
# Tools for Data-Driven Decision Making in Teacher Education: Designing a Portal to Conduct Field Observation Inquiry

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### Abstract

*Knowledge management (KM) and data-driven decision making (DDDM) are terms that are used with more frequency in teacher education. Although accreditation expectations and the increased focus on accountability have pushed these ideas to the forefront, the tools that support them are still not robust. Electronic portfolio assessment has been one approach that many schools of education adopt to address these gaps, but there has been little documentation on how electronic portfolios actually contribute to program-level assessment. This paper presents an application that provides an example of how data systems applied to existing practices can be used to support knowledge creation and DDDM in colleges of education. (Keywords: data-driven decision making, knowledge management, electronic portfolios)*


## Introduction

Knowledge management systems (KMS) are a blend of both technical and social mechanisms that enable the effective creation and transmission of knowledge assets to take place. The technical component seeks to "capture, package, and distribute tangible, documented products", whereas the social side "enables collaboration, connection, and reflection among system users" (Marhsall & Rossett, 2000, p. 26). The factors that determine whether or not these endeavors will be successful in the long run are likely to be institutional and social rather than technological (Niguidula, 1997). Unless the social mechanisms are in place to promote the use of this information, the organization will not benefit from improved performance. However, if the technical mechanisms for collecting, storing, and retrieving portfolio data are not effective, the adoption of this type of tool will be next to impossible. As Serben and Luan note, "Emphasis on technology alone will achieve little progress toward knowledge management, but even the strongest commitment to knowledge management that is not supported by robust technology will not succeed" (2002, p. 2).

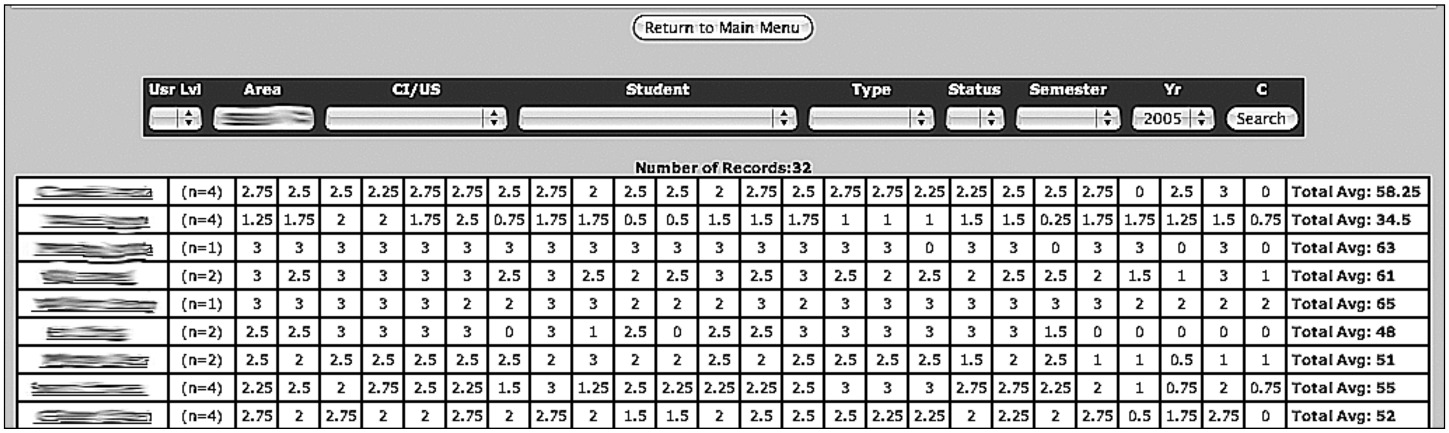
Data-driven decision making (DDDM) can be described as the use of systemically and systematically collected data to guide a range of decisions. Although there is a growing number of scholarly works related to K–12 use of DDDM, there is a glaring absence of similar type work in teacher preparation. What does DDDM mean for teacher education? Recent studies documenting portfolio system implementations at several institutions are available, but findings from these studies do not detail the way portfolio systems actually facilitate program-level assessment (Beishuizen, J., Van Boxel, P., Banyard, P., Twiner, A., Vermeij, H. & Underwood, J., 2006; Strudler and Wetzel, 2005; Wetzel & Strudler, 2005; Wilhelm, L., Puckett, K., Beisser, S., Wishart, W., Merideth, E. & Sivakumaran, T., 2006). Ikemoto and Marsh (2007) describe factors that facilitated DDDM in K –12 settings, including accessibility of data and tools. The authors state, "Even when examining simple data, educators valued *data dashboards* that summarized data and data software systems that allowed them to manipulate and display raw data" (p. 124). The term *data dashboard* creates a vision of providing feedback while in the midst of performing a task, such as driving, and dovetails with the goals of continuous assessment in that one is receiving feedback in the midst of action. Although a useful metaphor, Ikemoto and Marsh did not provide any description of what these dashboards looked like or how they actually functioned. This leaves a cognitive gap about what a data dashboard might look like for teacher education. This paper presents an example of a dashboard application for teacher education and the emergent design process that precipitated it.

### Old Wine in New Bottles

The expression "old wine in new bottles" is often used to describe a new phenomenon that bears a resemblance to an existing condition. Often the expression is used to convey a message of being underwhelmed, as in "been there and done that." However, new bottles can change the way we interact and use a product. For example, if you wanted a Guinness Draft before the late 1990s, the only way was to go to a bar or restaurant that served it. Around 1996, Guinness introduced their "draft can" that allowed people to have the same product experience at home. Most recently, they have created a bottle that preserves the draft condition but doesn't require the consumer to pour the beverage in a glass. By evolving the packaging, the company was able to take its existing product and expand the avenues through which it could be consumed. In other words, the "new bottles" quite literally added value to the experience by making the content more accessible.

Databases combined with the power of the distributed Web-based networking offer the same opportunity to repackage practices that currently exist in teacher education programs to generate new types of knowledge. Classroom observations, lesson plans, and student reflections are examples of a few data artifacts that are commonly collected by programs for both accreditation and certification purposes. Although these data are used to assess individual students, it is extremely difficult to do any inter-student analysis because of the administrative overhead associated with managing and processing the artifacts. This administrative overhead also means that there are many lost opportunities when it comes to refining our practices in teacher preparation (e.g., student teaching supervision, curricular instruction, etc).

Knowledge management (KM), DDDM, and continuous assessment are increasingly touted as practices that teacher education need to adopt (Moss, 2007). In 2002, the National Council for Accreditation of Teacher Education (NCATE) established the expectation that teacher preparation programs will develop assessment systems to conduct ongoing evaluation at all levels of the program (NCATE, 2003, para. 3). The increased emphasis on accountability has created the need for new tools that will enable institutions to collect, manage, and interpret large volumes of data. The purpose of this study is to explore the value added by migrating




| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | (n=4) | 2.75 | 2.5 | 2.5 | 2.25 | 2.75 | 2.75 | 2.5 | 2.75 | 2 | 2.5 | 2.5 | 2 | 2.75 | 2.5 | 2.75 | 2.75 | 2.25 | 2.25 | 2.5 | 2.5 | 2.75 | 0 | 2.5 | 3 | 0 | Total Avg: 58.25 |
| [illegible] | (n=4) | 1.25 | 1.75 | 2 | 2 | 1.75 | 2.5 | 0.75 | 1.75 | 1.75 | 0.5 | 0.5 | 1.5 | 1.5 | 1.75 | 1 | 1 | 1 | 1.5 | 1.5 | 0.25 | 1.75 | 1.75 | 1.25 | 1.5 | 0.75 | Total Avg: 34.5 |
| [illegible] | (n=1) | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 3 | 0 | 3 | 3 | 0 | 3 | 0 | Total Avg: 63 |
| [illegible] | (n=2) | 3 | 2.5 | 3 | 3 | 3 | 3 | 2.5 | 3 | 2.5 | 2 | 2.5 | 3 | 2.5 | 3 | 2.5 | 2 | 2.5 | 2 | 2.5 | 2.5 | 2 | 1.5 | 1 | 3 | 1 | Total Avg: 61 |
| [illegible] | (n=1) | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | Total Avg: 65 |
| [illegible] | (n=2) | 2.5 | 2.5 | 3 | 3 | 3 | 3 | 0 | 3 | 1 | 2.5 | 0 | 2.5 | 2.5 | 3 | 3 | 3 | 3 | 3 | 3 | 1.5 | 0 | 0 | 0 | 0 | 0 | Total Avg: 48 |
| [illegible] | (n=2) | 2.5 | 2 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2 | 3 | 2 | 2 | 2.5 | 2 | 2.5 | 2.5 | 2.5 | 2.5 | 1.5 | 2 | 2.5 | 1 | 1 | 0.5 | 1 | 1 | Total Avg: 51 |
| [illegible] | (n=4) | 2.25 | 2.5 | 2 | 2.75 | 2.5 | 2.25 | 1.5 | 3 | 1.25 | 2.5 | 2.25 | 2.25 | 2.25 | 2.5 | 3 | 3 | 3 | 2.75 | 2.75 | 2.25 | 2 | 1 | 0.75 | 2 | 0.75 | Total Avg: 55 |
| [illegible] | (n=4) | 2.75 | 2 | 2.75 | 2 | 2 | 2.75 | 2 | 2.75 | 2 | 1.5 | 1.5 | 2 | 2.5 | 2.5 | 2.5 | 2.25 | 2.25 | 2 | 2.25 | 2 | 2.75 | 0.5 | 1.75 | 2.75 | 0 | Total Avg: 52 |

*Figure 1: Program Data Observation Data Summarized by Student.*

**Table 1: Summary of Visitations and Number of Students Supervised for Each Observer**

| | | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| **Supervisor W** | **Retired Teacher** | **18 (5)** | **-** | **-** | **-** |
| **Supervisor X** | **Retired Teacher** | **30 (8)** | **23 (8)** | **-** | **-** |
| **Supervisor Y** | **Retired Teacher** | **-** | **18 (6)** | **-** | **3 (3)** |
| **Supervisor Z** | **Doctoral Student** | **17 (5)** | **-** | **-** | **44 (17)** |
| **Faculty** | **Assistant Professor** | **3 (3)** | **15 (14)** | **24 (14)** | **8 (8)** |
| **Total** | | **65 (18)** | **56 (14)** | **24 (14)** | **51 (17)** |

***Note: The first number in each column represents the [number of visitations?], and the number in parentheses represents the number of students supervised for each observer.***

the manual paper-based process of collecting classroom observations to a digital, online process.

Based on previous evaluations of an electronic portfolio system, a module to collect classroom observations was developed and tested at a research university in the South. From a data-collection perspective, the implementation proved to be successful. Both students and teachers were able to post their documents to the online electronic portfolio tool. As a record, individual students could access their portfolio items easily, even for use in applying for a job. However, as a program-level assessment tool, the utility was lacking. For example, field observation reports written by teacher educators, cooperating teachers, and field supervisors were available online and could be shared, but in this initial format, the university faculty ultimately responsible for program assessment could not disaggregate the assigned ratings as well as the commentary provided by the respective evaluator. Because the electronic portfolio system has an underlying database structure, the opportunity to revisit the data and perform additional manipulations exists. The process and results of those manipulations, and how the availability of real-time, updateable data changes the experience of using the "old wine" of classroom observation, is the focus of the analysis.

## Theoretical Framework

Kidwell, Vander Linde, and Johnson (2000) define KM as "the process of transforming information and intellectual assets into enduring value" (p. 28). Data, information and knowledge are distinct elements according to KM theory (Kidwell, et.al., 2000). Data is made up of raw facts, numbers, and text and becomes information when it is put into context so that the relationships between data can be understood. Knowledge occurs when information is combined with experience and judgment to understand the patterns of the information. In general, however, intellectual and knowledge-based assets fall into one of two categories: explicit or tacit. As a general rule of thumb, explicit knowledge consists of anything that can be documented, archived, and codified, often with the help of technology. A much harder concept to make visible is that of tacit knowledge, or implicit knowledge —the know-how contained in people's heads. Often termed "the wisdom of practice," tacit knowledge is difficult for even the expert to articulate. The challenge inherent with tacit knowledge is figuring out how to recognize, generate, share, and manage it. Tacit knowledge can be thought of as that which enters into the production of behaviors and/or the constitution of mental states but is not ordinarily accessible to consciousness. Nonaka and Takeuchi (1995) outline four processes of knowledge conversion: socialization, externalization, combination, and internalization.

### *Socialization*

Socialization is the conversion or transfer of tacit knowledge from one person to another person. "Socialization is the process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills," according to Nonaka and Takeuchi (1995, p. 62). For example, the sharing of anecdotal stories with colleagues or students about classroom experiences would be considered knowledge transmission by socialization.

### *Externalization*

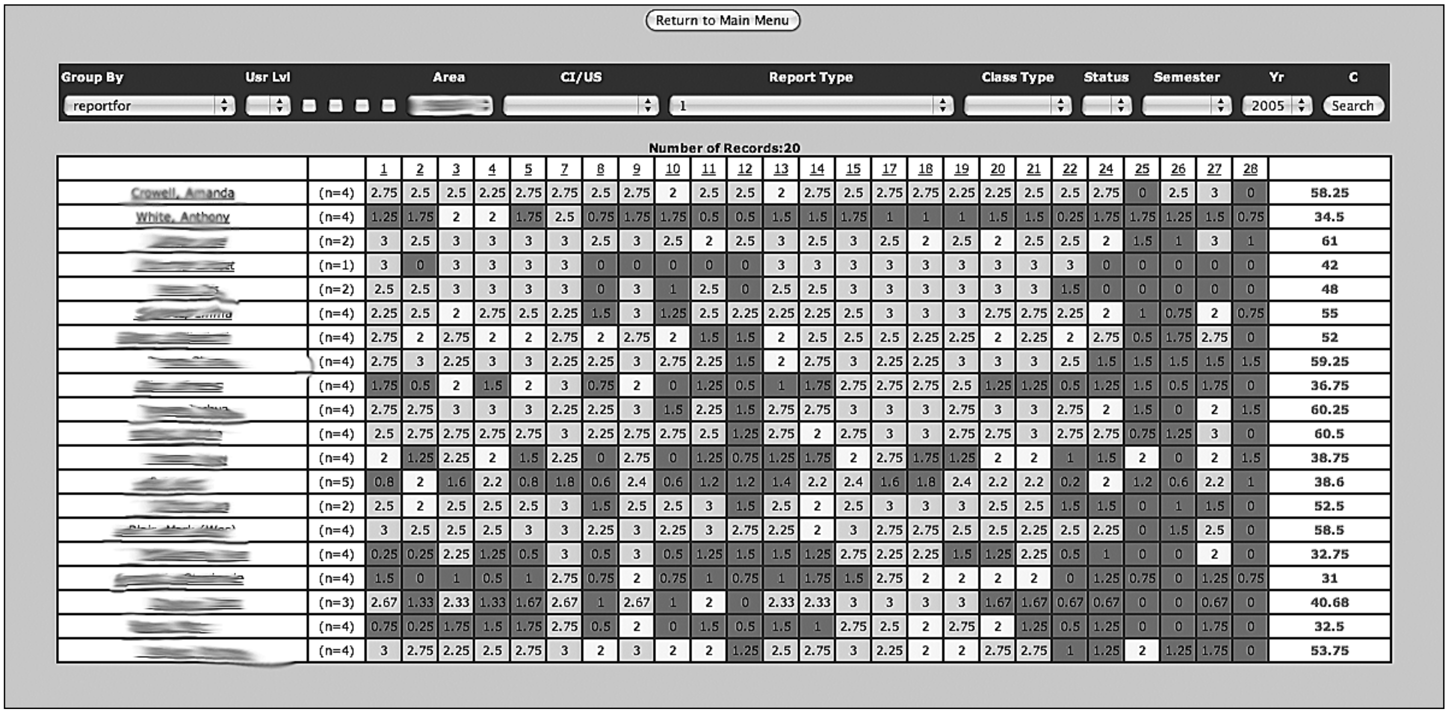
Nonaka and Takeuchi (1995, p. 64) state, "Externalization is a process of articulating tacit knowledge into explicit concepts. It is a quintessential knowledge-creation process in that tacit knowledge becomes explicit; it takes the shapes of metaphors, analogies, concepts, hypotheses, or models." Externalization occurs during concept creation in which conversation and/or reflection act as a catalyst. Externalization often involves the creation of a metaphor and/or an analogy.

### *Combination*

Combination is the conversion of multiple bodies of explicit knowledge to form new bodies of explicit knowledge. Nonaka and Takeuchi (1995, p. 67) define it as "a process of systemizing concepts into a knowledge system." This may take place during activities such as "sorting, adding, combining, and categorizing" (p. 67).

### *Internalization*

The transition from explicit knowledge to tacit knowledge is known as internalization. "When experiences through socialization, externalization, and combination are internalized into individuals' tacit knowledge bases in the form of shared mental models or technical know-how, they become valuable assets," according to Nonaka and Takeuchi (1995, p. 69). To aid the internalization process of the knowledge, such activities as documenting, verbalizing, and diagramming the knowledge is necessary.



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| Group By | Usr Lvl | Area | CI/US | Report Type | Class Type | Status | Semester | Yr | C |
|---|---|---|---|---|---|---|---|---|---|
| reportfor | | | | 1 | | | | 2005 | Search |

Number of Records:20

| | | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 17 | 18 | 19 | 20 | 21 | 22 | 24 | 25 | 26 | 27 | 28 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crowell, Amanda | (n=4) | 2.75 | 2.5 | 2.5 | 2.25 | 2.75 | 2.75 | 2.5 | 2.75 | 2 | 2.5 | 2.5 | 2 | 2.75 | 2.5 | 2.75 | 2.75 | 2.25 | 2.25 | 2.5 | 2.5 | 2.75 | 0 | 2.5 | 3 | 0 | 58.25 |
| White, Anthony | (n=4) | 1.25 | 1.75 | 2 | 2 | 1.75 | 2.5 | 0.75 | 1.75 | 1.75 | 0.5 | 0.5 | 1.5 | 1.5 | 1.75 | 1 | 1 | 1 | 1.5 | 1.5 | 0.25 | 1.75 | 1.75 | 1.25 | 1.5 | 0.75 | 34.5 |
| [illegible] | (n=2) | 3 | 2.5 | 3 | 3 | 3 | 3 | 2.5 | 3 | 2.5 | 2 | 2.5 | 3 | 2.5 | 3 | 2.5 | 2 | 2.5 | 2 | 2.5 | 2.5 | 2 | 1.5 | 1 | 3 | 1 | 61 |
| [illegible] | (n=1) | 3 | 0 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 42 |
| [illegible] | (n=2) | 2.5 | 2.5 | 3 | 3 | 3 | 3 | 0 | 3 | 1 | 2.5 | 0 | 2.5 | 2.5 | 3 | 3 | 3 | 3 | 3 | 3 | 1.5 | 0 | 0 | 0 | 0 | 0 | 48 |
| [illegible] | (n=4) | 2.25 | 2.5 | 2 | 2.75 | 2.5 | 2.25 | 1.5 | 3 | 1.25 | 2.5 | 2.25 | 2.25 | 2.25 | 2.5 | 3 | 3 | 3 | 2.75 | 2.75 | 2.25 | 2 | 1 | 0.75 | 2 | 0.75 | 55 |
| [illegible] | (n=4) | 2.75 | 2 | 2.75 | 2 | 2 | 2.75 | 2 | 2.75 | 2 | 1.5 | 1.5 | 2 | 2.5 | 2.5 | 2.5 | 2.25 | 2.25 | 2 | 2.25 | 2 | 2.75 | 0.5 | 1.75 | 2.75 | 0 | 52 |
| [illegible] | (n=4) | 2.75 | 3 | 2.25 | 3 | 3 | 2.25 | 2.25 | 3 | 2.75 | 2.25 | 1.5 | 2 | 2.75 | 3 | 2.25 | 2.25 | 3 | 3 | 3 | 2.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 59.25 |
| [illegible] | (n=4) | 1.75 | 0.5 | 2 | 1.5 | 2 | 3 | 0.75 | 2 | 0 | 1.25 | 0.5 | 1 | 1.75 | 2.75 | 2.75 | 2.75 | 2.5 | 1.25 | 1.25 | 0.5 | 1.25 | 1.5 | 0.5 | 1.75 | 0 | 36.75 |
| [illegible] | (n=4) | 2.75 | 2.75 | 3 | 3 | 3 | 2.25 | 2.25 | 3 | 1.5 | 2.25 | 1.5 | 2.75 | 2.75 | 3 | 3 | 3 | 2.75 | 3 | 3 | 2.75 | 2 | 1.5 | 0 | 2 | 1.5 | 60.25 |
| [illegible] | (n=4) | 2.5 | 2.75 | 2.75 | 2.75 | 2.75 | 3 | 2.25 | 2.75 | 2.75 | 2.5 | 1.25 | 2.75 | 2 | 2.75 | 3 | 3 | 2.75 | 2.75 | 3 | 2.75 | 2.75 | 0.75 | 1.25 | 3 | 0 | 60.5 |
| [illegible] | (n=4) | 2 | 1.25 | 2.25 | 2 | 1.5 | 2.25 | 0 | 2.75 | 0 | 1.25 | 0.75 | 1.25 | 1.75 | 2 | 2.75 | 1.75 | 1.25 | 2 | 2 | 1 | 1.5 | 2 | 0 | 2 | 1.5 | 38.75 |
| [illegible] | (n=5) | 0.8 | 2 | 1.6 | 2.2 | 0.8 | 1.8 | 0.6 | 2.4 | 0.6 | 1.2 | 1.2 | 1.4 | 2.2 | 2.4 | 1.6 | 1.8 | 2.4 | 2.2 | 2.2 | 0.2 | 2 | 1.2 | 0.6 | 2.2 | 1 | 38.6 |
| [illegible] | (n=2) | 2.5 | 2 | 2.5 | 2.5 | 2.5 | 3 | 1.5 | 2.5 | 2.5 | 3 | 1.5 | 2.5 | 2 | 2.5 | 3 | 3 | 3 | 2.5 | 2.5 | 1.5 | 1.5 | 0 | 1 | 1.5 | 0 | 52.5 |
| [illegible] | (n=4) | 3 | 2.5 | 2.5 | 2.5 | 3 | 3 | 2.25 | 3 | 2.25 | 3 | 2.75 | 2.25 | 2 | 3 | 2.75 | 2.75 | 2.5 | 2.5 | 2.25 | 2.5 | 2.25 | 0 | 1.5 | 2.5 | 0 | 58.5 |
| [illegible] | (n=4) | 0.25 | 0.25 | 2.25 | 1.25 | 0.5 | 3 | 0.5 | 3 | 0.5 | 1.25 | 1.5 | 1.5 | 1.25 | 2.75 | 2.25 | 2.25 | 1.5 | 1.25 | 2.25 | 0.5 | 1 | 0 | 0 | 2 | 0 | 32.75 |
| [illegible] | (n=4) | 1.5 | 0 | 1 | 0.5 | 1 | 2.75 | 0.75 | 2 | 0.75 | 1 | 0.75 | 1 | 1.75 | 1.5 | 2.75 | 2 | 2 | 2 | 2 | 0 | 1.25 | 0.75 | 0 | 1.25 | 0.75 | 31 |
| [illegible] | (n=3) | 2.67 | 1.33 | 2.33 | 1.33 | 1.67 | 2.67 | 1 | 2.67 | 1 | 2 | 0 | 2.33 | 2.33 | 3 | 3 | 3 | 3 | 1.67 | 1.67 | 0.67 | 0.67 | 0 | 0 | 0.67 | 0 | 40.68 |
| [illegible] | (n=4) | 0.75 | 0.25 | 1.75 | 1.5 | 1.75 | 2.75 | 0.5 | 2 | 0 | 1.5 | 0.5 | 1.5 | 1 | 2.75 | 2.5 | 2 | 2.75 | 2 | 1.25 | 0.5 | 1.25 | 0 | 0 | 1.75 | 0 | 32.5 |
| [illegible] | (n=4) | 3 | 2.75 | 2.25 | 2.5 | 2.75 | 3 | 2 | 3 | 2 | 2 | 1.25 | 2.5 | 2.75 | 3 | 2.25 | 2 | 2 | 2.75 | 2.75 | 1 | 1.25 | 2 | 1.25 | 1.75 | 0 | 53.75 |

*Figure 2: Program Data Observation Data Summarized by Student with Color Mapping.*

This may also aid in the transfer of this knowledge to others. It is really the "re-experiencing of other people's experiences" (p. 69).

If one thinks of DDDM as individual or organizational action initiated by knowledge, then examining how tools can facilitate knowledge generation in teacher education is a worthy goal. The framework presented in this section provides an established language for classifying what happens in the case study presented within this paper.

## Methodology

The starting point for this study is an electronic portfolio system that contains a module through which classroom observations have been collected for inclusion in a preservice teacher's portfolio. During the field placements at this research institution, student teachers are observed four times by a university supervisor. The university supervisor is often a part-time faculty member (e.g., a retired teacher) who files formal reports following the four visits. For this study, the university supervisor filed the reports through the electronic portfolio system by way of the individual student teacher portfolio. To orient the reader to the electronic portfolio system used in this study, Appendix A and B were created to demonstrate a typical student portfolio that was constructed and a sample observation report filed by the university supervisor.

Once the four field observation reports were collected, the reports were automatically shared with the various parties who need access to them, such as the student teacher, methods faculty, supervising teachers, etc. At this institution, the methods faculty reviewed the individual reports and ultimately signed off on the student teacher's certification. Although it could be argued that this is an improvement for the movement of data between stakeholders, by itself, this mechanism is not DDDM nor is it KM. Both KM and DDDM infer a level of analysis of data collected by the system. To this end, the dashboard is envisioned as a place for triggering and facilitating the analysis (i.e., a portal to conduct inquiry). To produce an authentic dashboard application for teacher education fieldwork, the technical development and academic inquiry is driven by the question, "What is the validity of the local classroom observation process?"

### *Data Sources and Analysis*

The classroom observation tool that was integrated into the system was a 25-item instrument based on the institution's state-mandated new teacher standards. A 4-point scale was used to rank each item (0 = not observed, 1 = observed at a basic level, 2 = satisfactory implementation, 3 = exemplary implementation). The report engine of the dashboard gives the mean score for each item and sums the mean for each item to give an aggregate number that will be referred to as an *implementation score*. A higher implementation score should indicate a high level of proficiency across a large number of instructional practices. Table 1 provides a breakdown of the various supervisors that were involved in the field supervision process from 2005 through 2008.

To examine the validity of the implementation scores, the author exsamined the predictive nature of the classroom observations. For the academic years 2005, 2006, 2007, and 2008 the faculty member in charge of the program was asked to rank the students from those years using the holistic criteria of hiring order. The rankings generated by the faculty member's holistic evaluation and the implementation scores generated by the system will be compared for agreement using the Spearman correlation.

The faculty member conducted all rankings in retrospect for this study. She was asked to rank the students according to how she would recommend them for jobs. In addition to being the figure in the admission process, the faculty member is the methods instructor and advisor, makes and oversees field placements in the fall and spring semesters, and interacts with the department chairs in the local school counties where most of the students get jobs. Additionally, she tries to observe as many of the students in her program during their student teaching placements as her schedule allows.

In the school districts surrounding the university, it is common for the faculty member to receive a call from a department chair asking for specific students to interview for job openings. The recommendations that this faculty member gives are critical and involve a tacit synthesis of academic performance, social interaction, and performance. The fact that schools have validated her vetting of candidates was one of the primary reasons that the author asked her to provide rankings on the students in a holistic manner that reflects her job recommendations.

The implementation scores are based on the supervisor's perception of what occurred in the classroom and should have some relation to the recommendations of the faculty. The alignment of the explicit data of the

**Table 2: Correlations Between Holistic Rankings and Classroom Observation Aggregates by Observer**

| | | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| Supervisor W | Retired Teacher | .6 | - | - | - |
| Supervisor X | Retired Teacher | .40 | 0.74*^ | - | - |
| Supervisor Y | Retired Teacher | - | 0.26 | - | - |
| Supervisor Z | Doctoral Student | 0.2 | - | - | 0.63*^ |
| Faculty | Assistant Professor | - | 0.47* | .77*^ | 0.74*^ |
| Total | | .33 | .51* | .77*^ | 0.75*^ |

classroom observations and more tacit rankings of the faculty member provides a rudimentary form of convergent validity that can be used to guide the continual development of the teacher preparation program, which includes plans to collect observations from the cooperating teachers the students are paired with during field placements.

The actual production of the data dashboard is as crucial a part of the results as the actual outcome of the analysis of the classroom observations. To accomplish this, the analysis and results will be presented in a narrative that presents the parallel tracks of the dashboard development and the data analysis.

## Results

The results section is broken into three subsections. The first, Developing the Dashboard, describes the initial design process and provides insight into the sequence in which the features were integrated. The second section, Testing Validity, focuses on the computational analysis conducted once the dashboard had reached a satisfactory level of functionality. The third section describes further development and results that were prompted during the validity testing. The intention of the results section is to give the reader a sense of the emergent process of development and analysis. The narrative presented in this section serves to provide the reader with a sense of how the dashboard facilitates analysis and presentation of data. The researcher's aim in this paper is not to acquire absolute proof of the utility of such dashboards, but to demonstrate the plausibility of their value through the presentation of the various aspects of the interface and a case of the tool being used for analysis. This case-based format was chosen to "enrich and potentially transform a reader's understanding of a phenomenon" (Khan, 2008, p. 425).

The following quote is taken from interviews conducted for another study and was one of the drivers for the work presented in this paper. It is presented because it represents the problem and frustrations of trying to achieve DDDM.

> For the last NCATE review and TEAC, we did go back and aggregate all the evaluations, and it was very labor intensive to do that. I had doctoral students and secretaries working on it. We went back over and did three years, and we got very little out of it.
>
> For TEAC they came back and said, "How do you interpret these scores that you got with no differences in any of your students?" And we really didn't have any…. I said they are all good students. That was the only thing I could say…. I had nothing. Because it was so lumped and it was so hard to separate meaningful items out, we never did an item analysis or factor analysis.
>
> They literally did hundreds of scattergrams so that we could find the few truly exceptional students and the few outlying students that were on the lower end and try to look at differences between those four students, to see what is the difference, if any, among these four students. We were making things up. Even these scattergrams didn't show us very much. We had high-low, low-low, high-high, and low-high on these four variables. So you have student B and C who are the outliers, but we would sit and they would run these scattergrams for hours on hundreds of students on 20 variables…. We were desperate to find some difference

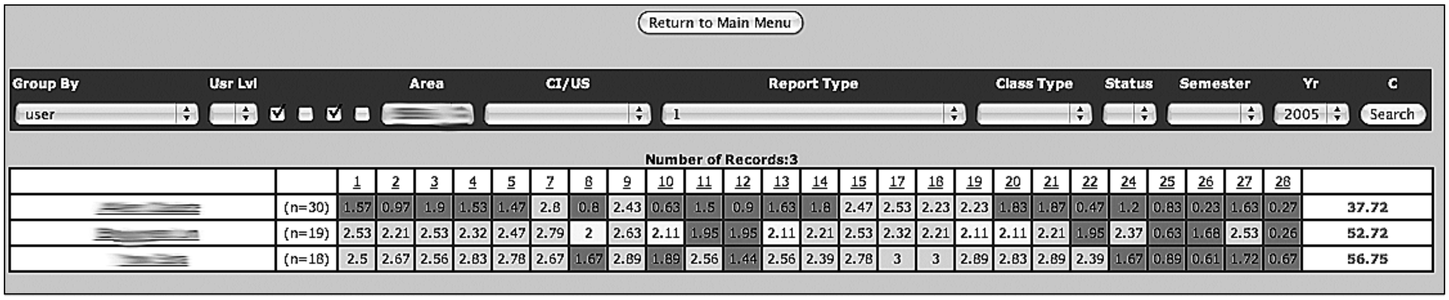
**Table 3: Means and Standard Deviations for Each Item by Observer**

| | Means for Items | | | | | Standard Deviations for Items | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Item | W | X | Y | Z | Fac | W | X | Y | Z | Fac |
| 1 | 2.53 | 1.72 | 2.57 | 2.58 | 2.44 | 0.82 | 0.98 | 0.49 | 0.53 | 0.81 |
| 2 | 2.21 | 1.19 | 1.9 | 2.61 | 2.31 | 0.52 | 1.12 | 0.92 | 0.58 | 0.85 |
| 3 | 2.53 | 1.87 | 2.24 | 2.61 | 2.58 | 0.5 | 0.7 | 0.61 | 0.49 | 0.64 |
| 4 | 2.32 | 1.58 | 2.52 | 2.61 | 2.54 | 0.46 | 0.98 | 0.59 | 0.61 | 0.68 |
| 5 | 2.47 | 1.7 | 2.14 | 2.65 | 2.44 | 0.6 | 1.14 | 0.71 | 0.51 | 0.84 |
| 6 | 2.79 | 2.62 | 2.52 | 2.55 | 2.42 | 0.41 | 0.62 | 0.73 | 1.01 | 0.93 |
| 7 | 2 | 1.04 | 2.81 | 2.32 | 1.96 | 0.86 | 1.2 | 0.39 | 1.01 | 0.87 |
| 8 | 2.63 | 2.32 | 2.33 | 2.73 | 2.54 | 0.67 | 0.95 | 0.78 | 0.45 | 0.64 |
| 9 | 2.11 | 0.79 | 2.52 | 2.32 | 1.98 | 0.64 | 1.14 | 0.59 | 0.89 | 0.9 |
| 10 | 1.95 | 1.55 | 2.48 | 2.52 | 2.33 | 1.1 | 1 | 0.66 | 0.8 | 0.9 |
| 11 | 1.95 | 0.92 | 1.9 | 1.35 | 1.69 | 1.1 | 1.27 | 1.11 | 1.46 | 1.21 |
| 12 | 2.11 | 1.85 | 2.48 | 2.6 | 1.92 | 0.85 | 0.92 | 0.59 | 0.49 | 1.04 |
| 13 | 2.21 | 1.89 | 2.29 | 2.45 | 2.21 | 0.61 | 0.9 | 0.88 | 0.64 | 0.71 |
| 14 | 2.53 | 2.28 | 2.52 | 2.58 | 2.69 | 0.6 | 1.05 | 0.66 | 0.61 | 0.62 |
| 15 | 2.32 | 2.34 | 2.9 | 2.89 | 2.63 | 0.92 | 0.89 | 0.29 | 0.32 | 0.73 |
| 16 | 2.21 | 2.13 | 2.71 | 2.89 | 2.6 | 0.95 | 1.06 | 0.76 | 0.32 | 0.73 |
| 17 | 2.11 | 2.21 | 2.38 | 2.61 | 2.42 | 0.79 | 1.05 | 0.58 | 0.49 | 0.73 |
| 18 | 2.11 | 1.66 | 2.19 | 2.68 | 2.56 | 0.55 | 1.18 | 0.66 | 0.47 | 0.64 |
| 19 | 2.21 | 1.85 | 2.19 | 2.69 | 2.5 | 0.61 | 1.19 | 0.79 | 0.58 | 0.61 |
| 20 | 1.95 | 1.02 | 2.38 | 2.26 | 2.5 | 1 | 1.02 | 0.72 | 1.03 | 0.65 |
| 21 | 2.37 | 1.15 | 1.24 | 1.74 | 1.73 | 0.81 | 1.22 | 1.44 | 1.31 | 1.25 |
| 22 | 0.63 | 0.72 | 0.71 | 0.74 | 1.27 | 1.13 | 1.22 | 1.28 | 1.27 | 1.41 |
| 23 | 1.68 | 0.34 | 0.1 | 0.65 | 1.1 | 0.98 | 0.78 | 0.43 | 1.21 | 1.31 |
| 24 | 2.53 | 1.58 | 1.67 | 1.92 | 1.96 | 0.82 | 1.12 | 1.46 | 1.36 | 1.17 |
| 25 | 0.26 | 0.26 | 0.43 | 0.69 | 1.38 | 0.78 | 0.76 | 1.05 | 1.24 | 1.38 |
| Total | 52.72 | 38.58 | 52.12 | 56.24 | 54.7 | 19.08 | 25.46 | 19.17 | 19.68 | 22.25 |

### *Developing the Dashboard*

The first step in developing a dashboard was to create a report that would aggregate the classroom observations to give an implementation score for each student. Figure 1 shows a sample output from the initial version of the dashboard.

The scores ranged from 31 to 60.5 and 33.99 to 63.5 for the first and second years, respectively. The standard deviations for the implementation scores were 10.32 and 10.91 for each of the 2 years. Although this display gave an indication of performance, it was very difficult to read or interpret. To enhance pattern recognition and make trends and relationships more prominent, color-coding was added to the display. If the mean for a particular item was below 2.0 it was coded as red; between 2.0 and 2.2 was coded yellow; and above 2.2 was coded green. Figure 2 shows the updated display.




| | | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 17 | 18 | 19 | 20 | 21 | 22 | 24 | 25 | 26 | 27 | 28 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (n=30) | 1.57 | 0.97 | 1.9 | 1.53 | 1.47 | 2.8 | 0.8 | 2.43 | 0.63 | 1.5 | 0.9 | 1.63 | 1.8 | 2.47 | 2.53 | 2.23 | 2.23 | 1.83 | 1.87 | 0.47 | 1.2 | 0.83 | 0.23 | 1.63 | 0.27 | 37.72 |
| | (n=19) | 2.53 | 2.21 | 2.53 | 2.32 | 2.47 | 2.79 | 2 | 2.63 | 2.11 | 1.95 | 1.95 | 2.11 | 2.21 | 2.53 | 2.32 | 2.21 | 2.11 | 2.11 | 2.21 | 1.95 | 2.37 | 0.63 | 1.68 | 2.53 | 0.26 | 52.72 |
| | (n=18) | 2.5 | 2.67 | 2.56 | 2.83 | 2.78 | 2.67 | 1.67 | 2.89 | 1.89 | 2.56 | 1.44 | 2.56 | 2.39 | 2.78 | 3 | 3 | 2.89 | 2.83 | 2.89 | 2.39 | 1.67 | 0.89 | 0.61 | 1.72 | 0.67 | 56.75 |

*Figure 3: Program Data Observation Data Summarized by Observer.*

**Table 4: Count of Scores Used per Observation by Observer**

| | | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|
| Supervisor W | Retired Teacher | 10.0 | 10.8 | 1.1 | 3.1 |
| Supervisor X | Retired Teacher | 6.5 | 9.3 | 0.6 | 8.6 |
| Supervisor Y | Retired Teacher | 11.9 | 7.6 | 1.4 | 4.1 |
| Supervisor Z | Doctoral Student | 14.6 | 6.2 | 0.1 | 4.1 |
| Faculty | Assistant Professor | 12.7 | 7.6 | 1.5 | 3.3 |

In this new display, the patterns jump out at the viewer. Rows of red indicate students who are potentially underperforming, whereas columns of red indicate items that are not being implemented regularly. In the case of item 12, which is about summative evaluation, one would expect to see fewer occurrences, as students are most likely to try and showcase more dynamic lessons when being observed. Items 24 through 28 deal with technology/media use and illustrate that there are much lower implementation rates compared to other areas of instruction. Although the exact reasons for this must still be explored, the dashboard provides concrete data that immediately indicates a jumping off point for exploration.

### *Testing Validity*

The next questions that arose were: "How valid is this separation of scores?" and "How does it compare with another source?" The program faculty member was asked to rank a list of students from each of the years based on her experience with the students in class and within their field experience. This ranking was done prior to showing the faculty member the summaries of the classroom observations. Each of the results was copied to a spreadsheet where several comparisons were run on the rankings using the Spearman correlation. The correlations for 2005, 2006, 2007, and 2008 were .31, .51, .77, and .75, respectively, and the correlations in 2006, 2007, and 2008 were significant (see Table 2). For all observers who participated for multiple years, there was an increase in the correlation strength in the following years. The overall ratings improved over the first 3 years and maintained a high correlation in the 4th. This is an encouraging finding for the program, as it shows that the tacit perceptions of the faculty are reflected and supported by the explicit sources of data.

Table 3 shows the means and standard deviations for each of the items for all the supervisors. These numbers are cumulative across all four years. These are provided to tell the story of the correlations; the reader may decide if they are meaningful or not.

### *Fine-Tuning the Dashboard*

The lower correlations in the 2005 and 2006 academic years led to questions about the supervisors in those years. To explore this aspect of the data, the dashboard was modified to allow the user to modify the variables that the data was grouped around. This allowed the researcher to look at the data according to the individual supervisor and academic year (see Figure 3). Supervisor X had consistently lower implementations scores than the other supervisors. When her students were compared against the faculty rankings, the correlations were .40 and .74 for the 2005 and 2006 academic years, respectively. T-tests confirmed that the distribution of student rankings between Supervisor X and the other supervisors were not statistically different ($p > .78$ in both cases), whereas the differences in the implementation scores were different ($p < .05$ in both cases). A search option was added to the dashboard to count the number of times a particular score was used rather than computing the mean of the scores. Combining this new functionality with the ability to change the grouping variable produced the data shown in Table 4, which shows that Supervisor X assigned a zero score to items twice as often as the other supervisors. She also gives out exemplary scores less frequently than other supervisors. Given the strength of the correlations between her observation implementation scores and the holistic rankings, one could conclude that although there is some discrepancy in how she assigns the level of scores, there is consistency in how she makes those judgments.

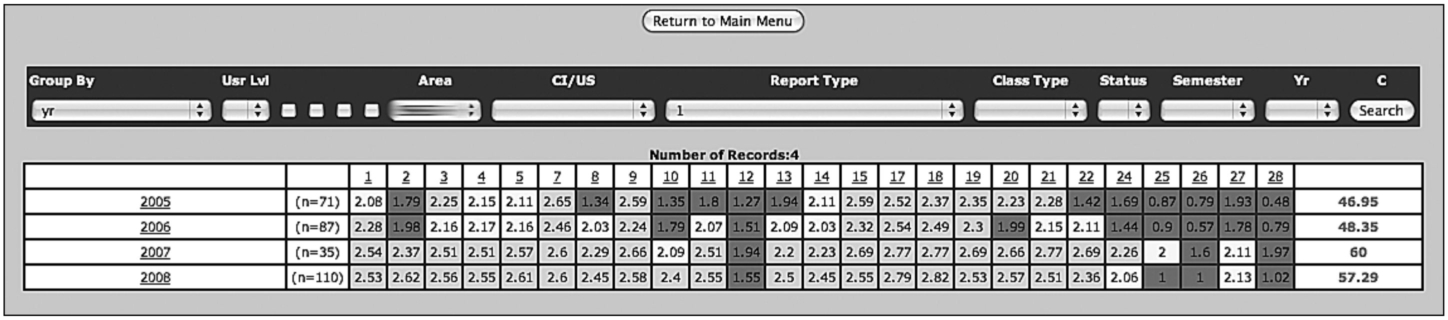
This supervisor was clearly approaching the observation process in such a way that it was providing feedback that aligned with the judgments of the faculty member. These results also indicate that some sort of intervention for university supervisors to help achieve better consistency in how scores are assigned would help the overall observation process, especially during the initial year.

Another element that the grouping choice allowed was to look at the mean item rankings across time. By changing the grouping variable to the academic year, the patterns of implementation seemed to hold steady across years (see Figure 4, page 112).

Item 12 shows low occurrence rates across all 4 years in addition to the technology-related items. Whereas item 12 refers specifically to summative evaluation, the others address formative assessment. The faculty member indicated that there had been an increased focus on formative assessment over the past 3 years because she felt that students were leaving without an understanding of the intent or actual implementation of formative assessment. The first 2 years in the summary reflect the concern of the faculty member and the latter 2 suggest that the curricular changes were having an effect. Although this is largely a face-value analysis, it does help to add weight to or contradict one's tacit perceptions.

## Discussion

Although the specific analysis of the classroom observations may not be generalized beyond the study setting, the tools and process of employing a dashboard to provide higher-level analysis for programs is. Accrediting bodies such as NCATE have established the expectation that teacher preparation programs will develop assessment systems enabling them to conduct ongoing evaluation (NCATE, 2003). The increased emphasis on accountability has brought with it a new attention to DDDM. Most universities offer some sort of Web application infrastructure that is widely accessible to students, staff, and faculty. The author was able to




| | | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 17 | 18 | 19 | 20 | 21 | 22 | 24 | 25 | 26 | 27 | 28 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | (n=71) | 2.08 | 1.79 | 2.25 | 2.15 | 2.11 | 2.65 | 1.34 | 2.59 | 1.35 | 1.8 | 1.27 | 1.94 | 2.11 | 2.59 | 2.52 | 2.37 | 2.35 | 2.23 | 2.28 | 1.42 | 1.69 | 0.87 | 0.79 | 1.93 | 0.48 | 46.95 |
| 2006 | (n=87) | 2.28 | 1.98 | 2.16 | 2.17 | 2.16 | 2.46 | 2.03 | 2.24 | 1.79 | 2.07 | 1.51 | 2.09 | 2.03 | 2.32 | 2.54 | 2.49 | 2.3 | 1.99 | 2.15 | 2.11 | 1.44 | 0.9 | 0.57 | 1.78 | 0.79 | 48.35 |
| 2007 | (n=35) | 2.54 | 2.37 | 2.51 | 2.51 | 2.57 | 2.6 | 2.29 | 2.66 | 2.09 | 2.51 | 1.94 | 2.2 | 2.23 | 2.69 | 2.77 | 2.77 | 2.69 | 2.66 | 2.77 | 2.69 | 2.26 | 2 | 1.6 | 2.11 | 1.97 | 60 |
| 2008 | (n=110) | 2.53 | 2.62 | 2.56 | 2.55 | 2.61 | 2.6 | 2.45 | 2.58 | 2.4 | 2.55 | 1.55 | 2.5 | 2.45 | 2.55 | 2.79 | 2.82 | 2.53 | 2.57 | 2.51 | 2.36 | 2.06 | 1 | 1 | 2.13 | 1.02 | 57.29 |

*Figure 4: Program Data Observation Data Summarized by Academic Year.*

find hosting support for the application described in this study at four other surrounding institutions within 2 hours of his own institution. This illustrates the natural infrastructure that exists not only within institutions, but the opportunity for networks between institutions. Although the technology infrastructure for developing and implementing DDDM solutions is prevalent in many institutions, a clear vision of the potential value of transitioning from a paper-based infrastructure to a digital one is not documented in the literature. The case study presented in this paper explores the potential for DDDM that comes with migrating from an existing paper-based infrastructure to a digital one.

In this analysis, the idea of the dashboard seems to best represent Nonaka and Takeuchi's (1995) notions of *combination* and *internalization*. In this study, the existing tacit data is given new life through the dashboard application. The summaries generated through the system are explicit data being transformed into another state. The analysis done in this paper and the conversation with the faculty member are the internalization component of the knowledge-generation process. Socialization and externalization are processes that are more social in nature, as they assume a certain level of communication. This is where the social mechanisms and leadership in an organization become increasingly important. The supervision process at the study site is very decentralized. There are no shared procedures between programs, and little, if any, group planning is done. With no formal mechanisms to promote knowledge sharing, the socialization and externalization processes are unlikely to take place.

The creation of knowledge requires moving between and within tacit and explicit forms of data. Any faculty member will bring a wealth of tacit knowledge to a setting in the form of professional judgments, classroom experience, and research interests. What a well-designed dashboard can bring to the table is the ability to navigate through explicit data with a greater fluidity. Each of the reports shown in this paper takes seconds to run, allowing a user to engage in a much tighter inquiry cycle. Additionally, the dashboard allows faculty to migrate from an analysis of individual students in a piecemeal fashion to more meta-analysis of students and groups of students across time.

Digital portfolios have partially addressed some of these issues, such as a decreased need for physical storage space and the ability to have multiple persons reviewing the portfolio simultaneously (McKinney, 1998). The use of electronic portfolios as a medium for students to grow professionally and to present and share work is one great benefit, but stopping at digital data storage misses out on great potential to improve teacher education programatically through the use of the powerful database features of tools such as the dashboard presented in this report that support DDDM.

## References


Beishuizen, J., Van Boxel, P., Banyard, P., Twiner, A., Vermeij, H., & Underwood, J. (2006) The introduction of portfolios in higher education: A comparative study in the UK and the Netherlands. *European Journal of Education, 41*(3/4), 491–508.

Ikemoto, G. & Marsh, J. (2007). Cutting through the "data-driven" mantra: Different conceptions of data-driven decision making. In Moss (Ed.), *Evidence and decision making, 106*(1). National Society for the Study of Education Yearbook.

Khan, S. (2008). The case in case-based design of educational software: A methodological interrogation. *Educational Technology Research & Development, 56,* 423–447.

Kidwell, J. J., Vander Linde, K. M. & Johnson, S. L. (2000) Applying Corporate Knowledge Management Practices in Higher Education. *Educause Quarterly, 4,* 28–33.

Marhsall, J. & A. Rossett (2000). Knowledge management for school-based educators. In J. M. Spector and T. M. Anderson (Eds.), *Integrated and holistic perspectives on learning, instruction and technology: Understanding complexity*. Boston, MA: Kluwer Academic Publishers.

McKinney, M. (1998). Preservice teachers' electronic portfolios: Integrating technology, self-assessment, and reflection. *Teacher Education Quarterly, 25*, 85–103.

Moss, P. (Ed.). (2007). *Evidence and decision making.* Malden, MA: Blackwell Publishing.

National Council for Accreditation of Teacher Education (NCATE). (2003, Spring). *NCATE unit standards*. Retrieved May 1, 2008, from http://www.ncate.org/standard/unit_stnds_ch2.htm

Niguidula, D. (1997). Picturing performance with digital portfolios. *Educational Leadership, 55*(3), 26–29.

Nonaka, I., & H. Takeuchi (1995). *The knowledge-creating company*, Oxford University Press.

Serban, A. M., & Luan, J. (2002). Overview of knowledge management. *New Directions for Institutional Research, 2002*(113), 5–16.

Strudler, N. & Wetzel, K. (2005). The diffusion of electronic portfolios in teacher education: Issues of initiation and Iiplementation. *Journal of Research on Technology in Education, 37*(4), 411–433.

Wetzel, K., & Strudler, N. (2005). The diffusion of electronic portfolios in teacher education: Next steps and recommendations from accomplished users. *Journal of Research on Technology in Education, 38*(2), 231–243.

Wilhelm, L., Puckett, K., Beisser, S., Wishart, W., Merideth, E. & Sivakumaran, T., (2006). Lessons learned from the implementation of electronic portfolios at three universities *TechTrends: Linking Research & Practice to Improve Learning, 50*(4), 62–71.

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## Appendix A

Figure A (below) shows a typical student portfolio that was constructed using the tool. Students using the tool can post artifacts comprised of course assignments, reflections and planning materials from both their field experiences and course work. These artifacts are then mapped to various teacher performance standards governing the teacher education program. Student teaching field supervisors, cooperating teachers or teacher educators can interact with the student by posting classroom observations, post-observation conference notes and feedback to the posted artifacts. All of the documents can be made visible to fellow student teachers and supervisors at the discretion of the individual user.

## Appendix B: Field Observation Report

University field supervisors post classroom observation reports in forms/evaluations (see Figure B below) that students and teacher educators can view. All sections within the portfolio (e.g. forms/evaluations, professional documents, reflections, etc.) provide tools for feedback and comments by users.

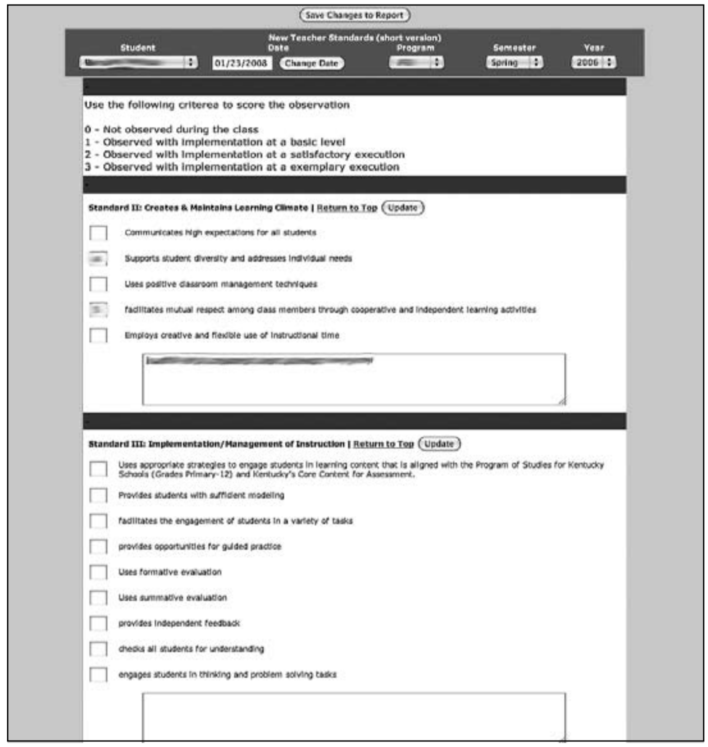


*Figure B: Field Observation Report.*


*Figure A: Student Portfolio.*