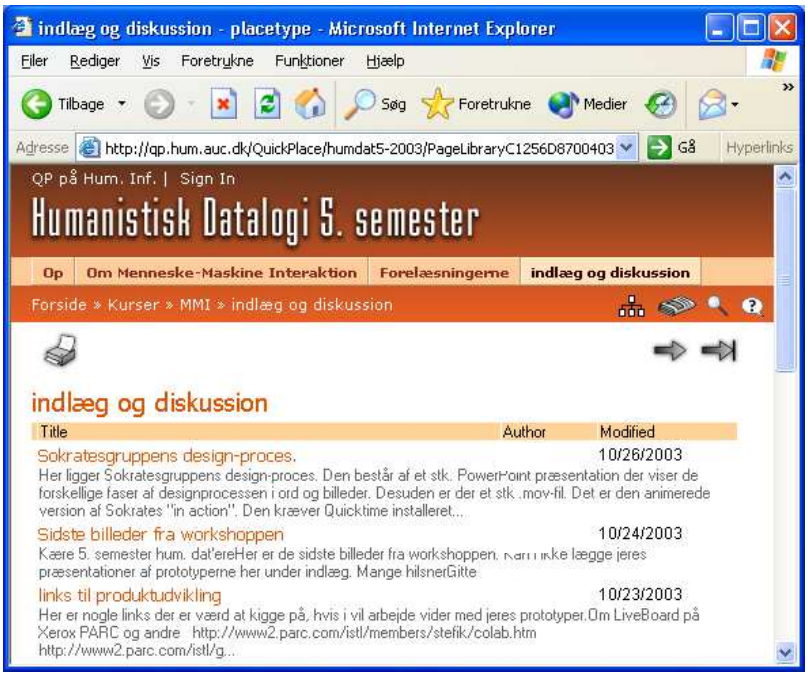
Lotus Quickplace

Lotus Quickplace er, som navnet tilsiger, udviklet af Lotus. Quickplace er udtryk for den sidste kategori, da systemet som udgangspunkt er udviklet som støtte til gruppers samarbejde og ikke specifikt til e-læringsrelaterede formål.

Pædagogikken

Selvom Quickplace som udgangspunkt ikke er udviklet til anvendelse i lærings- og undervisningssammenhænge, kan man godt sige, at det med sine funktioner og deres udformning knyttes til en bestemt pædagogik. I hvert fald er der ikke tvivl om, at systemet har potentiale for at understøtte et perspektiv, hvor projektorganisering står centralt.
Erfaringer med Quickplace

Nærværende analyse bygger på erfaringer opnået gennem halvandet års brug af Quickplace på Humanistisk Informatik og Humanistisk Datalogi. Analysen bygger på interviews med lærere og studerende på de omtalte uddannelser samt observationer af den konkrete brug af systemet. Yderligere behandling af ibrugtagningen af Quickplace i denne sammenhæng findes i Nyvang (2004).



Figur 4. Eksempel på brug af Quickplace i kursusundervisning.

Beskrivelse af Quickplace

Systemet tilbyder primært funktioner til asynkron kommunikation i relation til et samarbejde. Brugeren har således adgang til funktioner som: diskussionsfora, kalender, opgaveliste, links til andre steder på internettet og dokumentbibliotek. Quickplace kan desuden forsynes med et modul til synkront samarbejde beslægtet med det i Lotus Learningspace, men denne mulighed har vi ikke haft lejlighed til se at se nærmere på endnu. Det skal også fremhæves, at Quickplace har et særdeles fleksibelt interface i den forstand, at man som administrator let kan bygge en egen struktur og let kan uddelegere ansvar for forskellige dele af strukturen til forskellige brugere. Desuden kan Quickplace let tilpasses en organisations eksisterende grafiske identitet og dermed signalere et tilhørsforhold. Sammenlignet med for eksempel Lotus Learningspace er det vigtigt at bemærke, at indholdet i et Quickplace i stort omfang kan produceres direkte i systemet. Det er dog også i forhold til ethvert bidrag til Quickplace muligt at vedhæfte filer produceret i for eksempel et tekstbehandlingsprogram eller at oprette links til andre websteder med materialer.

Meningsforhandling

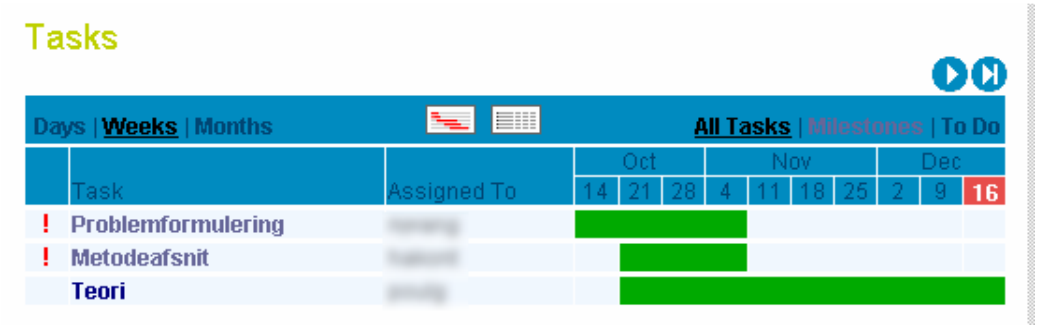
I Quickplace er det tydeligt, at samarbejdet mellem en gruppe studerende eller andre kan have flere former. Læsning af materialer af forskellig art, som andre har lagt ud i systemet, står således som et klart eksempel på deltagelse. Der er imidlertid heller ikke i Quickplace nogen automatisk reifikation af denne form for deltagelse, hvilket kan komplicere meningsforhandlingen unødigt. Deltagelsen synliggøres i form af egen produktion af indhold - f.eks. indlæg i diskussionen, publicering af dokumenter og tilføjelse af begivenheder i kalenderen. I Quickplace vælger man selv om et nyt indlæg fremstår som reaktion på eksisterende indhold, eller om det fremstår som et nyt emne eller tema uden direkte relation til tidligere indlæg. Dermed støttes reifikation af relationen mellem forskelligt indhold i systemet.

I Quickplace er afstanden mellem at læse og skrive i systemet ganske kort i den forstand, at man fra alle vinduer, hvor indhold læses, med et enkelt tryk på en knap kan skifte til et vindue, hvor nyt indhold kan produceres og publiceres. Denne tekniske detalje kan være med til at promovere aktiv deltagelse. Alle parter har også god adgang til at ændre eller lave tilføjelser til den struktur, man arbejder i og på den måde reifikere et bestemt syn på samarbejdet. Der kan for eksempel være tale om, at dokumentbiblioteket gøres til startside i stedet for diskussionsforummet, som en synliggørelse af, at man går fra forskningsfasen til produktionsfasen i projektet.

Koordinering

Quickplace indeholder en kalender, der deles af den aktuelle brugergruppe. Dermed er en vigtig understøttelse af gruppens koordinationsarbejde til stede. Omvendt kan det dog kritiseres, at der kun er tale om en delt kalender. Private kalendere må føres uden for Quickplace. Desuden er der ikke i systemet indbygget mulighed for let at skelne mellem faste aftaler som gruppen har indgået og forslag til aftaler eller deadlines, som stadig er under forhandling. Derfor understøtter kalenderfunktionen lige på dette punkt ikke aktivt selve den proces, det er at forhandle en aftale på plads.

Quickplace understøtter desuden koordinering og reifikation af det fælles projekt med en fælles opgaveliste, der kan sammenfatte projekt- eller rapportstruktur og arbejdsplan. Da uddelegering af opgaver står centralt i et projektarbejde kan opgavelisten være et meget nyttigt værktøj. Opgavelisten er naturligvis nært beslægtet med kalenderen, og de to funktioner er da også integrerede i den forstand, at man ved oprettelsen af en opgave kan vælge, om dens deadline også skal føres ind i kalenderen. Det betyder dog ikke, at forskellen på kalenderen og opgavelisten udviskes. I opgavelisten synliggøres det, som figur 5 herunder viser, tydeligt hvilken periode, der er sat af til løsningen af en opgave, samtidig med at den ansvarlige udpeges.



Figur 5. Taskliste i Quickplace. De forskellige opgaver og perioden afsat til at løse dem vises. Det markeres med udråbstegn i venstre side, at tidsfristen for en opgave er overskredet. Nærmere beskrivelse af den enkelte opgave findes ved at klikke på opgavens navn.

I problemorienteret projektarbejde kan der forekomme perioder, hvor gruppens medlemmer af ydre omstændigheder tvinges til at fokusere på andre opgaver end det fælles projekt. Her understøtter Quickplace en vis fastholdelse af den enkelte selv i perioder, hvor vedkommende ikke dagligt logger på systemet. Det sker ved, at der hver dag eller hver uge afhængigt af systemets opsætning genereres en e-mail til gruppens medlemmer, der orienterer om ændringer. Man kan således uden at gå ind i Quickplace, men direkte i sin mailbox i et almindeligt e-mailprogram se, når nyt er tilføjet i Quickplace.

Opbygning af delt repertoire, gensidigt engagement og fælles projekt må således også i Quickplace integreres i den generelle meningsforhandling. Dog har Quickplace den fordel, at projektgruppen har gode muligheder for at give reifikationen af det delte repertoire og vigtige gensidige forpligtelser og aftaler en særlig fremtrædende og synlig plads i den virtuelle rum. Risikoen for, at en central tekster forsvinder som en blandt mange i en diskussion med mange indlæg, kan således minimeres markant.

Ressourcehåndtering

Quickplace er skabt til at håndtere ressourcer uanset om de betragtes som indlæg i en diskussion, bibliotek(er) med links til eksterne ressourcer, tekstsider eller filer skabt i andre programmer. I forhold til tekstbehandlingsdokumenter skrevet i Microsoft Word gælder det særlige forhold, at de faktisk kan redigeres inde i systemet. Det vil sige, når først et Word dokument er lagt ind i systemet, kan det redigeres uden at blive taget ud af systemet igen. Samtidig understøttes ressourcehåndtering i specielt produktionsfasen af et projekt ved at have indbygget versionsstyring for alle typer af indhold. Quickplace hjælper således gruppen til blandt andet at holde styr på, hvilken version af et dokument, der er nyest samt hvem, der har ændret i det på hvilket tidspunkt. Konsekvensen er, at indholdets udvikling gennem et projektforløb kan synliggøres, så man hele tiden bevarer et grundlag for refleksion over samarbejdets produkter.

Opsummering af Quickplace

Quickplace markerer sig som en stærk teknologisk platform til støtte af problem- og projektorganiseret læring. Deltagelse og reifikation understøttes i forhold til meningsforhandling i en række sammenhænge; blandt andet i asynkron og synkron tekstbaseret diskussion generelt, i udarbejdelse af tidsplaner og fordeling af opgaver samt ved håndtering og deling af diverse ressourcer. Der er således ingen skarp adskillelse mellem funktioner rettet specifikt mod meningsforhandling, og funktioner rettet mod koordinering og ressourcehåndtering. I praksis betyder det, at meningsforhandlingen i Quickplace allerede i udgangspunktet giver arbejdet i projektgruppen en grundlæggende struktur. Ved siden af diskussionsfora med potentiale for meningsforhandling relateret til projektets fokus og indhold, giver kalender og opgaveliste fokus på meningsforhandling relateret til koordinering som en anden central aktivitet. Endelig bringes meningsforhandlingen knyttet til ressourcer og ressourcehåndtering også i fokus som en tredje central aktivitet.

Konklusion

Som konklusion på artiklen vil vi berøre tre temaer: Anvendelsen af modellen til analyse af e-læringssystemer i lyset af problemorienteret projektpædagogik, integration af et perspektiv på fleksibilitet i analysemodellen og endelig overvejelser om praktiske forhold i forbindelse med valg af e-læringssystem på baggrund af analysemodellen.

E-læringssystemer kan bidrage til at gøre undervisning og læring mere fleksibel og etablere egentlige virtuelle læringsmiljøer både horisontalt mellem forskellige professions- og faggrupper og vertikalt i et livslangt læringsforløb. I denne artikel har vi diskuteret tre forskellige typer af e-læringssystemer: konferencesystemer, indholdsleverancesystemer og groupware samt argumenteret for deres styrker og svagheder på baggrund af en analysemodel for e-læringssystemer til støtte af problemorienteret projektpædagogik. Netop udviklingen af denne analysemodel var artiklens primære mål. Modellens 3 teoretisk funderede omdrejningspunkter, meningsforhandling, koordinationsarbejde og ressourcehåndtering, har vist sig at bidrage til en analyse, der stemmer overens med vores konkrete erfaringer med anvendelse af tre forskellige e-læringssystemer. Det peger på, at modellen også med fordel vil kunne anvendes til analyse af nye systemer til understøttelse af problemorienteret projektpædagogik. Modellen fordrer dog med de tre relativt generelle omdrejningspunkter for analysen også et vist forkendskab til e-læringssystemer og problemorienteret projektpædagogik. For personer uden særligt forkendskab giver modellen et indtryk af pædagogikken og de medfølgende systemkrav, men er ikke i sig selv en fuldstændig indføring i området.

Projektorienteret projektpædagogik fremmer som nævnt flere gange læreprocesser, der med e-læringssystemer, kan tilrettelægges fleksibelt. Samtidig har analysen antydet, at forskellige krav om fleksibilitet kan begrundes i både læringsteori og konkrete erfaringer. Derfor må det overvejes om en fremtidig udgave af analysemodellen skal gøre fleksibilitet til et selvstændigt tværgående tema. Samtidig opstår dog også behov for, at vores forståelse af fleksibilitetsbe-

grebet må udvides og nuanceres. Analysen i denne artikel viser at mindst tre former for fleksibilitet efterspørges i e-læringssystemer til støtte af problemorienteret projektpædagogik:

1) Strukturel fleksibilitet – læringsrummet skal kunne udbygges og omorganiseres som en del af læreprocessen.
2) Kommunikativ fleksibilitet – læringsrummet skal tilbyde både synkrone og asynkrone kommunikationsformer, såvel tekstbaserede som multimediale.
3) Rolle-fleksibilitet – læringsrummet skal understøtte deltagernes skiftende roller i læreprocessen og sikre grundlaget for en demokratisk og socialkonstruktivistisk læreproces med lige adgang til at bidrage for såvel lærere som studerende.

Ingen af de systemer, der er analyseret i denne artikel opfylder til fulde alle krav, man kan stille til et fleksibelt virtuelt læringsrum til understøttelse af problemorienteret projektpædagogik. For beslutningstagere, der står foran at skulle vælge et system tegner sig mindst to forskellige strategier: Man kan sætte sig for at finde/konstruere det ideelle system, eller man kan vælge at integrere grænseflade og datagrundlag for en række moduler, der hver især opfylder forskellige krav. For valg af eet system taler, at integration af både brugergrænseflade og datagrundlag på tværs af enkeltfunktioner er implementeret af leverandøren. Det kan gøre brug af systemet lettere for både studerende, undervisere og teknikkerne, der står for drift og support. Til gengæld er det måske ikke muligt at finde et system, der lever op til alle funktionskrav. Netop dette forhold har fået både masteruddannelsen i Ikt og Læring og uddannelserne i Humanistisk Informatik har valgt denne løsning. Henholdsvis Virtual-U og Quickplace er del af en større webstruktur, der blandt andet supplerer systemernes dynamiske læringsrum med supplerende statisk information og interaktive web-baserede materialer. Udover at skabe et bedre læringsrum end enkeltdelene hver for sig kunne, giver disse løsninger også adgang til at udskifte enkeltdele. Det muliggør en gradvis udvikling, hvor det samlede e-læringssystem løbende tilpasses pædagogisk funderede krav i takt med at pædagogisk praksis og de teknologiske muligheder udvikler sig. Ulempen ved disse løsninger er, at integration af grænseflade og datagrundlag i udgangspunktet er ret dårligt. For at undgå dobbeltarbejde i forbindelse med indtastning af data eller forvirring ved navigation mellem forskellige delsystemer er det derfor nødvendigt at besidde kompetencer og ressourcer, der muliggør den nødvendige tilpasning.

Tak til

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Students Designing ICT Support for Collaborative Learning in Practice

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Abstract

The aim of this paper is to present an understanding of student practice and needs in relation to ICT-based support for Problem Oriented Project Pedagogy (POPP). The paper combines a theoretical understanding of POPP and results from a case study. An important characteristic of the students in the case study is that they construct and reconstruct a learning environment of their own choice without intervention from other parties. The paper identifies coordination of activities, coordination of knowledge construction and creation of joint images of experiences as key activities that may very well be supported by ICT. It is also clear from the case study that students demand a flexible tool that can be altered as the project progresses and needs emerge.

Keywords

PBL, POPP, communities of practice, coordination, learning environment, design.

Introduction

Design is never just about ICT, but also about a smaller or larger change of practice somewhere. The Scandinavian tradition for systems development has brought our attention to the need for user involvement from early stages in the design process and onwards (Dahlbom & Mathiassen, 1993). Today, part of the philosophy behind the concept of democratic design of information technology is finding its way into collaborative learning environments. In the case we have studied, students in a highly collaborative environment chose to combine ICT provided by their university with free software from the Internet to design their own virtual learning environment. This is not simply a user involving process, but a process carried out and controlled by users made possible by the Internet and the amount of free software and services available. Therefore, the use of ICT in the case is to a very high degree grounded in needs experienced by users and user initiative, and not in order to meet needs in the organization. By studying this case, we intend to expand understanding of ICT support for project-based learning as seen from the learner's perspective. The aim is to understand the role of ICT-based settings in student collaboration and to outline requirements for such an environment.

A case of student initiative

Human Centered Informatics

Human Centered Informatics is an educational program within the Faculty of Humanities at Aalborg University offering both bachelor (3 years) and master level (bachelor + 2 years) education. It combines communication, organization and ICT studies to provide students with the tools necessary to be critical, but constructive, participants in the evaluation and construction of ICT and new media. Students are exposed to software construction, internet technologies and programming. However, they are, in general, not regarded as skilled programmers, although they acquire some knowledge of programming during the course of their studies. In our case study, we included students that have not completed their bachelor, but are close to doing so (5^{th} and 6^{th} semester) and students that completed their bachelors and have just begun their master's degree (7^{th} semester).

The technological platform

IGroups was the virtual environment chosen by the project groups we studied. It is a groupware system provided free via the Internet (http://www.igroups.dk). IGroups has an open-ended design and provides a flexible and customizable environment where users, to a certain degree, can decide for themselves the composition and meaning of the available tools. The two most important tools used by the project groups in the case study were the file-sharing tool and the shared web documents. The files-sharing tool allows the members of the iGroup to upload and download documents in directories and to restructure the sequence in which they appear. The shared web documents make it possible to create new workspace on demand where the members can add content. In addition, iGroups provides tools such as calendars, conference forums, chat functions, SMS (at the time of the study), messenger services, e-mail lists, event managing, member managing, photo albums, voting, link lists and a game.

Problem Oriented Project Pedagogy

Problem Oriented Project Pedagogy (POPP) has been integrated in all programs at Aalborg University since it's opening in 1974. Human Centered Informatics and the students we studied are founded upon this tradition, as well. To understand what goes on in our unit of analysis, it is necessary to understand the basic aims and principles of POPP.

POPP builds on a constructivist understanding of learning that can be traced back to Piaget (1969) and Dewey (1966, 1997). Critical Sociology has also contributed significantly to the foundation of POPP (Dirckinck-Holmfeld, 2002, p. 35). Over the past years, Etienne Wenger has contributed with his understanding of *communities of practice* (Wenger, 1998). The aim of POPP is to educate students that can, through the use of a critical, analytic and constructive approach, contribute to elucidating and solving problems in society (Dirckinck-Holmfeld, 2002). Important principles are the formulation of problems and enquiries into those problems. Students are in charge of all processes in a project. They inquire into a problem they have formulated themselves. Students also decide which perspectives, theories and methods they want to include in the inquiry. To support the process, an advisor guides the students.

This is strikingly different from problem-based learning (PBL) where teachers, to a certain extent, define the problem and students thus experience less ownership of the problem and project they work on. According to Illeris (1981, p. 102), this difference is significant because students need to experience real ownership of the problem and project to have the highest degree of motivation to go through the complex and sometimes painful reorganization of mental structures that learning is.

Communities of Practice

The theory of learning in communities of practice is relevant both when it comes to explain how POPP facilitates learning and when the target is to understand the role of ICT in POPP. Our focus in this brief introduction will be on central concepts that can be used in the analysis of our case.

Wenger describes practice as *about meaning as an experience of everyday life* (Wenger, 1998, p. 52). What goes on in practice is therefore negotiation of meaning understood as a duality of *participation* and *reification*. In our study, negotiation of meaning takes place in the group of students. Participation in the negotiation of meaning takes several forms including participation in discussions and production of contributions to the project. At the same time, documents, infrastructures for collaboration and so forth are reifications of the negotiation of meaning.

A community is constituted by mutual engagement, joint enterprise and a shared repertoire (Wenger, 1998, p. 73). All three dimensions are both subject to, and influence, the negotiation of meaning in the community. In POPP, mutual engagement is linked to the formation of the project group and maintenance of social relations within the group. Joint enterprise is related to the common project and negotiation of its target and content. Shared repertoire refers to shared artifacts as well as the shared academic and social history of project group members.

In short, learning is all of the above, meaning that learning at the individual level means engaging in and contributing to a community while learning at the community level is refinement of practice.

The research study

The study is a traditional case study (Stake, 1995; Creswell, 1998) with one slight modification. Some of the teachers and students at Human Centered Informatics are also involved in an action-research (Baskerville & Pries-Heje 1999) project aimed at developing the courses and the coherence in administration and information through the use of ICT. Student-driven construction and use of ICT-based infrastructures to support their project collaboration is purposely kept out of the action-research project because we wanted to study student initiatives. However, the two processes are, of course, interrelated. Therefore, we involve teachers in the case study to estimate the broader impact of student decisions.

Data Sources and Timeframe

The study focuses on ICT support for students' own collaboration undertaken during one semester and involves 26 students divided into 5 project groups (3x6 students, 1x5 students and 1x3 students) and 4 teachers. This is all students from the 5th semester of Human Centered Informatics bachelor program and 1 group (the group of 5 students) from the 7th semester (1st semester of the corresponding masters program that follows the bachelor). We included the group from the master programme because it at first glance seemed to represent the same kind of developmental practice we saw emerge at the 5th semester and thus would either support or contrast our findings at the 5th semester.

Table 1. Data sources in the study.

	Students	*Teachers*
Interview/individual	X	x
Interview/groups	X	
Observations	(x)	(x)
ICT platform study	X	x

The category "ICT platform study" includes ICT infrastructures and virtual learning environments constructed by students and represents development over the course of a semester that is collected at the end of the semester. This is closely related to our use of observation because we do observations in the virtual collaborative spaces that also save traces of the process. Interviews were carried out in the last part of the semester and included discussion of data from observations and ICT platform studies.

Data Collection and Interpretation

All interviews were carried out as semi-structured qualitative research interviews (Kvale, 1996). This means that interpretations are present in all phases of the process from the construction of the interview questions to the actual interview to the resulting analysis. Furthermore we took information obtained in one interview to other interviews to test whether something was regarded a common theme or not. In one case we took conclusions back to a group of interviewees to include their feedback in our data. This approach recognizes that knowledge of social practice is constructed in social practice. Therefore, interviews are our primary source of data, meaning that we use the interview as a space for negotiation of meaning with the students or teachers we are talking to. Observations and ICT platform studies of different kinds are in the interviews used as artifacts representing aspects of the community of practice we are trying to understand.

The interview questions were constructed to uncover practice, tools, tasks, challenges and solutions in the collaborative process. It was done by drawing on our knowledge of POPP and communities of practice combined with the knowledge we prior to the interviews had about how the groups had used iGroups and other tools.

Table 2 represents the first level of analysis after the data are collected: A preliminary categorization that summarizes the construction and reconstruction made by each group of students in the study.

Table 2. Overview of the Data.

Group Size	Requirements expressed in tools	Construction Activity	Student Comments
6	File sharing, document version control, discussion forum, group e-mail, calendar.	Change of work and collaboration practice and reconstruction of iGroups.	ICT should help without creating an extra workload. Prefer to keep advisor out of collaborative space in iGroups, because they feel his presence may restrain their internal communication.
6	File sharing, version control for documents, news, calendar, access to see last login of other group members.	Change of work and collaboration practice and reconstruction of iGroups.	The same tool should support all activitities so that users do not have to switch between different tools. The tool should be flexible to allow ongoing adaptation. All members of the groups have high-speed flat rate internet access and uses on-line activities to maintain coordination of the group activities.
6	File sharing, discussion forum to share questions and ideas, group e-mail, meeting planner, literature list.	Change of work and collaboration practice and reconstruction of iGroups.	Too complex to use iGroups for simple file sharing. The upload procedure takes too long time to complete. Did not invite the advisor into Igroups. Wants to keep a private room, but is also open to collaboration with advisor in an Igroups-like environment. Finds it important to be able to sit at home and maintain on-line collaboration within the groups. It was a coincidence that they choose iGroups. One of the students at the semester recommended it and they choose to use it in a course. After that the group decided to use it.
3	Mail, shared e-mail for external communication. Har siddet hver for s	Change of work and collaboration practice.	The group was small and could easily keep track of everything without groupware. However the groups emphasizes that the free high speed internet connection at home they received through a research project meant a lot to the collaboration and changed it from earlier projects they had participated in. They found the new practice more collaborative due to better communication and coordination.
5	File sharing, discussion forum (synchronous and asynchronous), calendar.	Change of work and collaboration practice and reconstruction of iGroups.	High priority given to tools that made it possible to work distributed either synchronous (MS Messenger as tool) or asynchronous. Also focus on experiments with on-line support of collaborative knowledge building.

The analysis build on the data as table 2 does, but focuses on themes that emerge from the overview in table 2 in the light of Wenger's theory of communities of practice and the knowledge of POPP we presented earlier.

Analysis of the design and implementation process

The analysis is centered on three themes concerning processes that explain central aspects of how the students formed and used an ICT-based setting for collaboration: Choice of environment, reconstruction of environment and work practice in the environment. The perspective of the analysis is not to give a complete picture of all the cases, but to discuss practice and eventually to identify good practice for ICT support of POPP.

Choice of environment

The university at the time of the study provided students with e-mail addresses, space for publication of web pages and shared web folders for project groups. Therefore, students that wanted a groupware to support their project process had to look somewhere else for a tool. They also had to clarify their needs to find an appropriate tool. One group considered using a dedicated project management tool, but these tools were found not to provide the necessary flexibility needed in a project where the overall aim is to learn and not to produce a specific product. One student explained: " *(In a dedicated project management tool) one had to start defining a lot of tasks and create a lot of documents before one could even start on the project ... but when one starts on a project one does not have many ideas about where one is going*. "

The project groups also considered possible consequences of their selection of an environment in relation to decisions made by the university. Official communication from teachers and administration was placed in newsgroups, teachers supported courses with different web-based materials and two teachers were trying out Lotus Learningspace as a possible future framework for delivery of material in courses under Human Centered Informatics. At the same time, 5th semester students had chosen iGroups as a platform for collaboration at semester level. The students were aware that this web of infrastructures was very complex already and that what they needed for the projects was something truly helping them and not just another piece of technology.

They chose iGroups because it did not force them to work according to a predefined project method, and because it provided the necessary flexibility to customize and reconstruct the environment themselves according to their own needs. On one hand, it is impossible to foresee the specific needs one has in a project and what tasks a system should support, they told. On the other hand, the project groups pointed out that they had project experience from earlier semesters and, therefore, a general idea about what is to be expected. Thus, they gave high priority to an open-ended structure in which one is allowed to create appropriate forums or spaces when they are needed.

Flexibility and reconstruction of the environment

The project groups did not put much effort into reconstructing their iGroups spaces when they started using them or early in the project process. The basic structure was considered sufficient for a start.

Reconstruction primarily took place in the file-sharing tool where the joint project was put together. The students explained that the tasks of the project were not defined when they started. They were ever changing and established through negotiation and collaboration. As a consequence, the project structure that was created using the file-sharing tool dynamically reflected the progress as they were continuously reconstructing it.

Another important tool for customizing the environment were the shared web documents that they could create on demand. The shared web documents provided an open functionality and were used for creating new workspaces where ideas were generated and exchanged. They were used for creating literature list and links to internet resources and identifying and managing new and ongoing tasks. They were used for all activities that needed to be negotiated and reified, and they were preferred to asynchronous conferences because they were highly editable and easy to overview.

Coordination

All groups cited coordination as a main reason for the project groups to choose a virtual project environment. Students are active people; therefore it is a challenge to coordinate their work in a project. But coordination implies more than planning project meetings and project tasks. Coordination involves the whole mutual process of planning, structuring and creating a joint project.

The case study revealed two aspects of coordination where iGroups were involved: Coordination of project activities and coordination of knowledge construction. These two coordination processes are not independent dimensions, but rather in a collaborative project they identify two different aims of using a virtual environment.

Coordination of activities

All groups explained that the members were busy occupied with different activities outside of the university. Some were active in sports, others were working beside their studies, and therefore it was difficult to find time for collective meetings on campus. IGroups (and in one group e-mail) was thus used to get an overview of individual as well as collective activities. One group explained that they used the message function in iGroups to organize project meetings and to set up meetings with their advisor, and they had a shared calendar where the group members wrote down whether or not they where busy with external activities.

But coordination of activities is not merely a matter of organizing time; it is also a matter of identifying, sharing and managing new and ongoing tasks. The project groups used the shared

web documents or a discussion forum for this purpose. They wrote and corrected and tried to describe what the missing tasks were, which tasks people were working on and the problems they were dealing with. Using shared web documents, which everyone could edit, for these purposes gave a dynamic overview of the process, and it became a forum for idea generation and negotiation of the tasks involved.

But as one of the students commented, it demands a certain discipline among the group members to maintain the shared web documents. There is nothing in the technology that encourages or reminds one to update them. It is a matter of trust because if one cannot rely on the information, it becomes insignificant and the updating may end.

Coordination of knowledge construction

Coordination of knowledge construction is a central process in POPP. Students are not supposed to divide the project into discrete tasks, but, rather, they are supposed to engage in the process as a whole and to learn through confrontation and negotiation of perspectives and beliefs (Dirckinck-Holmfeld, 2002). This involves a lot of coordination between the group members.

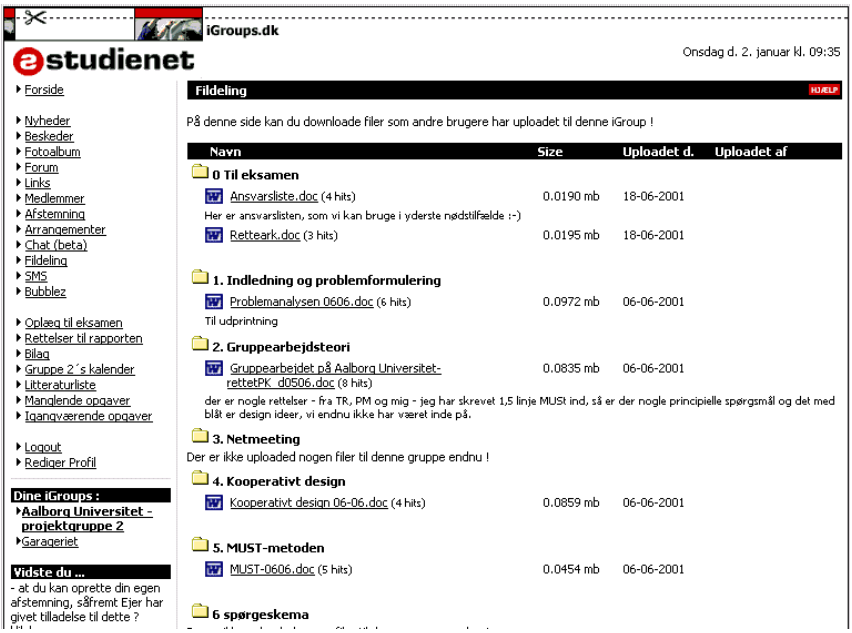

Figure 1: The file-sharing environment in iGroups taken from one of the study's project groups. An important feature of the file-sharing tool in iGroups is the possibility to view all links to the uploaded documents in different directories simultaneously and as a whole. This may appear an unimportant design detail, but it makes it possible to easily get a complete overview of the project development process. This visual feedback can be described as a joint image of experience reflecting the shared experiences of the project group.

However, the shared construction of knowledge in project-based learning only becomes visible for the members through the material that they produce. This made the file-sharing function in iGroups the central tool for the coordination of knowledge. The project groups used

the file-sharing tool to upload documents, to comment on each other's documents and to rearrange the structure of the project.
The file-sharing tool made the process and the project structure visible for all the of the group members. They could continuously view what the others had done, how far they had come, and what they lacked. Furthermore, they could easily notice if someone in the group had problems with fulfilling their part of the project.

The uploaded documents were downloaded by the others for commenting or further writing. This process needed a careful coordination. IGroups provides feedback on how many times a document has been downloaded, but not by whom and not the purpose of the download. One solution to that problem was to write meta-information to each document to inform the others of who had downloaded the document and why. Using this technique, the group members could coordinate the co-writing process and thereby avoid that more than one student commented or worked on the same document. Documents critiqued or rewritten by others were uploaded as new versions, thereby creating a document history, and the original owner of the document was finally given the task of reconstructing the new document.

The students argued that this coordination process created more mutual engagement and more mutual dependency in the project: "*I got more interested in what the others were writing when I could go directly to a document in iGroups, correct it and get immediate feedback on my comments from the owner*" *"... and if one got stuck while writing, or wondered where the project was heading, one always had access to what the others were writing."*

Boundary object and a joint image of experience

The file-sharing tool in iGroups functioned as more than a place for sharing documents. The project structure that was gradually emerging in the file-sharing tool was also a dynamic image of the progression, as it was developing over time, accumulating and reflecting the experience of the project group in creating a joint project.

One project group explained that, in the beginning, the file-sharing environment had one directory for each member of the group, where they downloaded their documents. The structure of the project was not apparent. It was something that developed over time. Gradually the structure of the project became more visible. New directories where added; first one for the problem formulation and one for the introduction. Later on, other directories where added or deleted and the order in which they appeared was changed until the file-sharing environment comprised the final project, but that was at the very end of the project.

The possibility to visually see the project grow over time, and to get an overall picture of the project as a whole, had a major influence on the coordination of the writing and the continuous reconstruction of the project structure. It worked as a coordination artefact around which they could negotiate their contribution and their position. The result of this negotiation was a dynamically developing project that before reaching each final status had undergone several changes and transformations.

This usage of the emerging project structure as a coordination artifact has similarities with what the sociologist Susan Leigh Star (1989) describes as a boundary object - an object that inhabits several communities of practice and has informational value in all of them. However we do not find the notion of the boundary object adequate when the focus is on a group of students constructing a dynamic artifact to enhance their collaboration. That is why we call this reification a joint image of experience - a joint image of an emergent structure that is both a result of past negotiations and input to future negotiation of meaning. When we broaden the scope and integrate more groups of students and advisors in our perspective it is, however, appropriate to understand the project-structure in the file-sharing tool as a boundary object. No groups had significant collaboration with advisor or other groups in iGroups, but all groups that used iGroups had considered it. The content-structure then had the potential to become a boundary object that continuously informs the advisor or other students with similar interests of the direction and progress of the project.

Conclusions and perspectives

The students in our case study had a practice highly influenced by their prior experience within the POPP tradition and the technological setting they chose to use. They formed communities of practice where iGroups supported the negotiation of meaning and the maintenance of the community. A POPP project is based on participant control, responsibility, problem orientation and collaboration (Dirckinck-Holmfeld, 2002). It is a complex process composed of several tasks and phases linked together. In order to support that with ICT, the technology has to be flexible and allow ongoing reconstruction along with the growth of the project. The case study shows ICT itself is subject to negotiation when students integrate it in a POPP project. They rearrange the environment and add new workspaces when needed. It is a matter of control over the virtual environment. If technology cannot be negotiated and reconstructed as part of the process, there is a risk that the technology will control instead of support the process, and thereby conflict with the central principles of POPP.

The demands for flexibility identified here are centred on different dimensions of coordination. Project groups need support for coordinating knowledge construction as the project evolves and meaning has to be negotiated. In addition they need flexible support for coordinating activities, organizing time and identifying, sharing and managing project tasks. The third dimension identified is linked to openness and transparency. IGroups made it possible for the students to open the project process, and to create an image of the emerging project structure around which they could negotiate their contribution, and their position. This was to a lesser extent used to open the project process to either a advisor or other students, but fully implemented this would strengthen the element of collaboration in POPP by enhancing collaboration between groups.

The findings in this case suggest a need to expand the understanding of the relationship between structure and openness in ICT used to support learning. Learning creates emergent

structures (Wenger, 1998) and can best be supported in an environment where these structures are allowed to grow according to the needs and goals of the learners.

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Using Activity Theory Framework (ATF) to build an analytic bridge across the Atlantic: Two cases of Information and Communication Technology (ICT) Integration

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Abstract: The purpose of this paper is to show how Activity Theory Framework (ATF) was used for understanding the challenges, contradictions, and turbulences that are inevitable when institutions of higher education (IHEs) as learning organizations integrate ICT to change teaching and learning practices, demonstrated through two cases. The first case is situated in a Danish university, whereas the second case is in a mid-western university in the U.S.A. In each case, qualitative methodology was used allowing for a deeper generalized understanding of the challenges, contradictions, and turbulences that accompanies integration of ICT. These two studies in different contexts revealed a number of similarities using ATF as an analytical framework. Thus, ATF is useful as it unearths the contradictions, challenges, and turbulences when integrating ICT in higher education illustrated in the lessons learned.

Introduction

By nature, change in one area of a learning organization impacts and is impacted by complementary changes in other areas (Davis, Kemis, & Johnson, 2003). Additionally, learning organizations is made up of complex, often contradictory, and interacting complex systems. For example there has to be congruence between the goals for ICT infusion and the resources available in learning organizations. Lack of congruence will inevitably lead to many challenges that - if allowed to go un-checked can inhibit any change process. According to Cohen and March (1986), IHEs are organized anarchies having multiple parts with multiple concurrent activities that are sometimes contradictory that can lead to anarchy within the learning organization. Based on the level of complexity in IHEs, outcomes depend heavily on factors related to more than one part of the IHE. The aim of this paper is to suggest a theoretical framework that will help construct a basic understanding of the different parts in a system and the relationships between each part.

In the field of educational technology we find research that try to explain the integration of ICT in teaching and learning. In a recent issue of the British Journal of Educational Technology Goodison (2003) and Tearle (2003) approach this problem area in two different ways. Goodison focused on the work of the teacher in the integration of ICT in classroom activities. Tearle (2003) takes a more general perspective on implementation of ICT in schools and asks why some schools have more success in the implementation than others. Tearle suggests a model for the process of an implementation and a model of the characteristics of a school in-

fluencing implementation of ICT. With this paper we want to suggest a theoretical framework that allows for a deeper understanding of the change processes for integration of the close focus on the classroom and the overall organizational focus on organizational implementation of ICT. The rest of the paper is organized into five sections addressing 1) The theoretical framework (ATF), 2) research methodology and design of our case study, 3) the two cases, 4) lessons learned, and 5) conclusion.

Theoretical Framework

Activity Theory Framework (ATF) is not a new framework for analyzing complex systems. However, in the last decade more attention has been paid to ATF as a suitable framework for analyzing multiple activities situated in various communities of practice (Cobb, P., McClain, K., Lamberg, T., & Dean, C., 2003). The principles in ATF of specific interest in this paper are 1) an activity system situates human practice in a structure of relations and mediating artifacts including tools, culture, and division of labor—all shaping actions, 2) an activity has an hierarchical structure and can be disaggregated into primary, secondary, and tertiary activities, and 3) contradictions inherent in all activities driving the change process (Leont'ev, 1978, Engeström, 1987).

The split of an activity into primary, secondary and tertiary activities opens for a distinction between motive formation (primary activity), pursuit of goals (secondary activity, and utilization of existing conditions (tertiary activity) (Leont'ev, 1978). The formation of motives is not restricted to the individual, but reflects motives shared across a community such as our overall reasons for engaging in implementation of ICT in IHE. The pursuit of goals refers to the activity we direct most of our attention to such as implementing ICT in IHE. The utilization of existing conditions refers to the activity we direct less attention to because it is more or less automated such as operating the most commonly used functions in a word processor.
The activity system unites the individual, the community and the change processes in a web of mediating artifacts including tools, culture and division of labor. It supports research into external factors that we internalize and let guide our activity. The activity system is a strong tool when it comes to research into the many influences on the relationship between the individual that engages in a change process, his/her community and the object of the process. It thus also supports research into the contradictions we face in the change process. Contradictions can be between different activity systems, different mediating artifacts in one activity system and between different levels of an activity. The threefold reason for highlighting contradictions in the implementation of ICT in IHEs includes: firstly, contradictions inherent in present practice may at the initial stage of a change process suggest reasons for change. Secondly, contradictions that can be foreseen to emerge during or after a change process may help participants in the process; eliminate negative consequences later on in the process. Thirdly, contradictions in an ongoing change process help participants to understand what the prominent obstacles are and how to move on.

Methodology

In both cases profiled, the research methodology selected was the qualitative or naturalistic paradigm because of this study's focus and to obtain thick and rich description for each case (Fraenkel & Wallen, 1993). Chua (1986), Guba and Lincoln (1994) suggest three underlying epistemologies for qualitative research: positivist, interpretive, and critical. The interpretive paradigm is the primary epistemology used to situate each case. However, the authors drew on relevant aspects of the critical epistemology most suitable for this study because of its philosophical assumption that there is a pervasive socially constructed reality. In addition, Kaplan and Maxwell (1994) suggest that the interpretative epistemology/paradigm focuses on the complex and "messy" nature of how individuals construct and make meaning of a phenomenon. The phenomenon in this paper being successful integration of ICT in higher education, demonstrated in both cases

Research Design: Case 1

Case Design, Sample Selection, Data Collection and Instrumentation

In case number 1, participatory action research approach was used, whereby, the researcher worked within a community of researchers, practitioners, and students in the dual role as a researcher and a participant (Baskerville & Wood-Harper, 1996). In the three iterations of the study, data was collected using semi-structured interviews and document analysis, which included log-files from web-supported courses within the program. Triangulation of data was obtained by 1) the use of multiple data sources (interviews, log-files and course content), 2) interviewing different stakeholders (faculty, students and administrators), and 3) the iterative nature of the study (three iterations). This gave a sample of 52 participants. The virtual collaborative learning environment developed and used in iterations 2 and 3 included content and log-files.

Teachers were interviewed individually in all three iterations for the first case. Students were interviewed throughout the semester in groups of 4-6 individuals. Interviews with teachers were audio taped whereas interviews with students were videotaped to keep track of whom in the group said what. All interviews were later transcribed. Logs of student activities in the virtual learning environment were collected throughout the second and third iterations (tools used in first iteration did not create logs) and were saved for later analyses.

The interview protocol was designed to elicit information relevant to an analysis based on ATF and to encourage interviewees to talk about both practicalities and more abstract aspects of teaching, learning, and administrative practice. The protocol was also designed to understand the change processes with questions about past, present, and future practice. The iterative design made it possible to compare statements about the future with later statements about the past. This triangulation made it possible to compare descriptions of practice from the interviews with the practices found in log files.

Research Design: Case 2

Case design, Sample Selection, Data Collection and Instrumentation

In case number 2, the case study approach postulated by Yin (1994), was selected. For a rich description of ICT implementation in teacher education, data was collected and triangulated through semi-structured interviews, observations, and document analysis. Further triangulation was obtained through interviewing multiple partners impacting the teacher education program. This resulted in a sample of 13 participants including: 3 principals, 2 technology coordinators, 1 department chair, 3 project leaders, 1 university faculty, and 1 apple computer executive.

After pilot testing and making the necessary changes to the interview protocol, face-to-face interviews were conducted over a period of 4 weeks with the 13 participants. Observations were important as part of the data collection strategy for this study to help with triangulation of data sources as well as providing greater understanding of the case (Stake, 1995). Documents reviewed included: grant proposals, websites, photo archives, projects, presentations, publications, minutes from meetings, and yearly reports.

Through prolonged engagement, member checking, peer debriefing, triangulation, and audit trail, trustworthiness was ensured in the data collection procedures. Confidence was generated through the establishment of credibility, transferability, dependability and conformability of the data postulated by Lincoln and Guba (1985). Authenticity was ensured through the representation of the multiple realities presented by different participants in the development in this paper (Denzin & Lincoln, 1998).

The instrument used to collect data in case 2 was a semi-structured interview protocol. The protocol was designed thematically in order to obtain answers to the three research questions posed. In addition, ATF was used as the guidepost for selecting questions. Questions for the protocol were drawn from several validated instruments as well as from the literature reviewed.

Data Analysis Strategy for Both Cases

The interviews were all audio taped for accuracy in transcription. A process of manual coding was used to interpret and reduce the data. Data analysis strategies for this study followed the analytic procedures postulated by Marshall and Rossman (1995), in combination with the guidelines presented by Erlandson et al. (1993). These guidelines are: organize data, categorize data in themes and patterns (here based on ATF and literature), test hypothesis, search for alternative explanations, and finally report findings.

The data collected in both case studies have been analyzed with focus on the key elements of activity theory.

Introduction to the Cases

The two cases are situated on opposite sides of the Atlantic (Denmark and U.S.A.). In each case the researchers examined how learning organizations integrate ICT to effect changes in the teaching and learning processes. The context given proposes an interesting consideration of how two different cultures have responded to the opportunities and inevitable challenges, which ICT brings to both learning organizations. According to Oh (2003), "ICT significantly changes the way learning is conducted" (p. 135). This is significant because integration of ICT calls for a shift in—paradigm, pedagogy, organizational support, learning environment responsive to teaching and learning with technology, relevant assessment strategies, as well as responding to new teaching and learning competencies, illustrated in case 1.

Case 1: Human Centered Informatics Program in Denmark

Situating the Case

The first case is situated in a Danish University. The program called Human Centered Informatics is placed within the humanities at this university offering bachelor (3 years), master level (bachelor + 2 years) and Ph.D. level (master + 3 years) education. The number of students is more than 500 students and has grown significantly over the past 10 years. Human Centered Informatics combines subjects as communication, organization, and theory and practice of learning and ICT studies to provide students with the tools necessary to be critical, and constructive, participants in the evaluation and construction of ICT and new media. The pedagogical foundation of Human Centered Informatics is the variant of Problem Based Learning (PBL) specifically known as Problem Oriented Project Pedagogy (POPP) (Dirckinck-Holmfeld, 2002). This means that students spend approximately 50% of their time on coursework and 50% on supervised group organized problem based projects.

The Human Centered Informatics program already used ICT to support student learning prior to the initiation of the development project. However, this approach was primarily dispersed and uncoordinated. Goals for the project were chosen based partly on efforts already in progress (but without focus on ICT) and partly on a literature study of what gains were suggested elsewhere. The initial goals of the development project thus were improvement in: Internal coherence of the program, flexibility for students and teachers, transparency and quality. Besides the above calls for change it was rated important to maintain a learning environment based on social constructivist principles and an ICT infrastructure that was open and flexible enough to allow teachers, students, and others to further innovate within the new frame.

Using ATF to Analyse Case 1

The analysis of this case is divided into two primary sections: 1) The goals expressed by the participants in the implementation project, and 2) an overview of the activity system(s) in the implementation project.

Teachers and students express the goals of implementing ICT this way

We posted slides [in the system] we had used [in the class] and assignments. And the students posted answers to the assignments (teacher, first iteration, course on human computer interaction).

We have had a double goal and two target groups. We wanted to make an interactive course material that could improve [subject area of program]. It is supposed to be our contribution to the international research community [within subject area] (teacher, second iteration, course on language and formalisation).

These quotes show different goals: Improvement of communication with the students, improvement of course materials, contribution to the international research community and last but not least a more open and democratic interaction between the stakeholders. In a university these are all legitimate goals so we cannot conclude that the individual goals pose a problem, but to accommodate all of them can truly be a challenge. The students indicate similar diverse goals:

What we need is a combination of a way to arrange meeting and a way to get in touch if someone sits and writes [alone at home] and suddenly don't know how to move on (student, second iteration).

You can discuss whether it is positive or negative [to use the virtual learning environment to obtain a quick overview of content of courses] but it has been helpful when you sit in the middle of a project process and find that you lack time. Then it is fine to be able take a quick look at what's there and. . . prioritise your time (student second iteration).

Student goals thus include easy access to communication, transparency and flexibility. Students do not directly say that they use ICT because it helps them to learn better, faster or more, but they ask for ICT that helps them become engaged in the processes set up be teachers to facilitate learning. In implementation of ICT these goals have to be weighed against the overall goals of an implementation and the goals expressed by the teachers. When teachers and students try to accomplish the goals by means of ICT they do it in a rich and influential context. In table 1 we use the activity system to give an overview of the context and the ways it posed challenges to the process.

ATF	Description	Contradictions
Object	The implementation of ICT in the practice of the program.	Teachers, students and administration may view implementation of ICT differently.
Subjects	Teachers, students, administration.	
Tools	New ICT and ICT already in use by different stakeholders.	Work practices of different stakeholders draw on different tools. Implementation of new ICT may fit one group, but contradict the needs of another. ICT in use influence the way new ICT is interpreted and implemented.
Rules and customs	Pedagogy, administrative practice, mutual expectations of students, teachers and administration.	Stakeholders engage in interaction and the change process with different beliefs and expectations. Students' expectations may not be met by a teacher that introduces a new innovative ICT supported pedagogy and vice versa. Teachers may also have to engage in collaboration with ICT support and didactical designers.
Community	Teachers, students and administration.	
Division of labor	Division between teachers, students and administration	
Outcome	New practice drawing heavily on new implementation of ICT	The new practice may contradict the original goal and perhaps the motive that lies behind the change process.

Table 1: Description of ATF and the contradictions in case 1.

This of course is a very brief introduction to the full analysis. However, in the following discussion and interpretation of the findings we want to expand on the central issues—namely turbulences, contradictions, and challenges, we set of to uncover in the first place.

Discussion and Interpretation of the Research Findings Case 1

In this case, the most prominent turbulences that arose derived from the mediating artifacts tools and rules & customs. Teachers and students asked questions addressing the choice of ICT and the reasons for using them in specific ways. The importance of a reliable tool underpinned all iterations. If a server was unstable, both teachers and students expressed doubts regarding the sustainability of the change. Similar doubts came up if the users could not envision significant gains moving from an old to a new tool.

Rules and customs came into focus as an important mediator when teachers introduced a new teaching and learning practice. Some of the students were surprised at first when teachers converted classroom activities to new on-line activities. On the other hand, some teachers stressed that they considered themselves good lectures and thus wanted to draw on that competence either by lecturing the traditional way or by developing a new virtual lecture to be part of an

on-line package. Rules and customs also played a role where the flow of information from administration to students changed. Both students and administration had to adapt in the transition from one ICT structure to the new ICT structure and that at some points led to contradictions and confusion about where to find what. Although there were challenges in both cases, there were contrasting contradictions in case 2 discussed next.

Case 2: Teacher Education Program in the U.S.A.

Situating the case

The second case is situated in a mid-western land-grant university in the U.S.A., with an award-winning Teacher Education Program (TEP) where ICT is embedded in the mission of the university and the TEP. There are 27,380 full time equivalent (FTE) students enrolled on this campus. Of this number, over 500 students are enrolled in the teacher education program with a faculty of 35. Part of the mission of the TEP is creating the best ways to use ICT to improve student learning at all levels. Meaningful uses of ICT are integrated throughout the pre-service teacher preparation program because teachers generally teach the way they were taught. If future teachers experience ICT modeled in their preparation they will be more likely to incorporate ICT in their classrooms. Students and faculty share a vision for the potential of ICT to improve learning. This shared vision creates both energy and excitement that permeates the TEP atmosphere and the activities within this case leading to meaningful changes (Schmidth, Thompson & Michelini, 2001).

The TEP has been known as having a history of technology innovativeness. Hence, the TEP was recognized and awarded for best practices in ICT integration as well as being recognized by Fortune magazine. With the awarding of a competitive grant ($1.5 Million) from the federal government "Preparing Tomorrow's Teachers to use Technology PT3), ICT was widely infused in the TEP. The infusion of new grant monies built upon previous ICT initiatives and facilitated the birth of new innovative projects. As part of the management strategy, the overall project developed was appropriately named Technology Colaboratives (TechCo) so that all participants including faculty would feel welcomed to be part of the collaborative effort to achieve the goal of integrating ICT in the entire TEP.

The goals and specific intent of TechCo included: 1) Identification, design and implementation of ICT experiences that will enhance education, 2) collaboration with K-12 teachers and administrators, incorporation of issues of equity and access with respect to technology throughout the TEP, 3) preparation of cohort groups of preservice teachers who are ready for leadership roles and who have had technology-enriched course and field work throughout their preparation, 4) design and implementation of a model technology-rich cohort teacher education program that can be adopted (all or in part) by other institutions around the country, and 5) to effectively disseminate outcomes and products from the project to TEPs around the country and the world.

These goals are being met as this research is being prepared through changes and reforms that have been made in the TEP. The changes the department underwent to facilitate successful

integration of ICT in the curriculum spanned curriculum changes, acquisition of ICT resources, the development of a college wide technology support centre, and a mentor-mentee initiative, whereby, students mentored faculty to use ICT in their classes. These changes were not accomplished without overcoming a number of challenges. Specific challenges for ICT integration in case number 2 included time, faculty commitment, acquiring financial resources, and faculty turnover.

Using ATF to Analyse Case 2

The following description shows how ATF was used to analyse the data and interpret this case. This will be accomplished by dividing the basic activity of integrating ICT in the TEP into smaller activity parts. A basic activity comprises the elements of Table 2 provided to offer the description of the elements of ATF as they relate to this case.

ATF	Description
Object	The integrating ICT in teacher education
Subjects	Also known as stakeholders; Pre-service teachers; university faculty; elementary school partners; Area Educational Agency (AEA) consultants; business partners; administrative leadership
Tools	Technology; relationships; communication; time
Rules and customs	Federal policies; University policies; department policies; technology standards; accreditation standards
Community	University; colleges; teacher education program; accreditation agencies; AEA; elementary schools
Division of labor	Labor divided based on the role of each stakeholder: Chair project leaders; faculty; students; elementary school partners; AEA consultants; business partners
Outcome	Successful integration of technology in the TEP

Table 2: Description of the elements of ATF

Discussion and Interpretation of the research findings in case 2

Based on the data collected through the interviews, observations, and document analysis the following areas emerges as pertinent to the successful integration if ICT in the TEP. In this section, the basic activity structure of ATF will be used to report the challenges and contradictions revealed from the data.

Each participant was asked to identify 5 challenges they have been faced with as they try to implement ICT. The major challenges highlighted and corroborated by the participants in case number 2 were: finance, time, rewards, and frequent changes in technology:

I do not have 5 [challenges] I have 1. It's the money. It's the money because the money drives everything else . . ... Money allows me professional development to bring in the best and the brightest. It's all money. I have one challenge and it is the money. (P3)

. . .the money issue, which would help with rewards for teachers than the time. Time is [also] a big one. (TC1)

we try to watch our costs and our budgets and everything else and people like me are stretched pretty thin and do not have the ability to invest the time and effort that we really would like to working with our accounts and our customers. (AE 1)

The literature reviewed indicated that money is a challenge to the smooth and successful implementation of ICT. In fact, as one participant indicated, money is the number one challenge from which all other challenges of time for ICT implementation; providing rewards for teachers who learn how to implement ICT and to keep up with the frequent changes in technology. In terms of ATF, the tool (money) as the mediator in this case 2 was identified as a major challenge. With grant money ended, the subjects felt constrained and unable to some extent to acquire the needed human and non-human resources to meet the final outcome of equipping preservice teachers with the skills needed to implement ICT in their classes. The challenges identified also revealed some contradictions during this process.

Contradiction in this context is defined as incongruence between outlined goals and results. The major contradiction ATF helped case 2 researcher to identify was that after four years of working with the project, building community and relationships ICT was still not institutionalized in learning organizations. In this regard, institutionalization refers to changes that have become integral part of the structure of the TEP.

Lessons Learned From Both Cases

ATF helped the researchers to develop a deeper understanding of the challenges, turbulences, and contradictions identified in the two cases. Applying the elements of ATF revealed (1) key relations between mediating artifacts of importance and (2) prominent contradictions important to the change process.

Strong leadership with high expectations of faculty, students, and partners is essential whereby the leader steps out of the way and assumes a facilitative and supportive role. The leadership, thus, supplies tools and ensures the right conditions for change: new laboratory space with up-to-date resources, consistent individualized professional development activities for teachers, sustained financial allocation for hardware and technological infrastructure, Competent and knowledgeable ICT coordinator and network manager to handle problems that will come up. However, the preliminary results in the cases suggest that shared leadership distributes responsibility and initiative to unleash the innovative power of participants we bring into focus.

The process of integrating ICT is not void of culture, which stands out as an important mediating artifact in these cases. For example, in a culture where faculty members are given a high degree of freedom to plan, organize, and implement their own courses there is likely be a high degree of faculty ownership of ICT integration, which lead to a higher degree of personal

commitment. However, the freedom may also lead to lack of integration because the individual members of the organization can choose not to utilize conditions made available to them. This is a contradiction that is difficult to handle. Sudden changes in teaching pedagogical concept in relation to integration of ICT may also produce contradiction between student expectations and actual practice even though the change is intended to improve student learning. Students, thus, need to be informed and be part of the change process when integrating ICT in the curriculum.

Conclusions

In this paper, we proposed ATF as an analytical approach for understanding the challenges, contradictions and turbulences inevitable when integrating ICT in two separate IHEs across the Atlantic. In both cases it was shown that ICT has permeated the practice of the IHEs in terms of changes in pedagogy, curriculum, administration and coordination of activities. These changes have been supported and made possible by the allocation of both financial and human resources for the integration of ICT.

Thus ATF is useful as it unearths the challenges, contradictions, and turbulences when integrating ICT adding credibility to the lessons learned. The lessons learned stress that integration of ICT in IHE takes place within a culture, that is an important mediating artifact affecting the change process in both cases. The motives and beliefs of faculty and students influence integration of ICT, and the contractions can be minimized by including students in the plan for integration of ICT, thus, improving the alignment between student expectations, student learning, and course activities.

It also remains to be cleared whether the specific types of challenges can be tied to specific genres of ICT pedagogy. It would be useful to measure the impact of the challenges of integration of a new teaching and learning practice with ICT on student learning.

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Teachers implementing ICT in higher education

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Abstract

Implementation of ICT in higher education learning environments is a complex task. Teachers and students but also management, administration and ICT support are effected by and effect the implementation. One of the very first steps needed in order to qualify the facilitation of the change processes is to actually understand what problems and challenges implementation of ICT leads to and how it affects practice. The paper suggests activity theory as a theoretical framework for analysis of implementation processes. To prove the framework useful and throw additional light on the implementation process a case from Aalborg University is analyzed. In the case study focus is on teachers and from that perspective implementation of ICT consists of three interrelated processes – each process presenting its own challenges: Selection of ICT, adaptation of ICT and change of practice with ICT. To the teachers in the case study the overall motivation for implementation of ICT is to improve quality in student learning based on a constructivist or social constructivist understanding of learning. The analysis also shows that implementation of ICT in itself is a learning process to the teachers.

Introduction

Implementation of ICT in higher education is a complex task. Teachers and students but also management, administration and ICT support and the ways we teach, learn, study and work are likely to be effected by and effect the implementation. At the same time the importance of ICT in learning environments in higher education increases in order to meet the needs for increase in quality, efficiency, flexibility and quantity. Higher education thus needs to explore ways to organize implementation of ICT in learning environments. Bearing in mind the continuous development of ICT it also seems important to recognize that implementation of ICT isn't going to be a one time event. One of the very first steps needed in order to qualify the facilitation of the change processes is to actually understand what implementation of ICT in learning environments is and how it affects practice. Here implementation is defined as *the process leading from one practice to a new practice where the new practice is characterized by use of ICT*. In addition implementation is understood as a social process and will be analyzed as such. It is also important to notice here that the focus of this paper is the teachers and their position in the implementation processes. This choice is not in any way made to suggest that the teachers are the only key actors but solely to narrow down and sharpen the focus of the paper.

Research in Computer Supported Collaborative Learning (CSCL) and related subjects has already stated that ICT influences from a organizational as well as a pedagogical perspective, but a deeper understanding of the implementation seems to lack (Dirckinck-Holmfeld & Fibiger 2002; Collis & Moonen 2001). The understanding of the implications beyond the practice of the individual teacher or small group of teachers is yet relatively vague. At the same time theories and methods explaining how to develop ICT in general seek to ensure that

the products meet user demands and needs, but a focus on implementation seem to lack (Bansler 1987; Dahlbom & Mathiassen 1993). It seems to be an implicit assumption that the implementation process is crucial, but also that one has to look elsewhere for information on how to design or support the process. Theories and methods explaining how to develop organizations could be the place to look and they do contain relevant aspects since implementation of ICT often follows or is followed by organizational change, but they also fail to explain implementation because the perspective on ICT is insufficient (von Krogh et al. 2000; Argyris 1999).

Higher education are thus in a situation where we are starting to acknowledge the need for a better understanding of the challenges deriving from implementation of ICT in teaching and learning. At the same time the theoretical foundation for understanding and improving the implementation processes is relatively weak. With the present paper I want to demonstrate one possible way to strengthen that foundation by drawing on the theoretical framework called activity theory. Activity theory seems relevant because it is already widely used to understand learning and development processes and useful when it comes to tying individual, organization and technology together in one framework.

An analytical framework based on activity theory is applied on an action research project with teachers implementing ICT at Human Centered Informatics, Aalborg University. Human Centered Informatics is an educational program within the humanities offering both bachelor (3 years) and master level (bachelor + 2 years) education and has approximately 500 students. It combines communication, organization and ICT studies to provide students with the tools necessary to be critical, but constructive, participants in the evaluation and construction of ICT and new media. Students are exposed to software construction, Internet technologies and programming. However, they are, in general, not regarded as skilled programmers, although they acquire some knowledge of programming during the course of their studies.

The combination of theory and action research is reflected in the structure of this paper. The first part is a short introduction of activity theory expanding the argument that it offers a useful perspective on implementation of ICT. After that the methodological background and content of the case-study is described prior to the analysis of the implementation process. The concluding discussion extracts practical and theoretical perspectives from the analysis.

Activity theory as perspective on implementation

Activity theory derives from Russian psychology where psychologist as Vygotsky (1978), Luria (1982) and Leontjev (1978) developed a cultural historical social psychology during the 20th century. Over the past 10-15 years activity theory has been subject to growing attention. Yrjö Engeström (1987) and others have developed activity theory to use on pedagogical development and design of software and the practice it aims at. Kari Kuuti has also taken part in the development of activity theory and defines it as:

"a philosophical and cross-disciplinary framework for studying different forms of human practices as development processes, with both individual and social levels interlinked at the same time" (Kuutti in Nardi 1996:41).

Human practice is always understood as practice in a context by activity theory. It is for example important to an understanding of my writing process that I am using a computer and a word processor. According to activity theory the computer and its software is mediating between me and the object (the text containing my message) I am working on. The mediation means that computer and software has an important impact on both the way I do the job and the way I on a cognitive level handle and interpret it. Another central notion in activity theory is that contradictions are inherent in all activity and the driving force behind change processes (Engeström 1987, pp. 67-75). Often contradictions are experienced as problems or challenges in our everyday life. For example a decrease in teaching budgets will often be interpreted as contradicting an increase in the number of students. Another possible contradiction in Danish universities lies in the fact that a university is supposed to award degrees of the highest possible level and quality. At the same time public grants for the universities are closely tied to the number of degrees awarded and exams passed by the students. In other words contradictions are problems that force us to (re-) consider our practice thoroughly and in the process decide which motives or competing goals to give the highest priority.
Contradictions in the implementation process tell us something about the core of the activity and reveals forces suggesting further change.

Tools are according to activity theory mediating artifacts that significantly influence the subject's manipulation of the object in the transformation process resulting in an outcome. Tool as a mediating artifact does not have to a physical object but can also be non-material. Figure 1 itself can be regarded a tool when the task is to explain what a mediating artifact is.

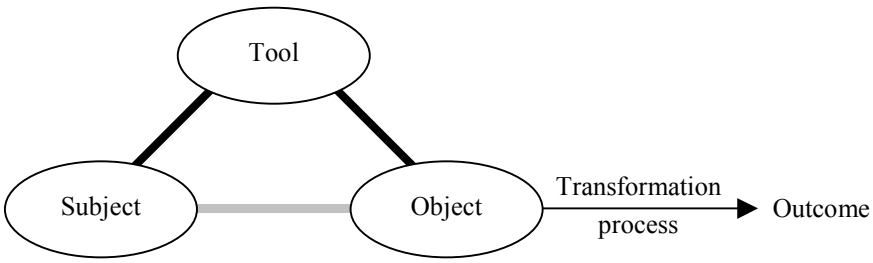

Figure 1. Tool as a mediating artifact in transformation processes. The tools we use also shape our interpretation of the task (Kuuti 1996, p. 28).

To include the context in which the subject uses a tool figure 1 has been extended by Engeström to include culture (rules), community and division of labor.

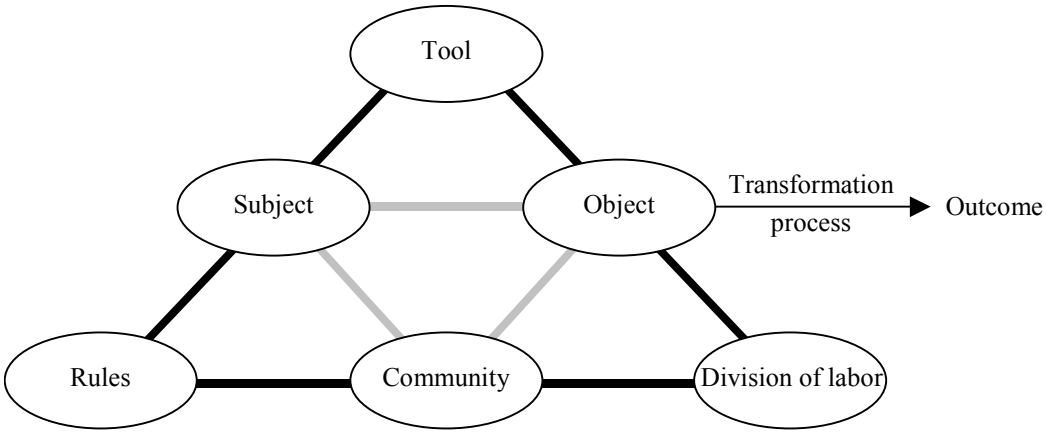

Figure 2. Kari Kuuti's model of the activity system based on Engeström's conceptualisation (Kuuti 1996, p. 28).

Tools, rules and division of labor are mediating artifacts that shape the way communities collaborate and the way an object is transformed. In other words the tools we use, the rules and culture we work within and the people we collaborate with influence the development processes we engage in. Implementation of ICT will as figure 2 indicates always for the individual teacher take place in a context of colleagues and students (community), rules (and culture) and technologies (tools) in use. The introduction of a number of mediating artifacts also underlines the other key-concept in activity theory, namely the contradictions between different mediations or between the aim of the transformation process and one or more mediating artifacts. When studying implementation of ICT these contradictions are important to notice because they explain the origin of most challenges and problems in the process. For example we may experience a contradiction between pedagogy as it is defined in the rules and culture of an organization and the tools in use if the pedagogy encourages collaboration and the technology in use only supports one-way distribution of learning material.

Activity theory also offers a perspective on different levels of the transformation process. It operates with a hierarchy of three functionally interrelated levels: Activity, action and operation. Activity is the overall process, the motivation for a number of actions and operations (Kuuti 1996). Actions refer to specific goals and the mental focus at any time in a transformation process. Operations refer to conditions that have to be present before the goal of the action can be reached.
Figure 3 shows the relation between the three levels in the process:

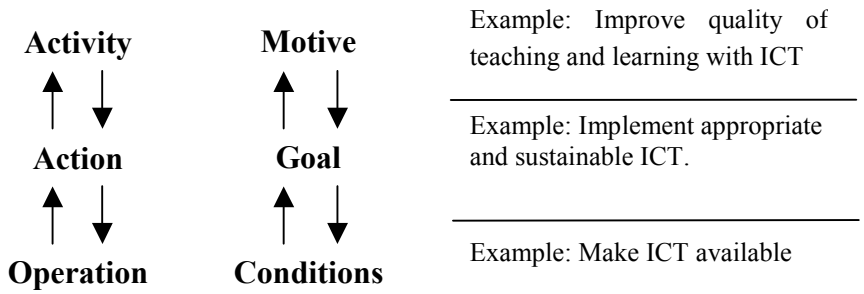

Figure 3. Levels of an activity (Kuuti 1996, p. 30).

The overall activity characterized by a motive guiding our practice can be broken down into specific actions with concrete goals. The actions can be broken down into operations that are the conditions that have to be present before goals can be reached. The arrows signify the dynamics between the three levels. The activity guides the actions, actions add to development of the activity, actions can be automated and thereby turned into operations and breakdowns in the automation can bring an operation back in the center of our focus and thus turn it into an operation again.

Implementation of ICT is a concrete goal teacher's work with on a conscious level, but it is also part of a larger scheme that is important to understand the background for the implementation. Over time focus of the teacher shifts and the processes he or she works with on a conscious level changes. According to activity theory our attention is directed towards the level action. We have a motive beyond our concrete goal at a specific point in time and we reach the goal by means of operations. Operations are more or less automated and can thus be carried out without removing attention from the goal.

The distinction between operation, action and activity is as pointed out directed towards understanding of processes and in a process motive, goal and conditions will dynamically replace each other. The motive in one process is goal in another process and so on. Therefore the distinction is understood as an analytical abstraction here and it can be used to shed light on the relation between a process and its context of motive and conditions. Implementation of ICT can as indicated in figure 3 at different steps in the process, be condition, goal and motive in sub processes.

Action Research with Teachers from Human Centered Informatics

Human Centered Informatics already uses ICT supported learning, but primarily in educational programmes placed off-campus. The action research project focuses on bringing ICT into the on-campus programs. The aim of the project is to specify how ICT can help to improve coherence, flexibility, transparency and quality in teaching and learning. The specification is supposed to be used in an implementation of ICT and change of practice. Another aim of the project is the one discussed here; to understand the implementation processes.

The action research approach was chosen for more reasons. First of all it is a way of combining research, practice and development with the researcher as active participant in the change process (Baskerville & Wood-Harper 1996). Thomas Mathiesen who also contributes to the field of action research points out that one of the important tasks in action research is to reveal contradictions inherent in existing practice (Mathiesen 1992, p. 19). He thus without drawing on activity theory himself indicates a clear link between activity theory and action research.

Action research ensures that knowledge gained in research is used in practice and that research is based in practice. It also ensures a change of practice because the researcher takes part in driving the project forward. Another reason for doing action research is the strength lying in practitioners and researchers collaborating on a joint project. All parties bring their own knowledge and ideas into the project and that creates ownership of the change among the teachers affected by and involved in it. In this project the practitioners are both teachers and researchers at a university and experienced in reflecting on their own practice and thus it is even more important to involve them in the combined change and research process. It is also important to notice that the teachers taking part in the action research project have chosen to do so and how to do it themselves. The action research project is divided in more phases gradually involving more teachers, students and support staff as summarized in table 1:

Phase	ICT implementation	Involved	Goal	Research method	Data
1. Fall and winter 2001-2002.	5th semester of Human Centered Informatics. Teachers free to choose technology.	6 teachers, 21 students	Document existing implementation procedures.	Pilot study of existing practice. Researcher has no part in design and implementation of ICT.	Interviews, ICT used in courses
2. Spring 2002 – winter 2003.	3rd semester of Human Centered Informatics. Teachers have to use the same technology.	20 teachers, 80 students.	Develop, use and document new implementation procedures.	Action research. The researcher takes part in design and implementation.	Interviews, ICT based infrastructures created and used, log-files.
3. Winter-summer 2003.	4th semester of Human Centered Informatics. Teachers have to use the same technology.	30 teachers, 160 students.	Develop, use and document new implementation procedures.	Action research. The researcher takes part in design and implementation.	Interviews, ICT based infrastructures created and used, log-files.
4. Summer 2003 -	All semesters and specializations of 3rd semester of Human Centered Informatics. Teachers are adviced to use the same technology.	60 teachers, 500-600 students.	Use implementation procedures.	Case study of practice.	ICT based infrastructures created and used, log-files.

Table 1 Phases in the actions research project.

The focus of this paper is findings from phase 1, the pilot study involving teachers and students at the 5th semester of the specialization with most emphasis on software evaluation and

construction. If we look narrowly at phase 1 it cannot be described as action research, but has more similarities with a traditional case study since the researcher is not directly involved in the development process. However phase 1 plays an important role as starting point for the action research project and is thus regarded part of it. The concrete aim of the pilot study is to document challenges related to implementation of ICT and thus create the base for a process of development, evaluation and reflection in the following phases of the action research project.

The time limit is chosen because a semester is the shortest natural time frame in the present organization. The actual semester is chosen because of a relatively small number of students (21) and teachers (6 in 4 courses). It is also chosen because of content and place in the educational programme. Some of the teachers had taken part in similar projects earlier and would also be able to discuss the project in their own teaching. The students at the semester are in a process of learning how to evaluate, take part in and manage construction of software, organizational development and pedagogical innovation. The above considerations were all taken to overcome some of the hardest challenges in the early phase of the project. The aim was to produce visible results and mature procedures and support functions in the project before targeting teachers and students less prepared for implementation of ICT.

The data collection in the pilot phase of the action research project has primarily been composed of two elements: Course materials, structures, plans and ICT based products and interviews with teachers and students towards the end of the semester. The interviews were carried out as semi-structured research interviews (Kvale 1996). In the analysis of the data the interviews have been the most important source of information. Course material and minutes from meetings have primarily been used where they supplement by adding further details to themes discussed in interviews.

Based on the above considerations the findings concerning the concrete implementation of ICT are expected to be valid. All teachers and students involved have been interviewed and this alone should be enough to paint a reliable picture of practices and challenges deriving from implementation of ICT in teaching and learning in the present case. Bearing in mind the close relation to the rest of Human Centered Informatics nothing so far indicates that the challenges uncovered here shouldn't be latent in later phases of the action research project too. It is not in any way however reasonable to claim that the specific findings of concrete practices and challenges of such a small sample can be generalized and say anything about another case outside Human Centered Informatics. The theoretical framework is another thing and should be useful in a broader context. Based on activity theory it has roots in a broadly acknowledged theoretical framework. The comprehension of implementation suggested should not be regarded a fully predictive or normative theory of implementation of ICT. It should rather be regarded *a way of thinking about implementation of ICT*. In the present case it has as shown in the following analysis been *a very useful way of thinking about implementation of ICT,* but future research is needed to reveal whether it has the same potential in other cases or it needs refinement.

Implementation of ICT as a multifaceted process

The analysis focuses on the teacher and challenges the teacher has to meet in the implementation process. The first part establishes focus points for the rest of the analysis by identifying important sub processes in the overall implementation of ICT.

Implementation of ICT is as a working definition defined as *the process leading from one practice to a new practice where the new practice is characterized by use of ICT*. Furthermore I want to draw on the conclusion from Chin and Marcolin (2001). They argue that the adoption of new technology has to be studied with focus on *deep usage* meaning that implementation of ICT to be fully understood must be studied as a social process and a change in work and learning practice influenced by ICT.

In the time span from one practice to a new practice with ICT the action research shows that the teachers have concerns of different kinds. First of all the teachers all express a common motive for introducing a new teaching and learning practice with ICT. They all want to improve quality one way or another. Prior to introducing a new practice and improving quality conditions have to be meet. The teachers have to select and adapt the ICT-tool they can use to form a new practice.

When selecting ICT access to feasible choices of ICT-platforms, programming environments or distribution media making it possible to try out alternatives has been important to the teachers. None of the teachers made the final detailed decision on how to use ICT in their course before selecting a technology, but worked on the basis of general idea about what they wanted to do. One teacher thus explained his choice with reference to the subject of his course. The students should learn to build web-sites and he chose to build a web-site with course related information the same way he was teaching the students to do.

The next important aspect of the implementation process to the teachers is the adaptation of the technology for a specific practice. In the adaptation process teachers also learn to master the technology sufficiently to use it in their courses. In all cases the learning process has reached into the teaching process, but started as part of the preparation of the courses. The condition for learning to use a technology is obviously that a technology has been selected. The teachers have had to learn to use the technologies on more levels. They have had to figure out how to operate it. Depending on previous knowledge and the choice of ICT the teachers have spent different amounts of time on this process. The teachers using a course management system thus spent more time on learning to operate the technology and adaptation at a technical level than the teachers that had a programmer and author build a web-based course-material.

Another element in the learning process is getting to know how to use it in a specific course, how to change practice. The teachers considered aspects of the change of teaching practice during the adaptation of the technology, but a full implementation of the new technology in practice of course involved the students too. They had to make sure that the students had ac-

cess to the support needed in order to use the technology effectively. Another and perhaps more difficult task in this process was to convince the students that the new practice was worthwhile engaging in.

Research on change related to implementation of ICT roughly supports the understanding of implementation as a process with a number of interrelated sub-processes, steps or levels. Everett M. Rogers has done research in what he defines as diffusion of innovations for close to 50 years and has thus been very influential (Cooper and Zmud 1990; Rogers 1995; Gallivan 2001). He suggests that diffusion of innovations by individuals can be understood as a process of knowledge, persuasion, decision, implementation and confirmation (Rogers 1995, Pp. 161-186). Cooper and Zmud (1990) suggest a phase model with the steps initiation, adoption, adaptation, acceptance, routinization and infusion. Gallivan (2001) argues that organizational adoption and assimilation of technological innovations only can be fully understood when an organizational, a managerial and an indivual perspective is combined in a study of the change processes.

The three aspects or sub-processes in the implementation of ICT can be understood in terms of the perspective on the transformation process offered by activity theory. Figure 4 shows the relation between the three elements in the process:

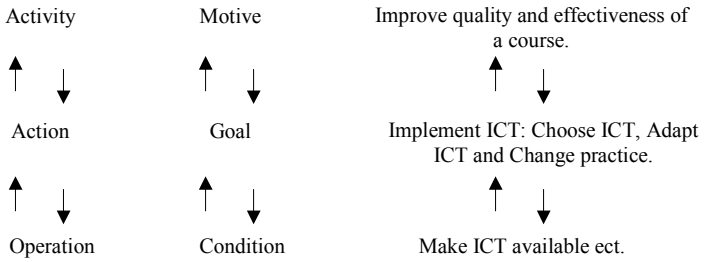

Figure 4. Three functionally interrelated levels of an implementation process: Activity, action and operation. To the right example of how the levels based on the action research project can be applied on implementation of ICT.

Our mental focus shift dynamically and what is placed on the level of action in one process may be at the level of activity or operation in another process. As indicated earlier the implementation process consists of at least three major shifts of goal at the level of action. Selection of ICT, adaptation of ICT and change of practice with ICT can all be placed at the level of action at different phases of the implementation process.

The three main actions; selection of technology, adaptation of the technology and changing teaching and learning practice are interrelated and are not to be regarded discrete steps following each other in a distinct order. Even though teachers in an overall perspective move towards a change of practice they seem to dynamically shift between considerations concerning

selection of ICT, adaptation of ICT and change of practice with ICT throughout the implementation process.

Each of the three actions will be analyzed using the basic structure of an activity and the teachers at the place of the subject as a framework. The 6 teachers implementing ICT in 4 courses represents 6 activity systems because focus here is on the teachers as subjects in the activity system. The analysis summarises findings from the 6 activity systems with focus on contradictions. Contradictions are as discussed earlier inherent in all activity and the driving force behind change processes according to activity theory. Looking for contradictions in the implementation process thus tells us something about the activity in itself as well as the forces suggesting further change.

The analysis is supplemented with quotes from an interview with two teachers regarding one of the courses. The course was on human computer interaction and the teachers implemented Lotus Learningspace as a course management system and a way of supporting a higher degree of collaboration in the course. This way of communicating is chosen for two reasons. At the general and conceptual level this course and interview represents challenges only partly visible in the rest of the interviews because the teachers I quote are the only real newcomers to the technology they use. At the same time the content links the quotes together saving the reader from having to relate to a new concrete practice and implementation process for every new quote. In other words the quotes themselves tell a coherent story about a specific implementation process. The interview was done in Danish but the transcript has been translated into English.

Selection of ICT

Selection of ICT is made by the individual teacher. The selection of technology is placed within the framework of task, transformation process and mediating artifacts. The next step thus is to identify key-elements and mediating artifacts in the context of the selection of ICT. Figure 5 summarizes factors influencing the teacher when they select which sort of ICT to use:

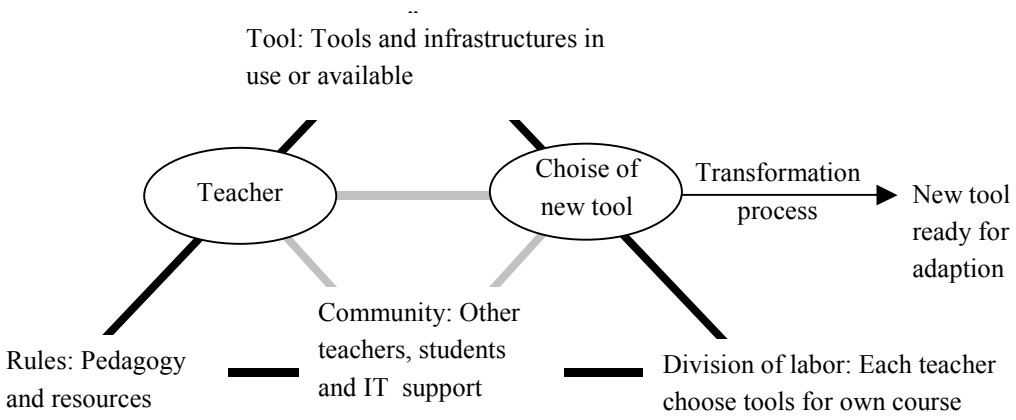

Figure 5: Activity system for selection of ICT.

Community is to the teachers colleagues, support staff (technical and administrative) and naturally the students. In the selection of ICT in the specific case the teachers refer to the closest colleagues, staff supporting the implementation and staff doing ICT support as the most influential members of their community. This is not because other groups such as students are not regarded important, but because they considered represented through the experience and knowledge of primarily teachers. This may pose a problem and perhaps a contradiction between actual practice and part of the goal since students could have valuable inputs that are not known be the teachers. On the other hand the discussion on how to involve students in quality improvement is ongoing and the teachers do later on involve students in evaluation of the experiments with ICT and new ways of teaching and learning:

Teacher 1: It would demand a lot of administration [to involve the students earlier]. You had to know which students that have registered for the semester before the summer holiday [for a course in the fall] in order to mail the students information welcoming and inviting them into Learningspace and telling them that they can find course descriptions and post suggestions for the semester in there. They would like to be able to start reading during the holiday and we could support that this way.
Teacher 2: Yes.
(…)
Teachers 1: It would have to be driven by the semester coordinator.
Teacher 2: Yes.
Teacher 1: If not it would be difficult to get it on track and keep it there.

Tool mediates between the individual teacher and the selection of ICT. The teachers refer to the influence of the tools and infrastructures they already use in their courses or in their job in general. Technologies as word processing, internet and e-mail have been implemented for some time and are thus an important frame of reference to the teachers when they are about to select a new technology. After having taught a course two of the teachers discussed their selection of ICT:

Teacher 1: I see Lotus Learningspace as a tool for what they call web-based training where you see learning as a matter of training. I think it is great for that.
Teacher 2: Yes, but it is not that suitable for our context.
Teacher 1: Perhaps for the lectures but it ends there. We can publish materials related to the lectures online but when it comes to collaboration it doesn't seem all that useful. And if it is not even that useful for publication of materials I am not sure whether I will use Quickplace, Learningspace or Igroups the next time. I haven't decided yet.
Teacher 2: No.
Teacher 1: But I would like to try out more systems instead of just randomly choosing a system and then subject myself to its limitations.

The new technology is interpreted within a frame of other technologies and at the same time technologies that are compatible with tools in use is preferred. Furthermore knowledge of technologies available in the organization, but not yet fully implemented influences the teach-

ers when they select ICT. Here is a possible contradiction between the wish to create something new and a selection of tool deeply rooted a well-known tools. It may somehow withhold the teachers from new and innovative selections of ICT that break with tradition.

Rules mediate between the teacher and the community of other teachers, students and support staff. Teachers primarily refer to the pedagogical and academic demands and resources available. Here a learning environment that builds on social constructivist principles has a high priority and influences the selection of ICT. The selection is tied to expectations of how a specific technology is going to support students construct knowledge both socially and individually. This is done by selected ICT that supports dialogue and reflection in one way or another. The demand for support of student learning is regarded important in the entire implementation process as it is the overall motive for bringing ICT into the courses. In the individual course the academic content also influences the selection. The teacher teaching production of web-sites selects to use knowledge inherent in the course to bring it on-line. Here is a contradiction between the practice of the teachers and the requirements expressed by the students. Students would prefer a more coherent learning environment based on shared rules for selection of ICT for all courses. Last but not least the demand for higher productivity and quality with the same or fewer resources pro student makes the teachers look for ICT that can contribute to a combined increase in quality and productivity:

Teacher 1: Perhaps some of these systems are missing the target. I would like to have a system where both the students and I can publish information.
Teacher 2: Yes.
Teacher 1: And then suddenly I have this giant thing and 140 new things to learn because of all the functionality I don't need. I only want to use two functions so perhaps I have chosen the wrong system. I would use less time on the technology if I used something simpler that fitted my needs better but that's how it is when you want to experiment.
Teacher 2: Yes, you are right but I would add that it could be right that our philosophy of teaching and learning doesn't fit that of Lotus Learningspace very well.

Division of labor in the present organization and culture lets each teacher choose methods and tools for the courses they teach. It also means that the resources allocated to each course normally are the same year after year. Teachers making an extra investment of personal time by developing a course and introducing ICT thus have to teach the same course more times to get the investment back. If the course is given to another teacher that wants to teach it another way the investment may be lost. The teachers of course consider this contradiction between the need for resources for development and lack of investment beyond the individual level when they select ICT. Furthermore the teachers at Human Centered Informatics normally need some sort of technical support when they implement new technologies. ICT that is not supported by the existing organization thus is a very problematic selection and we see a contradiction between the goal (development with ICT) and the organizational setup. Normally the ICT support staff is very cooperative when it comes to testing or implementing new technologies but at a formal level the relation between the ICT-support organization and the

teachers and educational programmes is quite weak. There is no organ for cooperation between the educational programmes and the ICT-support.

Conclusion on Selection of ICT

The teachers were free to choose ICT for the courses they had to teach. The teachers chose different solutions based on what was available and what they already knew about ICT in teaching and learning. Haven decided to test and use solutions outside the official ICT infrastructure the teachers received little or no support for the selection process. To support innovation in the following phases of the action research project it is advisable to improve the support for selection of ICT. This can be done in at least to ways: By choosing a common ICT platform that is flexible enough to allow different experiments for all courses or by improving access to a variety of sufficiently supported tools.

Adaptation of ICT

Adaptation of ICT depends on the technology and the purpose for using it. A tool for asynchronous communication demanded less adaptation than the course structure in a course management tool. In both cases we are looking at a basic technology that teachers change and prepare for use through an adaptation and learning process:

Teacher 2: That's what I mean because of course we had to learn to use Learningspace but that didn't take long time. What took the time was to decide how to use it.

Figure 6 summarizes factors influencing the teachers in the adaptation and learning process:

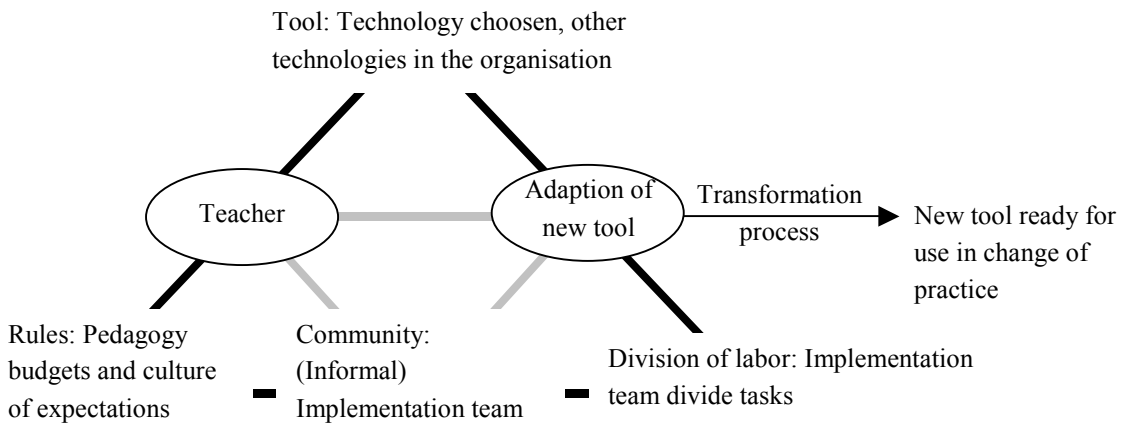

Figure 6. Activity system for adaption of ICT.

Community is in the adaptation process characterized by a clear distinction between those that take part in the process and those that form a more remote frame. Teachers tend to form informal adaptation teams that collaborate with the teacher on adaptation and creation of content on top of the basic technology. The members of the adaptation team are found among other teachers, internal consultants supporting the project and ICT support staff. In this case it

is important to notice that the adaptation teams are not formally appointed but instead groups of people whom due to their job, competences and interests join the teacher in the adaptation process. A high dependency on the teachers' personal network contradicts a more systematic implementation of ICT where support of equal quality and quantity is available to all teachers. On the other hand present practice based on a number of scattered personal networks potentially brings a lot of new ideas that would otherwise not come up. In the less involved part of the community is found other teachers, students and support staff not directly involved in the adaptation team.

Tool primarily represents the technology that is the focus of the adaptation process. It may seem strange that a technology can be a mediating artifact in a transformation process aiming at adaptation of the technology itself. The reason is that adaptation to a very high degree is shaped by the possibilities most obviously offered the technology. Less obvious or more complicated options are left out of focus. When adaptation demands complicated tools, new competences and extra resources teachers are less inclined to do it unless extra help and resources are available:

Teacher 2: We primarily used it to distribute information by publishing information on what was going on in the course and exercises in the system. To a certain extent we let the structure suggested by the system control the way we split the content we published into modules. We had one header for each meeting in the course. At the time I was thinking that we didn't have to do it that way but I couldn't come up with a better idea.

Rules of importance are again culture and guidelines for allocation of resources. Focus is on the academic and pedagogical outcome of the process while the resources are considered too. It seems reasonable to suggest that there is a contradiction between the complexity of the tools and the following complexity of the adaptation and the way founds are allocated to courses and teachers. With a fixed amount for each course each year and little tradition for allocating extra resources to innovation teachers may be less inclined to implement new technology even though they are expected to do so. Long-term investments are in other words usually at the teachers own risk.

Teacher 1: It is the classical problem. It takes time to learn new technology. And even though this is the third time I organize and teach this course it has been different every time. And the four hours you have to prepare for a lecture you usually use to read a new text that you want to use. And then suddenly you have to use 45 minutes or so to upload something in this system and it ends up being work for free. If the university wants us to use ICT then I think we one way or another should have some extra time for it.

The pedagogical and academic tradition is important to the teachers in the adaptation process because they seek a change towards a new practice based in tradition. This could be interpreted as a contradiction holding back change and limiting innovation. The teachers express it in another way and see the implementation of ICT as a way of re-interpreting values inherent in tradition:

Teacher 2: I think that putting more supporting material on the web is rooted in thoughts we had before we started to look at Learningspace, supporting the study work between the lectures. And my motivation to work with that has increased even though I don't think we came that far this time. I think I saw the possibility to do it here.
Teacher 1: Publish exercises and so on.
Teacher 2: Yes, it can be improved a lot. The contribution of the students can also be improved. We just have to be a little better to plan for it. We also have to learn how to do it. I have seen other teachers do it and in that respect it is not revolutionizing but I think it is a good thing when it comes to qualify the time we spend with the students.
Teacher 1: That's right. If you only focus on the lectures you don't really improve quality. But if you have a course where you can use the system to improve what goes on between the lectures then it is smart.
Teacher 2: Yes, but they always have to prepare.
Teacher 1: Now it is more visible that they have to.
Teachers 2: Yes, exactly. We often think that the students don't read enough. At the same time the students feel a lack of opportunity to discuss what they have read because we spend the lectures on lecturing. Some of the students came and asked me questions and in a virtual environment I could have given a general answer that all could have gained from. You could also have a student driven discussion after the lecture.

Division of labor is important when teachers engage in an adaptation process. Without some sort of division of labor is in practice almost impossible for teachers to take part in the adaptation because they need support of different kinds. In the present case the teachers did manage to collect the resources necessary to form adaptation teams with the teacher as a sort of project manager responsible for the decisions made along the way. The division of labor contradicts tradition where teachers have worked more individually with the planning and teaching of courses. Since the adaptation teams are not formally put together and allocated resources to support an implementation the teachers do express doubts about how much help to expect from whom at which point in time:

Teacher 2: You are right that it is difficult to delegate responsibilities in Learningspace. You can compare it to Firstclass where we had a similar problem but managed to work around it giving all users the possibility to create new conferences.
Teacher 1: I noticed that [another teacher] used iGroups in her course because the students used it and suggested she did so too.
Teacher 2: That's what I mean. You could say that it was a bit unfortunate that we didn't use that but it didn't seem to annoy them.
Teacher 1: Yes, I don't know.
Teacher 2: I was a bit afraid that would happen.
Teacher 1: [With reference to the students using iGroups] And then the teacher published information to the students but they were in control of the system and took part in the chat and creation of the structure whereas we controlled what happened in Learningspace by

structuring and publishing while the students primarily read and published answers to exercises. It is two completely different approaches.

Conclusion on Adaptation of ICT

Again much depended on the network and resources of the individual teacher. The adaptation process is highly influences by the pedagogical strategy chosen by the teacher, but it is also depending on the teacher to take charge of the actual adaptation. This poses a risk to the teacher who risks running into tasks consuming much more time that expected. Another risk is that the teacher at a late stage in the adaptation process discovers that the tool doesn't fit the needs.

To support innovation in the following phases of the action research project it is advisable to improve the support for adaptation of by removing some of the risks in the process. Formal adaptation or implementation teams could be one way to give the teacher technical or pedagogical help and advice grounded in practice.

Change of practice

Change of teaching practice was through the entire process the overall goal for guiding the teachers through the initial selection of technology and the following adaptation. The challenges in the change of practice is of course closely connected the nature of the change. It is also here the result of selection and adaptation of technology is tested in real life with students in a learning process. A higher degree of service to the students where the teachers offers something besides what the students are used to is relatively easy to introduce. It is a greater challenge to introduce new ways of learning that changes the division of labor between students and teachers and puts greater responsibility and perhaps greater workload on the students. Figure 7 summarizes factors influencing the teachers when changing practice:

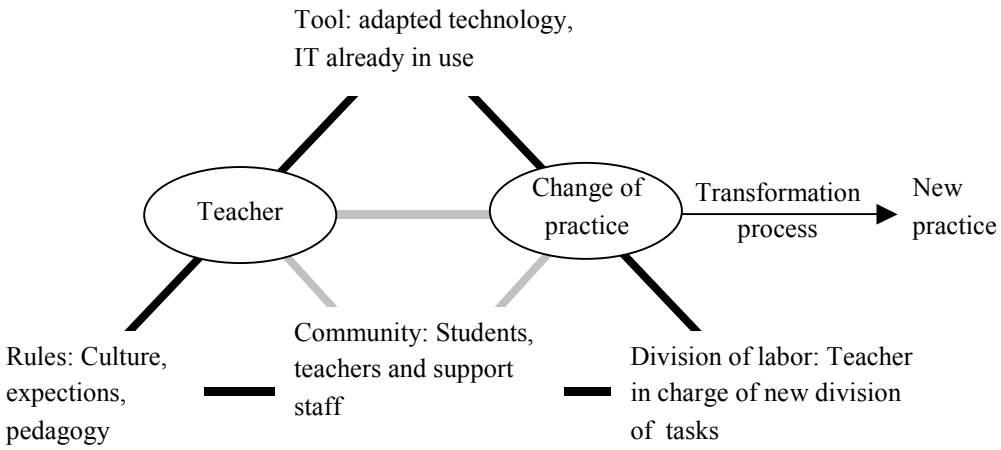

Figure 7. Activity system for change of practice with ICT.

Community is especially other teachers and the students. In the every day support of the ICT in use the adaptation team may still play a role, but here it is not that significant. The students are important because that teacher is teaching now and thus in direct interaction with the stu-

dents. Other teachers influence through the collegial network or by teaching related courses. They are significant because they also take part in defining the academic and pedagogical tradition that is part of the context the individual teacher shapes his or her own course within:

Teacher 1: Some use a web-site in their course to publish information and give students access to publish as well. I saw that [teacher at Aarhus University] had made one, she had written something and then students had written something. It had different themes and so on and that's not what we have been doing. We have published something and then the students have read it. Well, one time I forced them to do some exercises on-line. I thought that we have a system made for distance education then lets try to use it that way just as an experiment. Then we instead of a traditional lecture spent time on on-line discussions. I sat in my office and the students sat in a lab or somewhere else. I had spent long time on preparation and upload of exercises but the students thought it was stupid.

Tools are primarily the technology that has come out of the adaptation process, but tools already in use may also influence and even contradict the new tool just as the new tool may turn out to contradict the reason for using it. The teachers that had chosen to develop an interactive web-based course-material aimed for at practice in which only a small amount of the activities in the course were traditional classroom lectures. In another the teacher over some years had developed a web-based source of information relevant for his course in multimedia production and programming. Here the information source gave a special situation too. Use and further development had to be included in the teaching practice. The teachers that had adapted an information and communication system for their course also had chosen some conditions for their change of practice. Their plans were to create a practice where communication in virtual spaces supported the traditional classroom lectures. It turned out that they had selected a tool that contradicted their goal. The communication system was to hard to use compared to the actual outcome.

Tools already in use by other teachers or students can also influence a teacher trying to change practice in his or her own course. Other technologies can be inspiration but also competition. This contradiction will be treated further in the following discussion of rules.

Rules in the sense culture and tradition are a very influential factor when it comes to changing practice. The teacher needs to get the students to be part in a practice that is new to both teacher and students. Since the teacher has already decided to aim for a new practice the students and their readiness to try something new is crucial to the success of the entire implementation. In the case here the teachers have had to work within a tradition where they construct, own and maintain their own web-based information systems. It is an advantage that the students are used to collaborate in virtual spaces. On the other hand it is very complicated for the teacher to introduce a practice based on a new system because it easily ends up competing with what the students use already. Direct or indirect competition with other systems in the organization is also a possibility. One example is the administration that uses newsgroups for communication with the students. The challenge to the teachers is to introduce norms for a

successful coexistence of different tools and channels of communication. Once again the lack of a common framework for use of the web in courses seems to introduce problems while ensuring the free choice of the individual teacher.

In all cases students had mixed attitudes towards the practice with fewer lectures as it turned out to contradict student expectations even though students were supposed to get a better product this way. Some students would rather attend a lecture than work in a web-based environment on their own. On the other hand most students liked the use of interactive web-based materials even though they to a large extent chose not to use it. It is a challenge to the teacher to establish a norm saying that presence and activities and a virtual space is just as important and real as presence in a classroom.

Division of labor is here primarily between the division between teacher and students. In the planning phase and in the course the teacher is at least laying out an overall framework for the activities. At the same time the development carried out in the case in focus here indicates that the teachers based on a constructivist understanding of learning want the students to be an active part in the learning process. Focus is moved from lectures to courses where student responsibility for production of knowledge is emphasized. As indicated earlier this contradicts student expectations and poses a major challenge to teachers. In this case there is some evidence that student expectations in general and especially when it comes to division of labor is one of the most significant challenges teachers have to meet when implement ICT.

Conclusion on Change of Practice

The teachers are of course very important during the change of teaching and learning practice, but the change of practice also poses considerable risks to the teachers. To support innovation in the following phases of the action research project it is advisable to improve the support for both students and teachers in this process. To avoid loss of time and build-up of frustrations students may need introduction to the new technology and the teachers may need support for developing their use of the technology. It should also be considered whether the advantage of experimenting with more technological platforms is bigger than the disadvantage of forcing students and teachers to navigate across multiple platforms.

Concluding Discussion

It is fair to say that implementation of ICT is a complex and challenging process on more levels. Focus has been on the teachers and that alone has revealed challenges to teachers, students, support staff and the culture of the organization at different steps in the implementation process.

In the present study teachers were faced with two different types of contradictions in the implementation process: Contradictions that were a driving a force to the teachers and contradictions that were a barrier to the teachers (but often a driving force for change in other parts of the organization). Contradictions become a driving force to the teacher when it motivates developing activities within the existing boundaries of the teachers' work but a barrier when the development process is withheld by factors outside immediate reach of the teacher. This sug-

gests that a feasible way to support implementation of ICT would be to unleash the driving force of the contradictions by helping the teachers to identify them and furthermore mediate between the teacher and his or her organization so that the organization may develop and improve conditions for the teacher. Based on activity theory, we can thus talk about support at different levels; support improving the conditions, support helping to establish and reach the goal or support aiming at establishing a clear and operational motive for the implementation.

In the discussion on how to support teachers in the implementation processes it is, on the other hand, important to remember that it is a learning process and, as such, it is expected to be a challenge to the teacher. If all challenges are removed from the process, the teacher's active contribution to the change process is likely to be removed as well. Instead a continuous exposure of contradictions emerging in the implementation process may be used to motivate and drive the learning process forward. Engeström (1987, pp. 113-175) combines Vygotsky's definition of the zone of proximal development with later research. He ends up with an understanding of learning that links learning, new activity forms and change in the subject of an activity. This perspective seems to be a promising way to expand both the theoretical and practical understanding of implementation of ICT.

The present study has been used to improve the organizational support for the implementation of ICT in teaching and learning at Human Centered Informatics and to develop a framework describing the implementation processes. Future research will show the reach and usefulness of this framework in other contexts. Due to its base in activity theory that is widely used and accepted the framework is so far expected to be useful to analyse and identify the need for support of implementation processes in other contexts. Based on the above analysis and discussion it was decided to move into the second phase of the action research project with a higher degree of support to teachers, administration and students and a higher degree of coordination of the implementation. The decision to do so was grounded in the fact that most challenges in the first phase study turned out to be grounded in rules and culture, tools, a community and a division of labor that are shared with the rest of Human Centered Informatics. We chose to implement a common, but flexible infrastructure across a semester framing more courses and included teachers, students and administration in the project. Analysis of the data is ongoing and so far the distinction between choosing ICT, adapting ICT and changing practice with ICT seems useful when it comes to explaining the implementation process and when looking for ways to support it. It is most likely though that the results also will be a new set of contradictions that once again will call for refinement of both the practical aspects and theoretical understanding of implementation. It would, in other words, be a mistake to regard implementation of ICT in higher education a one-time event. New technologies and ways of using them will evolve and from time to time new implementations with new implications will take place.

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Creating an Educational Infrastructure - Experiences, Challenges and Lessons Learned

Ann Bygholm & Tom Nyvang

Abstract

This paper presents some of the results from the Human Centered Informatics subproject of the Digital North Denmark Project Virtual Learning Environments and Methods. Human Centered Informatics is a bachelor and masters program at the faculty of the humanities at Aalborg University. The part of the project in focus here is the implementation of a new infrastructure for communication and collaboration. The paper describes and categorizes the challenges that emerge in the implementation process to inform future implementation projects in similar contexts. Our claim thus is that it is impossible to prevent all challenges and contradictions from arising. It is, however, also our claim that knowledge about the nature of the most prominent challenges that can be expected to arise may be helpful in an attempt to prevent some challenges, handle some so that they do not turn into barriers and even turn some into driving forces.
Keywords: Infrastructure, implementation, learning, higher education.

Introduction

Educational technology has had many forms over time. Different forms have corresponded with different views on what a computer or ICT is. Here we want to mention three significantly different perspectives: The computer as an instrument for automation, the computer as tool and the emerging perspective on the networked computed as an infrastructure. It is our claim that the different approaches to the interpretation of the computer point out different opportunities and challenges to the users. In the early years of educational technology when great hopes were attached to *automated* instruction one of the major challenges was to represent a subject area to the student and afterwards test whether the student had met the learning goals (Skinner 1968). The automated instruction paradigm still plays a role in educational technology, but very seldom as the stand-alone application some had expected. It has turned out to be one ICT use among many others in education. With the spread of the personal computer it became a *tool* for learning – at first as a sophisticated typewriter that made it a lot easier to work with traditional texts and later on graphics, photos, video and interactive presentations. The computer was not thought to be an active part of the learning process, but a supporting tool that made is easier for students and teachers to write, print, save and edit learning products and materials. The challenge was to develop accessibility and quality of materials and communication (Collis & Moonen 2001; Dirckinck-Holmfeld & Fibiger 2002).

With the emergence and growth of the internet the network of computers processing and distributing information is in focus. We have also started to talk more about IT or ICT and less about computers. In education as in the rest of the society ICT has become a platform for communication and collaboration. One of the major new challenges is to create ICT based networks that meets the needs of the individual user and the community. This is complicated

by the fact that most users are part of more (learning) communities and have different needs and goals. To qualify the understanding of the new challenges further we turn to the term infrastructure (Star 1996).
Viewing the ICT for educational purposes as a new infrastructure, we identify and discuss levels of problems that appear in the process of infrastructure development. This analysis exposes the complexity in use, support and system administration of the new system. Generally speaking the implementation is viewed as an ongoing negotiation of meaning in the educational working practice.
The paper is divided in five sections. In section two (the next section) we discuss our theoretical approach to infrastructure. Section three describes our case and methodology of the case study. In section four we analyse data from the case and finally in section five we conclude on the challenges inherent in the emergence of an infrastructure and on the usefulness of our theoretical approach.

Understanding Infrastructure

The traditional conception of an infrastructure is something that is just there, ready-to-use, completely transparent and not to question like e.g. the water system, the electricity supply, the railway, the mail services and the Internet. This understanding focuses on infrastructure as an object, something that is build and maintained and then sinks into the invisible background. It follows from this that the activities around the infrastructure are heavily shaped by its structure. In a way this is exactly the kind of infrastructure we want in our educational setting, something just working, supporting learning activities and communicative practice. But in order to discuss how something becomes an infrastructure, the design and re-design of infrastructure, the question of how the structure should/could be, we need to focus on the process, the infra-process instead of the infra-structure. Following Star and Rudledger we in this paper understand infrastructure as a relational concept. *Thus we ask, when – not what – is an infrastructure* (Star & Rudledger 1996, 113). Stressing the fact that it is the use context and use practice that defines whether or not a given technology becomes an infrastructure.
In order to characterize the relational side of infrastructure Star & Rudledger suggest eight dimensions, that is *embeddedness* (integrated in social structures and practices), *transparency* (can be used without removing focus from the task), *reach or scope* (goes beyond individual tasks or processes), *learned as part of membership* (an inherent part of an organization), *links with conventions of practice* (shapes and is shaped by practice), *embodiment of standards* (builds on standards and conventions), *build on an installed base* (must relate to existing technologies), and *visible upon breakdown* (looses transparency and is drawn in focus when it breaks down). These dimensions are quite general, in fact they could be used to characterize very general phenomena like for instance language, which indeed is an infrastructure and, we take it, is meant to point at the ambiguity and complexity in seeing infrastructure as a relational concept. In the words of Star and Rudledger: *An infrastructure occurs when the tension between local and global is resolved. That is, an infrastructure occurs when local practices are afforded by a larger-scale technology, which can then be used in a natural, ready-to-hand fashion (op. cit. page 114)*. And to be sure it is not a one time, once and for all procedure it is a never-ending ongoing dynamic process. Still this focus on the relational part of infrastruc-

ture becomes even more insistently when your, like in our case, is in the process of establishing a new one.

To address the fine balance between practice and technology and to sort out the many problems arising in the emergence of infrastructure Star and Ruhleder turns to Bateson and his understanding of communicative systems. Communication in Bateson's term is an extensive and far reaching concept referring to the kinds of phenomena that cannot be understood in term of physical laws. His study of communicative behaviour included problems from very different domains e.g. schizophrenia, alcoholism and the communicative system of whales and dolphins. Regardless of the particularities in the concrete problem involved Bateson focus was on understanding the general laws and patterns of communication inspired by Bertram Russell's theory on logical types Bateson has pointed out that human communication operates at several levels of abstraction. The levels are organized in a hierarchical structure such that the above level is about the sub level. The level that is about communication is called meta-communication, and the level that is about meta-communication is called meta-meta-communication and so forth. In the distinction between the content and relationship level of a message the relationship level is about the content. The relationship or meta-communicative level is used to classify the content level of the communication, to inform on how to understand the message.

Bateson points out that there is a gulf between the metamessage and the message. A gulf that is of the same nature as the gulf between a thing and the word that stands for it, or between the members of the class and the name of the class (Bateson 1972, 247). Batesons understanding of learning corresponds to his theory of communication in the sense that learning is communication and like all communicational phenomena should be understood as a hierarchy with different levels.

The number of levels possible to identify in human communication is not fixed but like Star and Ruhleder we identify three levels as relevant for understanding the problems involved in the process of creating/ re-creating an infrastructure. Level one problems appear as matter of fact problems, like not knowing how to get a user name, or publish a message in the system or not understanding what is wrong when the server go down. Level two problems are concerned with how to use the system properly, what kind of messages should be published and to whom. Thus level two is in fact concerned with classifying, with discussion and reflection about the type of problems involved in using, supporting and running the system in the use context. Level three is one step more abstract, and involve questions like what kind of learning goals we want to pursue using ICT or the general politic of the choice of platform (vendor locked or open source). We would say the issues raised on level three is concerned with the fundamental issues and values in the concrete practice, in this case the educational practice.

The importance of communication in emergence of an infrastructure is especially important when it comes to second and third order issues. To elaborate on our understanding of this communication we turn to the work on learning in communities of practice done by Etienne Wenger. According to his research the core of learning in communities of practice is participation in negotiation of meaning. Practice is *about meaning as an experience of everyday life* (Wenger 1998, 52). Negotiation of meaning is understood as a duality of *participation* and *reification*. This corresponds very well with the idea that infrastructure emerges from use in

practice. It also indicates that we may have to look closer at the term community to see whether it can cast additional light on the emergence of an infrastructure. A community is constituted by mutual engagement, joint enterprise and a shared repertoire (Wenger, 1998, p. 73). All three dimensions are both subject to, and influence, the negotiation of meaning in the community. Learning at the individual level means engaging in and contributing to a community while learning at the community level is refinement of practice. In that respect it is our claim that the emergence of an infrastructure represents learning at the level of the community of users of the infrastructure.
In the analysis we want to explore the challenges to the emergence of an infrastructure.

Case: A new infrastructure for Human Centered Informatics

Human Centered Informatics is an educational program within the humanities offering bachelor (3 years), master level (bachelor + 2 years) and Ph.D. level (master + 3 years) education and has approximately 500 students. It combines communication, organization and ICT studies to provide students with the tools necessary to be critical, but constructive, participants in the evaluation and construction of IT and new media. Human Centered Informatics already use ICT supported learning, but primarily in educational programs placed off-campus.
The pedagogical foundation of Human Centered Informatics is the variant of Problem Based Learning (PBL) specifically known as Problem Oriented Project Pedagogy (POPP) (Dirckinck-Holmfeld 2002). This means that students spend approximately 50% of their time on coursework and 50% on supervised group organized problem based projects. In the effort to create a new educational infrastructure this is significant because it indicates that the infrastructure must support some sort of collaboration and community building involving both students and faculty
This study is part of a larger action research project that has been divided in three phases, moving from implementation of ICT in a semester involving relatively few students (21) and faculty (6) to a semester involving more students (80) and faculty (20) and then at last to a full scale implementation. Phase one was used to uncover practical problems related to implementation of different kinds of ICT and study teachers implementing ICT in individual courses without much coordination. Phase two focused on using ICT to improve coherence, flexibility, transparency and quality in teaching and learning. The degree of coordination of use of ICT was higher in the second phase. Among other things this meant that a common platform was implemented across all courses and activities at the semester involved. Lotus Quickplace that was chosen was mainly chosen due to the flexibility it offered. Quickplace was used to create on open ended structure that tied all activities together in a common structure while being open to local re-design by faculty, students or administrators. In the third phase the Quickplace based structure from phase two was refined and expanded and implemented across the Human Centered Informatics program.
Prior research in the project has focused on the components of the implementation process from the perspective of members of faculty and students. In (Nyvang 2004) the processes faculty engaged in implementation of ICT in phase one is analysed. Not surprisingly it turned out that faculty were heavily influenced by their contexts and personal knowledge. The study showed that the time consuming processes in the implementation were: Choice of ICT, adap-

tation of ICT and change of practice with ICT. The next phases of the project were designed to support these processes. (Nyvang et al. 2004) developed a theoretical model that supports the choice of ICT support for project oriented project pedagogy that is the basic pedagogical approach chosen by Human Centered Informatics. (Nyvang & Tolsby 2004) analysed student practice in the choice of ICT, adaptation of ICT and change of practice with ICT in support of POPP. In either case the demands are centred around negotiation of meaning in general and two specific genres of negotiation of meaning; namely coordination of learning and teaching practice and handling of resources used in teaching and learning. The POPP approach has also given students that found the implementation of ICT in their own program the option to take it up the their POPP projects. These projects give us a unique student perspective in the sense that the students have analysed specific issues that they find important.

This study is designed as a case study and is carried out after one semester with the full-scale implementation.

To document the implementation process we have monitored the use of the Quickplace environment over the past semester and conducted semi-structured research interviews with key figures. A key figure is here defined as a person that seems to have played an important role in the process or showed an above average devotion to the use of Quickplace. We thus selected members of faculty, administrators, students, Quickplace supporters and system administrators for interviews.

In the interviews the discussion was centred on knowledge, competencies and opinions in relation to aspects of practice affected by the implementation of Quickplace. The transcripts of the interviews have been reorganized according to the theoretical framework and according to themes that emerged across the interviews. It turned out the problems could be organized in three themes with focus on aspects of communication and pedagogy, organisation and technology. In the following section we turn to the analysis of those themes.

Analysis and discussion

In the search for patterns in the data beyond the overall themes communication and pedagogy, organisation and technology we arrived at three more specific topics. Under communication and pedagogy patterns in the data suggested that different problems deriving from a shift in media were specifically significant. Under the theme organisation design and support turned out to be the area with the most significant problems. Under the theme technology the significant set of problems all had to do with a piece of unstable server software. We elaborate on these three significant problem areas in the following sub-sections.

Communication and media

The emergence of a new infrastructure is closely linked with the emergence of a new pattern of communication and to some extent a shift to a new set of media. This of courses raises a number of questions and problems. Surprisingly we did not trace any interest in talking about first order issues here. It could be because the there was no first order problems in the sense that everyone found the infrastructure easy to use and useful. However it could also be that second and third order issues were so significant that the people we talked wanted to handle them before anything else. For example one associate professor we talked wanted to discuss

what good communication is and this is at least a level two problem. She stressed that good communication in her point of view is richer than what electronic communication offers today. In her role as coordinator of the first semester of Human Centered Informatics she discusses it with her colleagues from time to time. They want communication to be a rich social interaction, but they do not see that in electronic communication. The broad discussion about the importance and characteristics of dialogue indicates that it is in fact a level three problem we see here. Furthermore the semester coordinator stresses that the first semester is especially important because this is where students are socialized into the university culture and that a communication based on rich social interaction is a crucial part of it:

> The first semester has some completely different problems compared to other semesters because you [students] have to be integrated in a culture and in the second semester the culture has been established, but in the first semester it is not there. But then the question is: what tools do we need to communicate in the first semester and how can be show that we are in a department of communication?

However this is not the only problem she has experienced during the remediation of some of the communicative processes. In earlier years a lot of the communication between faculty, students and coordinator of the semester went through a secretary that came to know almost everything about a semester. Today this is changing because all parties by means of electronic media have got easier access to communicate directly and the danger is that no one really has an overview of everything that is going on. At the same time an old discussion about division of labour between different groups of employees in the university emerges again because the new media calls for a review of decisions on who does what. The other members of faculty and coordinators of higher semesters in the same programme we talked to agree and add that on-line communication changes their work conditions. ICT comes with new tasks for them in their role as faculty and coordinators. ICT expands student access to ask questions 24 hours a day, have written comments on papers instead of oral and require on-line publication of PowerPoint presentations and lecture notes. Either of those requests may seem reasonable for different reasons, but the faculty we have talked to argue that this is all part of a transformation of their work conditions and demands. They take on new tasks and feel they are forced to do so due to the expanded access to communicate on-line, but do not get rid of any tasks.
The semester coordinator we talked to suggests the use of physical room and objects in it such a notice boards and paper as a way to facilitate the rich social interaction the promotes. If students have to find information e.g. outside the offices of the faculty her experience from other programmes tells her that the notice boards become the centre of informal gatherings where students and faculty meet to discuss important issues. In her point of view the same kind of interaction cannot yet be facilitated by ICT. She also suggest the use of traditional notice boards and paper because it is her impression that some or perhaps a lot of the new students are not ready to communicate electronically; they are not yet familiar with the university ICT systems. We have talked to a student on a later semester and he does not support this view and argues that one integrated ICT based platform for communication and collaboration will make it far easier to keep track of all relevant information. However he does not consider the possible implications of less use of physical space.

To raise the attention on special occasions she chooses to distribute relevant information on paper. Asked if she used the Quickplace virtual environment to communicate with the faculty and teaching assistants and project advisors she answered:

> No, I have a certain principle with advisors [of group organised projects]. I use e-mail unless it has to do with exams. They get that on paper. And I have discussed it with [one of the advisors] because they wonder why I do so and I said it is because I think, in respect of the students you need to have it in front of you on paper. [...] I simply do it to sharpen the attention on the fact that it is a special occasion [...] of importance to the students.

It is clearly a challenge to identify what media to use for communication for a specific purpose. Different media seem to have different affordances according to the people we have talked to. Furthermore the question of what media to use and what to communicate appears to be interweaved with the question about how to communicate by means of the media chosen. It is stressed by two of the semester coordinators we talked to that the implications of a message is closely linked to the way it is communicated both in terms of words and medium chosen. They felt that the Quickplace environment had made their work and communication more visible, transparent and less private in a way that was at times quite troublesome. In general they had nothing to say against transparency and visibility, but felt the virtual environment made some of the problems that are inevitable to arise during a semester visible and public in an unreasonable way. In a specific case complaints from individual students were posted in a shared forum and even though the matter was out of the hand of the coordinators they felt bad about the situation – not only because of the problem, but also because the complaints even though unjustified made them look responsible and thus loose face.

To reach a deeper understanding of the communicative issues we have to take a closer look at why the perspectives discussed here differs. We have heard a student, semester coordinator/faculty members and secretaries ask for what may be summed up to efficient and flexible communication, but it seems increasingly clear that they define what this is in different ways. The students want a common structure on-line giving easy access anytime anywhere. If we add the interpretations made by the members of faculty and the secretaries students also want the greatest possible amount of help and service. The secretaries want to reach as many students and faculty as possible as fast and easy as possible. The semester coordinators and faculty on the other hand stress that they as professional experts in communication see a need for at more diverse pattern of communication than the virtual environment offers. They also stress that the degree of service and flexibility that students find convenient may not be advisable or possible from their professional point of view.

It seems that the communicative behaviour in the organization is guided by both politics and culture. Part of the integration of new communicative media thus must be development of new politics and culture framing especially on-line communication. So far neither politics nor culture is in place. Both should be subject formal and informal negotiation, but the question is whether this is actually the case. There seem to be some negotiation between students and faculty in the way that students set demands and faculty on the individual or small group level decide whether or not to meet those demands. We have also talked to several informants who suggested different forms of evaluation of the use of the on-line communication and interpret

this as a step towards negotiation of good communicative practice. Besides that we cannot identify any real productive negotiation of the future culture of communication.

Design and Support

In present project it was an under laying assumption that the right planning of the implementation of the new ICT platform would support the emergence of a new infrastructure. Another assumption was that we needed to design an iterative project where evaluations were fed back into the implementation process continuously. That decision was made based on experience, literature and prior studies that suggested that implementation of ICT could be understood as a learning process (Nyvang 2004).

The support team was one full time e-learning consultant (he did not spend full time on this project though) and two part time student assistants. The students study Human Centered Informatics and are thus students in the program we study as well.

The support team had different roles in different parts of the process. They started with design of the structure and interface of the Quickplace environment based on experience from a pilot project (this was the primary representation of the future users) and their own knowledge relevant to the task at hand:

> At first we looked at how it had been running so far. I had been in the semester in which it was used [part of the pilot project]. And [name of the other student assistant in the interview] had been a supporter there and then we talked about the things we would like to change and wrote a list and then we started on the design. The layout of a page. There were some things that we thought should be done differently. And then we made different models. [...] Regarding the structure and similar issues we talked to the semester coordinators. We talked to the semester coordinators to find out what their needs were. If there was specific need on the individual semesters [...].

Here we see that the design and support team had a pretty clear idea about how to solve the level two problem about how to obtain the knowledge needed to design and implement a structure in the web-environment. However they had some level one problems when it came to the implementation of a single sign-on that would allow users to use the full structure without signing in more than once. Fortunately the server administrators solved this problem.

Then they moved on to offer short courses before or early into the semester to faculty, students and administrative staff that had no prior Quickplace experience. The courses gave a short introduction to the new platform and then lead on to small exercises in use of it. This course did not give much attention to proper and efficient use of the platform. Next focus of the support was twofold: Support that helped users to use the platform and implement their own ideas and furthermore support to handle the frustrations in the organization with regards to the highly unstable server. Later in the semester when the server problem had been solved they moved on to plan smaller design changes based on user feedback. None of the people we talked to had anything but positive comments on the support they had received. However none of those whom we talked had had a lot of contact with the support.

The supporters noted several challenges in the way things were done in the implementation of the new platform. First of all they were in another organizational unit than the system administrators and felt that the "chain of command" was unclear. They feel a clearer division of responsibility had made some of their work easier because it had enabled them to make faster decisions on some issues. The supporters also underline that even though the new platform is widely known and used in the organization there is still work to do to on pedagogical and didactical innovation and on utilization of all features in the platform (e.g. the support for collaborative work and learning). The student we talked to supports this statement. He sees a great need for a more innovative use to harvest some of the real benefits of the new platform.
The level 3 problems does not seem to be discussed much when it comes to support. It turns out to be an under laying assumption that support is something we need in a project like this and that the present support was well functioning in this case. However we see an emerging discussion about what a flat and a hierarchical structure is. The design and support team believes that they have designed a flat structure whereas one of the semester coordinators think it is hierarchical. We also see different opinions on the role of the support and that suggests an emerging discussion with focus on whether support should just take care of technical problems or take a more integral approach to technical problems and development of practice with the technology. In the present case the supporters have knowledge about the program they support, solid knowledge about the technology and knowledge on the use of ICT in learning and teaching. On that background we suggest that support is seen as a mediator that promotes the emergence of a new infrastructure by solving actual problems for users and by guiding them towards efficient and innovative use.

Technology – a Server Problem

In this part we discuss problems with task related to finding out about the system, installing it, and running it seen from the perspective of the system administrator's office. It is a story that illuminates the fact that finding a solution on a relatively simple technical problem can be an extremely complex process involving all sorts of issues, technical and non-technical.
During the first months of the full scale implementation the system went down with unpredictably but frequently intervals. This was of course very inconvenient and confusing for the users, of whom many had just started to use the system. Apart from restating the server, which made the system work again, the system administrator's office started the process of finding out what caused the problem and how to solve it. The failure had not occurred during the former phases of use and focus went to what was special for this implementation. And, in contrast to previously, the system had this time been integrated with the general catalogue of users kept by the system administrators' office in order to avoid the work with entering all the users in the system manually. This integration was possibly according to the system documentation. But never the less it was figured that the problem had something to do with the system loosing contact to the user catalogue, meaning that it was impossible to log in. It was then tried to get help from the supplier of the system, which had a quite formally support system all organized on the web. In order to be allowed on the support system at all you had to have a customer number. But as the system was given to the department as a part of a joint research project the department was not registered as customers, thus had no number. It was quite an

effort, involving a meeting and a lot some time to sort this out and actually get a number, thus being able to report the problem to the supplier's support system. In the meantime the system administrator's office decided as a temporary solution to restart the server every night. Also they put up a surveillance system in order to detect exactly when the problem occurred. In one of the log files they found something that looked suspicious and this part of the log file was send to the supplier's support system. It appeared that the supplier knew the problem and that they had a fix for it. When this was implemented the problem was solved. This process took about two months.
The problem turned out to be a level one problem, but the process of solving this problem, getting the right information and installing the fix created several consideration related to level two and three. The idea of putting up a surveillance system is an example on a level two problem, that is a consideration on how to act when something is not working. Also the operating of the system was brought into attention. There was no explicit decision concerning watching the server which meant that it was operated in normal working hours. But it turned out that was a need for round-the-clock watch because the users were using the system at all hours. This implied that if the server went down at 4.02 pm it would not get stated again before next morning at eight when the system administrators office were back at work. The problems related to getting support from the supplier of the system should also be mentioned here. Working with the server problem also brought up some level three questions e.g. the discussion on platforms. It was difficult for the system administrator's office to actually work with the problem because they had no access to the systems code. They would have preferred a more open source system. Besides there were some organizational considerations concerning e.g. who is going to decide what and how to pay for it and so on, that is how to handle these kinds of experiments in an organizational context.

Conclusion

The conclusions from our analysis can be summed up in this matrix of problems related to the emergence of an educational infrastructure:

	Level one	Level two	Level three
Communication and media	Access: Lack of ability to sign on and publish massages.	Process in context: What kind of communication is relevant in which media?	Goals and values: What is the role of dialogue?
Design and support	Access: Lack of single sign on.	Process in context: How and on what knowledge base is the structure designed?	Goals and values: What characterizes a flat or hierarchical structure?
Technology	Access: Server breaks down.	Process in context: How is the server problem solved?	Goals and values: Who owns, controls and has access to the source code of the software?

The problems listed in the matrix above point to fact that the challenges involved in creating of a new infrastructure are manifold and of diverse nature. The problems elucidated in this

study and here nicely presented as separate problems on different levels appear in real life mingled together in all sort of ways. Following Bateson's distinction between content and relationship level of a message there is a gulf between them meaning that they are of a different sort. E.g. the system administrator's office needed some information on how to handle the integration of the system and the catalogue of users. This level one problem lead to consideration on several problems of a more general kind on how to run system more safely. Which again lead to considerations on how to do this kind of experiments in a more orderly and controlled way.

But apart from being of a different sort there can also be a contradiction between the levels, which can develop a so-called double bind situation. Bateson coined the term double bind to refer to a contradiction between the content and relationship level - basically that is saying something with your words and another thing with your body/context - to explain the development of schizophrenia. Here, like Star and Ruhleder, we use this distinction to draw attention to the contradiction between different levels of problems. As examples of contradictions in our case we could mention at the one side the ideal of a communication with the student based on face-to-face dialog derived from the POPP pedagogy connected with the fact that as a teacher you maybe have eighty to hundred students and not very much time. Or the commitment to participate in experiments and technical development from the system administrator's office connected with running a system with no access to source code. These kinds of contradictions are more a rule than an exception in most organization.
As for the solution and further work with the concrete problems elucidated in this study we would like to stress the importance of organizational structures that support not only the use of the infrastructure, but also the discussion about the proper use of the system in the context and the discussion about the goals and values.

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