

Electronic Portfolios Through a Qualitative Lens

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Abstract

This report illustrates the use of qualitative methods and an interpretive framework (Cultural Historical Activity Theory) to examine educational interventions. The techniques are applicable to engineering education where researchers seek to investigate questions with rich contexts and compelling examples. The specific study illustrating the use of these techniques explored the impact of adopting portfolio management systems for accreditation on the learning experiences of the students required to use them. The data and interpretive framework highlight how use of portfolio assessment to satisfy accreditors' demands creates a variety of tensions - some of which can be resolved by improved design or implementation.

1. Introduction

The National Science Foundation has suggested mixed-mode (qualitative and quantitative) evaluation for education research [1, 2]. Unfortunately, guidance for interpreting qualitative data is flexible (some would say, vague), to an extent beyond the comfort zone of many classically trained researchers. Qualitative methods create opportunities for exposing unexpected results, for generating and building a plausibility argument for hypotheses that can be refined for quantitative research, and for providing factual, richly detailed examples important for making a claim or model credible or comprehensible for some people [3, 4].

This paper presents the use of an interpretive model, Cultural Historical Activity Theory (CHAT) [5], as a guide for collecting and interpreting qualitative data. The example, evaluation of the impact of student portfolio systems on student experiences, will resonate with members of the engineering education community who face accrediting agency demands similar to those found in education—the context from which this example is drawn.

Today's electronic portfolios have roots in paper predecessors—an assessment innovation that exploded in the 1980s and 1990s [6]. In today's technological landscape with widespread access to personal computers and the convergence of technologies such as ubiquitous Internet access and web-enabled databases, customized electronic portfolio systems have become technically feasible. Not surprisingly, accrediting bodies such as the Accreditation Board for Engineering and Technology (ABET) have encouraged institutions seeking accreditation to use the powerful technologies behind today's electronic portfolios tools to collect and aggregate data for accreditation initiatives. Commercial vendors such as *LiveText*, *TaskStream*, and others have entered the market with business plans that market their products to institutional decision-makers but shift costs to students by charging them approximately \$100 for a three-year subscription to portfolio services. This business model has become a popular and economical alternative for cash-strapped departments and institutions seeking to satisfy accreditors' demands. Other institutions, such as the University

of Minnesota and the University of Delaware have begun collaborating on an Open Source Portfolio Initiative¹ (OSPI) featuring open-standards and portability across institutions [7].

Electronic portfolios are used in fields as diverse as art, health, education, engineering, and hospitality management. Colleges of education are on the leading edge of portfolio implementation with adoption rates estimated at 90% [8]. Most use, or are moving to, electronic portfolio formats [9, 10]. The influx of portfolio tool developers to the software market to meet this demand has been called an "electronic portfolio boom" [11] and the electronic portfolio "higher education's new 'got to have it' tool" [12, p. 1]. Concerns about the effects of widespread implementation of electronic portfolio tools on students [13-17] prompted Fiedler's dissertation research examining the question, "What are the users' experiences using tools to create an electronic portfolio?" Fiedler used CHAT [5] as her theoretical and analytical framework, in conjunction with qualitative research methods to gather and analyze data. Although the study reported in this paper was based in undergraduate teacher education programs, the findings yield useful insights for computer science and software engineering educators as they consider using portfolio assessments in support of accrediting initiatives. Further, the methods used to conduct Fiedler's study of students using a software innovation offer a demonstration of powerful methods for researchers in computer science and software engineering to explore their own research questions.

2. Theoretical framework

Grounded in the Soviet psychological tradition, CHAT highlights the influence of learners' social contexts, tools, actions, and purposes on their cognition and learning [5]. CHAT has been used to examine diverse topics including language acquisition, play, learning, work, addiction, and therapy [18]. It has also been used in human-computer interaction [19-21] and other research on educational applications of technology [22].

For a CHAT theorist, an activity is the "minimum meaningful unit" as the actor seeks to transform that which he or she is acting upon. The activity involves both context and purpose. Figure 1 presents a simplified representation of the CHAT model. The sides of the CHAT triangle represent a *subject* acting on an *object* to obtain a specific *outcome*. This action is embedded in a *community* or social context. In the activity of portfolio authorship, the subject (a student) acts on an object (a portfolio) to achieve a specific outcome (satisfy a graduation requirement). The portfolio activity is embedded in a community context (institution). Notably, even solitary activity has generally been shaped by a social structure in one form another. For example, early man foraging for food most likely learned how to forage or where to forage from another older or more experienced gatherer.

The intersections of the triangle's sides represent interactions between the components. The node at the top of the triangle represents the role of *tools* in mediating a subject's actions upon the object of interest. These tools may be tangible (a carpenter's hammer or a portfolio author's computer), symbolic (language), or psychological (a mental model or heuristic). Similarly, the interaction between a subject and his or her community is governed by *rules, norms, or conventions*. For example, the portfolio author's activities may be guided by a very precise set of requirements specifying portfolio format and/or content. The final node in the CHAT model is labeled *division of labor* and it represents the interactions of a community surrounding an object. Division of labor can be horizontal (between peers with relatively equal status) or vertical (between those in the community with relatively unequal status). In the portfolio authorship activity, peers may divide their labor by proofreading one another's

¹ In 2003, OSPI was an independent project focusing solely on an open source portfolio. In July 2004, OSPI leaders began to work more closely with the Sakai project, another open source initiative.

work before submitting portfolios for a grade. One example of vertical division of labor is the practice of providing faculty-developed templates to facilitate the portfolio creation task.

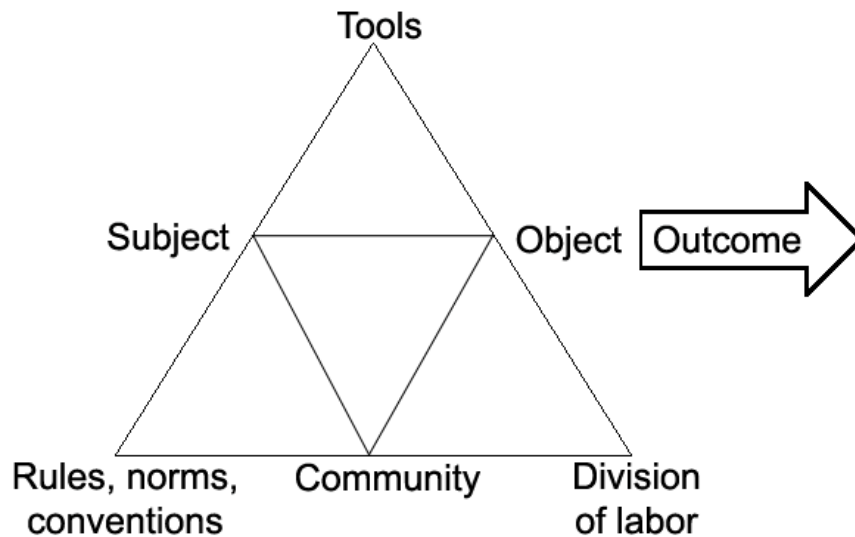


Figure 1: Cultural Historical Activity Theory model.

CHAT also illustrates that activity is inherently networked in nature [5]. The central activity generally has other activities or actions embedded within it (e.g. portfolio authors may need to scan images to include in their portfolio). Engeström calls this type of activity an "object activity" because the embedded activity shares the same object as the activity of interest. However, there are also nearby activities that may focus on other aspects of the CHAT model. Those include rule-producing activities (creating rules, policies, or legislation impacting the activity of interest); subject-producing activities (recruiting students for a program or training them to use the portfolio authoring tools); and tool producing activities (developing templates to use for portfolios, upgrades to the portfolio software, and computer maintenance by lab technicians). The networked nature of activity is evident as subjects in an activity bring knowledge or practices from a nearby activity to the central activity of interest as they seek ways to satisfy needs or resolve problems in the main activity.

Finally, Engeström's CHAT model describes four levels of tensions or contradictions within activity. These tensions or contradictions arise from the interaction between components of the central activity [5, 22] and between nearby activities. Such tensions are neither inherently good nor bad; they are present in any functioning activity and may serve as a motivator for actors within an activity to change or expand the activity. In fact, tensions motivate innovations. Understanding the system's tensions is essential to the researcher seeking to describe the system. This understanding may also help the administrator or faculty member who seeks to evolve the system. The levels of tension will be more carefully described and illustrated with examples from the research in the Findings of this paper.

3. Qualitative methods

The research described in this paper investigated the experiences of preservice teachers using portfolio creation software to create a program-required portfolio. In this study, the research setting, context, and interactions with and between study participants were essential to explore the research question. These needs suggested qualitative methods would be most

appropriate. The specific qualitative method chosen was a multi-site case study [23]. This allowed the first author to join the portfolio community at the selected institutions and to see the individual participants as they continued to work within their home community and to glimpse the cultural aspects of portfolio authorship at the respective institutions.

Two institutions were selected for this study. At VendorBuilt College (VBC)², a small liberal arts college in the southeast, students used *CommercialFolio*, a web-enabled portfolio management system designed to support accreditation initiatives. At Mason State University (MSU), a large, Midwestern university, students used off-the-shelf HTML editing tools (Netscape *Composer* and *Dreamweaver*) to create their portfolios.

Because this study investigated an existing practice, it qualified for an expedited review from the Institutional Review Board at Fiedler's home institution. Before proceeding with the study, Fiedler also obtained the appropriate approvals from the institutions she visited. During her visits at the institutions, she disclosed the nature and purpose of her visit to research participants and guided the "formal" participants through an informed consent process.

To collect data, Fiedler visited MSU for a five-week summer semester. She visited VBC for five weeks spread across the following Fall semester. For each visit, she lived on or near the campus and spent between eight and ten hours a day on the campus.

3.1 Data collection and management

Yin [23] proposes three principles of data collection: use multiple sources of evidence; create a case study database; and maintain a chain of evidence. He also identifies six sources of data a case study researcher can use for a study: documentation, archival records, interviews, direct observations, participant observations, and physical artifacts [23]. For this study, Fiedler conducted focus group interviews; individual interviews; observations of students in class; observations in computer labs; and thinkaloud work sessions. She reviewed student portfolios and other work products along with documents from the institutions describing their portfolio initiatives and requirements. Finally, she scanned work products and took photos of theoretically interesting events and interactions. Because interviewees came from a variety of programs (elementary education, social studies, education, art education, etc), they held a variety of perspectives on their institution's portfolio initiatives.

To collect and manage this mass of data, individual and focus group interviews were digitally recorded and the resulting files were transferred to backup hard drives. The videotaped thinkaloud work sessions were also backed up to drives. Fiedler made a complete transcription of each recorded interview and work session using a combination of *Dragon Naturally Speaking* voice recognition software (Windows only) and *Transcriba* transcription software (Macintosh only). She compiled the resulting transcripts, photos, text from work products, and institutionally-generated work products into one "hermeneutic unit" using *ATLAS.ti* qualitative data analysis software. *ATLAS.ti* served as the case study database. The memo capability within *ATLAS.ti* maintained the chain of evidence Yin [23] suggests.

3.2 Data analysis

Data analysis was guided by Creswell's "data analysis spiral" [24]. The spiral image illustrates the researcher's repeating path through the data. Data collection serves as the entry point to the spiral and the account—in this instance, a paper—at the exit. Creswell's "data analysis spiral" serves as the organizing structure for this section of the paper, but the reader should realize that actual analysis does not proceed as linearly as presented here.

² Throughout this paper, we use pseudonyms to refer to the institutions under study and the portfolio tool in use at VendorBuilt College.

The second loop of Creswell's spiral is data management. During this stage, the researcher's focus is on organizing data to preserve it, to facilitate retrieval, and to prepare it for analysis. For this study, activities in this loop included designing and executing a back up strategy, converting field notes and interviews to digital format, storing digital photos, preparing the hermeneutic unit for *ATLAS.ti*, and a variety of similar tasks. The next loop Creswell describes is reading and memoing. In this stage, the researcher reads and re-reads the collected data making notes about emerging themes and insights. Examining data while still immersed in the research site allows a researcher to follow-up on interesting developments and flesh out sketchy details about matters of interest. *ATLAS.ti* offers the capability to collect and organize the resulting memos.

The fourth stage of Creswell's spiral is description, classifying, and interpreting. This reminds the researcher to describe the setting and participants, the methods he or she is using and the decisions he or she is making. The researcher codes the data, looking for themes and dimensions. *ATLAS.ti* and other qualitative data analysis software can help manage this process. To avoid becoming completely overwhelmed by data collection, the researcher begins to sift through the data, choosing some to continue exploring and setting other data aside. Tentative interpretations begin to take shape so the researcher can look for both confirming and disconfirming evidence while still at the research site. The final loop of data analysis is that of representing and visualizing the data. At this stage, the qualitative researcher determines how to present the data in figures, graphs, tables, and or charts. For an excellent treatise on qualitative data analysis and presentation, see [25].

Although the *process* of data analysis can be guided by Creswell's "data analysis spiral," some qualitative researchers guide the *substance* of their data collection and analysis using a theoretical framework. In this study, CHAT provided the theoretical guidance for data collection and analysis and *ATLAS.ti* served as the primary data management tool.

4. Findings

Using CHAT in the context of a multi-site case study amply demonstrates the utility of these methods and this framework to examine a complex task such as portfolio authorship. The study revealed similarities between and differences across the research sites. The theme of "creativity" was strongly present at both institutions as students stressed the importance they placed on creativity in completing their portfolios. They demanded the freedom to make their portfolios an expression of their individuality. The most striking differences between the institutions were in the Rules and Tools nodes. Mason State's students reported the guidelines for their portfolio authoring provided ample flexibility for them to create a portfolio that reflected their beliefs and accomplishments. Further, the tools they used offered more than enough capability for them to create a portfolio reflecting their individuality. Students at VendorBuilt College painted a strikingly different picture of their institution's rules and tools. They railed against the prescriptive rules they had to follow because those rules left little room for students to choose which work to highlight and how to represent their accomplishments. Further, the limitations of the *CommercialFolio* tool prevented them from changing the look and feel of the portfolio interface to reflect their individuality.

Another important and theoretically interesting theme that emerged from this study is one of "transition." Students at both MSU and VBC mentioned "transition" in nearly every conversation. They told how their institutions were "in transition" as they implemented their portfolio initiatives. Several students recognized that changes were in response to external forces. Occasionally, the students spoke about other kinds of transitions such as those from student to professional; from dependence on their parents to the independence of their first

jobs; or the transition of a career change. CHAT is particularly well suited to capture transitions such as these as well as the influences of other activities on the central activity.

Data collected throughout this study revealed an abundance of evidence about the networked nature of the portfolio activity. The interplay between various components of the central activity and those between the central activity and nearby activities gave rise to a variety of tensions. The students' recognition of outside influences on their institution hint at such a network and the influence of networks will be elaborated in the next section.

4.1 Tensions within the portfolio activity

CHAT outlines four levels of tensions. As expected, all four levels were present at both institutions. In this discussion, we limit ourselves to tensions surrounding the inflexibility of the tools and the prescriptive rules at VBC with respect to the creation and display of tables.

We begin with a tension between two nodes of the CHAT model. At VendorBuilt, the Rules of the activity frequently conflicted with the Tools. One of the problems centered around *CommercialFolio's* ability to reproduce tables and VBC's requirement that students display tables in their portfolios. Most faculty graded student assignments against a rubric. Some created the rubrics and provided student feedback through *CommercialFolio*. Students were required to display these faculty-completed rubrics with the associated work products in their portfolios, but *CommercialFolio* did not offer a way to display the faculty-completed rubric *with* the specific artifact. To comply with this portfolio requirement, students needed to print the rubric, scan it, and then upload it as an image. Students were generally disappointed with this result because the printouts (and resulting images) were not optimized for this presentation. This contradiction between what is required and the capability of the tool (between Rules and Tools) is an illustration of what is called a secondary tension. However, a secondary tension can be between any two components of the CHAT model.

As students explored workaround solutions to this secondary tension, they tried to recreate the rubrics using the *CommercialFolio* table tool. Several were able to create a table that satisfied their portfolio requirement and their sense of aesthetics. Later, they were dismayed to find that their painstakingly constructed table did not display correctly when they returned to their portfolios another time. They were angry and frustrated that *CommercialFolio* could not display a table created within the software itself. (Fiedler believes this was a software bug that had not been fixed). Tensions within one node of the CHAT model are classed as primary tensions. In this case, the tension is within the Tools, but they are possible within any node.

Other tensions exist between one way of conducting an activity and another, more advanced form of the same activity. At VBC, preservice teachers are required to complete a designated number of field experiences and include evidence of those field experiences in their portfolio. To do this, the preservice teachers take hard copy forms into the schools they visit for cooperating teachers to fill out. Much of the data on these forms is contained within a table. Because there is no way for cooperating teachers to enter this information into the portfolio system, and the student teachers can not recreate these forms, they must spend many hours scanning the forms, resizing them, adjusting image size, and uploading them to the *CommercialFolio* system to bridge the chasm between the "old" way of doing paper portfolios and the newer *CommercialFolio* portfolios. This illustrates a tertiary tension—between old and new.

By now, a reader may be wondering why VendorBuilt faculty require students to include so many tables in their portfolios if the *CommercialFolio* tool has such difficulty creating and displaying the tables. The answer to that question is simple; their accrediting agency demands it of them. Interviews with the Portfolio Coordinator reveal that VendorBuilt's prescriptive rules—and even their choice of *CommercialFolio* as the portfolio tool—are rooted in

accrediting agency requirements. This exemplifies a quaternary tension (tension between two nearby activities)—between educating students and seeking accreditation.

The tensions in these examples seem counterproductive to student learning. However, some tensions result in learning and even encourage it. At Mason State, for example, students talked about a secondary tension between their tools and themselves as users of their tools. All of the Mason State students seemed to recognize that the capability of their tools outpaced their ability to use the tools. Several were eager to become more technically proficient so they could take advantage of the untapped capabilities of their tools and had ideas about how they would apply what they learned through the portfolio activity to their future work in classrooms. This is in striking contrast to students at VendorBuilt College who specifically indicated that the *CommercialFolio* tool constrained them and what they were able to accomplish. They classed the activity as "busy work" or "a bunch of B.S." claiming the portfolio was "not the means to an end, but the end." They viewed it as "a waste of time." Their dissatisfaction with the task seems to be rooted in the extreme time demands of their task; nearly constant struggles to look for workarounds to tool constraints; and resentment of the prescriptive rules that have taken a disproportionate number of the decisions about the portfolio from the student and given them to the institution. The result is that most students at VendorBuilt feel little ownership of the portfolio and see little use for it in their futures.

5. Conclusions

This work amply illustrates the necessity of educators—teacher educators or engineering educators—to balance the tensions students face in an accreditation support initiative. Careful attention to these matters can maximize student learning and minimize student resentment toward an important and high-stakes task.

More importantly, this work demonstrates the utility of qualitative methods and theoretical frameworks to guide research efforts that can, in turn, reveal important insights about the activities under investigation and the impact of those activities on users engaged in the activity. Although data collection for qualitative research is time-consuming, voice recognition software and qualitative data analysis software is sufficiently usable to facilitate the collection, management, and preparation of qualitative data for analysis. Furthermore, the use of a robust theoretical framework (such as CHAT) offers useful guidance to the researcher who is awash in a sea of data and potential data. A theoretical framework is useful at each stage of Creswell's "data analysis spiral" as the qualitative researcher determines what questions to ask; what observations to make; what notes to take; which leads to pursue; what codes to assign; and what sense to make of everything he or she sees.

This approach has use beyond educational research. For example, we are exploring it as a vehicle for characterizing the user requirements for a new product, the effect of a process change, and the project impact of changing the role of a group (in our case, software testing) in a development project. We are also beginning to use it as an explanatory tool in class to help students understand the rich and conflicting contexts in which products are created.

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