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 unearth 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 influencing 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
situating 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

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.
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 (Schmidt, 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 Collaboratives (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.

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

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, IT 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.

References


