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Reconceptualizing Teacher Education:

Supporting Case-Based Instructional Problem Solving on the World Wide Web

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Abstract

The general goal of our work is to find ways of making the conceptual systems "sold" in large college courses truly useful in students' future professional lives. Facing evidence that traditional instructional models have not succeeded in this regard, we are seeking methods for closing the gap between classrooms and fields of practice, through new forms of technology-based course design. Using a tool for online course building that we developed, we have designed and tested new theory-based instructional models that systematically integrate video case study with problem-based and text-based learning. We have implemented and tested these models over several years in eSTEP (Elementary and Secondary Teacher Education Project) courses, a series of online learning science courses for teachers taught at the University of Wisconsin-Madison and Rutgers University. Our work provides evidence to support several new cognitively-based learning approaches that might be implemented on a large scale using Internet technologies.

Key words: Web-based learning; design-based learning; collaborative tools; problem-based learning; cognitive theory; transfer; learning science; teacher education; instructional design; assessment; rubrics

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Ideas are powerful things,

requiring not a studious contemplation but an action,

even if it is only an inner action.

-- Midge Decter, American writer

The broad practical question motivating our work is a version of the cognitive “transfer” problem: How can we make the conceptual systems that are taught in college classrooms truly useful in students’ future professional lives? Evidence from multiple disciplines shows that transfer of training from classroom to practice is very difficult to achieve (Gick & Holyoak, 1980; Lave & Wenger, 1991; Salomon & Perkins, 1989). Many researchers and educators have sought ways of closing the gap between classrooms and fields of practice, through innovative learning environment designs. Proposals such as Cognitive Flexibility Hypertext (e.g.,Spiro, Feltovich, & Coulson, 1992), online Problem-Based Learning (e.g., Koschmann, Kelson, Feltovich, & Barrows, 1996) and anchored instruction (Cognition and Technology Group at Vanderbilt, 1993) represent significant advances; yet the search for practical, high-impact solutions for large-scale instructional needs in disciplines such as teacher education is far from over (Barab et al., 1999). We are still in need of better designs for learning that can be implemented on a large scale and that will positively impact students’ future professional practices in their own classrooms.

In the present chapter, we describe an innovative course and a related course Web site, eSTEPWeb.org. We will illustrate Web-based features that were theoretically designed to address a specific problem of cognitive transfer and large scale implementation: helping preservice teachers develop useful knowledge of the *learning sciences*,[1] a subject taught in psychological foundations courses within teacher education programs. This chapter will begin with an overview of the theoretical basis of our course design (see also Derry, in press), next we will present preliminary data showing the positive reception of course features by students, and finally we will provide an example illustrating the rubric-based measures that have been used to document evidence of student learning. We briefly discuss data-gathering properties of our Web-based learning system and give examples of how we are using some of that data to examine predictors of student learning. Finally, we discuss some current directions and future plans for this work.

An Online Course Solution: *eSTEPWeb.org*

Using Web technologies, we designed and tested an innovative, theory-based instructional approach to help future teachers acquire professionally useful knowledge about learning sciences. Our approach is partly based on our cognitive analysis of what Salomon and Perkins (1989) and others (e.g., Schwartz & Bransford, 1998) have described as the transfer problem. Our goal is to help students develop transferable knowledge that incorporates course ideas–learning-sciences concepts and skills, in this case. An important stage of transfer occurs when, during professional practice, there is spontaneous and situationally-appropriate activation and use of complex knowledge systems that incorporate course ideas. We call those knowledge systems *schemas*, in the tradition of Bartlett (1932). The goals of our courses include helping students develop schemas that promote spontaneous transfer, “professional vision” (Goodwin, 1994), and continued learning through reflective practice (Schön, 1983).

The schemas we attempt to help students acquire are characterized by a high degree of analogical interconnectedness among the *concepts* and *skills* taught by the course and the *visions* and *plans* for learners' professional practice. In our eSTEP (Elementary and Secondary Teacher Education Project) courses, preservice teachers intensively study video cases to help them activate perceptual knowledge about many different types of events they will encounter in their future classrooms. Through activities that integrate this video case study with study of text and other discourse-based instruction, learners repeatedly map their active perceptions of classrooms to conceptual understandings based on the science of learning. Further, these "perceptualized" conceptual understandings are brought into collaborative lesson-design projects in which students create, critique, and improve justified plans for their own future classroom instruction. Our goal is to prepare new teachers to enter classrooms with schemas that support perceptually-triggered activation of learning-science interpretations of classroom events. These interpretations should also trigger ideas about what kinds of actions might be taken in various situations, as well as habits of mind related to reflective practice. We claim that our methods orient new teachers toward a scientifically-informed "seeing" of their professional environment that not only increases the probability that they will consider reasonable actions to support desired learning goals, but that also enhances their potential for future development and learning.

We developed extensive online video cases, text materials and related instructional methods, and online tools for supporting and testing our approach. The materials and tools are available through eSTEPWeb.org, a Web site that exemplifies many features of our method. This Web site is currently in use within teacher education programs at the University of Wisconsin-Madison (UW-Madison) and Rutgers University.

The main components of eSTEPWeb.org, are:

1. *Knowledge Web:*,A multimedia online resource that includes two integrated networks: (a) The *case library*, a digital library of stories of real-world cases representing a

"landscape" (e.g., Spiro et al., 1992; Wittgenstein, 1953) of teaching practices, and (b) the *theories net*, a hypertext book containing conceptual knowledge from the learning sciences and representing a conceptual landscape.

2. *PBL online*: A site including step-by-step scaffolding and tools to help groups carry out authentic lesson design tasks.

The following will explain the Web components in greater detail, describing theoretical issues related to their design.

The eSTEP Knowledge Web

We draw a distinction between two kinds of domains: the highly perceptual domain of professional practice (e.g., classroom teaching, medical practice, etc.) versus the highly conceptual[2] domains of classroom subject-matter knowledge through which professional practice is understood and interpreted (such as learning psychology as a basis for teaching; physiology as a basis for medical practice). The eSTEP *knowledge Web* (KWeb for short) is a multimedia hypertext resource that contains video case materials, used to help students activate highly perceptual visions of teaching practice, interlinked with highly conceptual text materials conveying the subject domain of learning science. The KWeb is explicitly designed to support forms of instruction that help learners create cognitive representations (schemas) that represent appropriate conceptual/perceptual meshing between these domains.

The "case library" as a landscape of practice. Our case library is a flexible instructional resource that, at this time, contains eleven cases for five secondary subject disciplines (science, mathematics, social studies, English, and foreign language). Cases vary in how they are designed. Most cases in our collection are stories about learning and instruction in actual classroom settings. A typical "story case" includes approximately 15-20 minutes of edited video plus supplementary materials, such as teacher commentary, examples of student work, class handouts, test scores, information about school context, etc. These cases range from examples of problematic classroom instruction that could be improved to examples of instruction we would like the preservice teachers to emulate. A typical way to use such cases in teacher education involves close study of one or more cases through group discussion, followed by an assignment in which learners are asked to create a lesson plan that adapts or redesigns the studied approaches.

To enable instructional flexibility we edited video footage in a way that captures major to-be-taught themes in small segments of video called minicases. In eSTEP, cases are collections of such minicases; however, when desired, minicases can also be extracted from their larger case contexts and reassembled into different groupings for instructional purposes. For example, a lecture or other presentation for an eSTEP course might use an assembly of minicases, drawn from various case contexts, that illustrates a particular course topic, such as *assessment* or *teaching for transfer*. A typical assignment when cases are grouped conceptually involves having students sort the cases and create justified explanations for their categories. Research has shown that such activities involving contrasting cases can be very effective in promoting conceptual transfer when they are combined with reading assignments pertaining to the concepts under study (Beitzel, 2004; Schwartz & Bransford, 1998).

The "theories net" as a conceptual landscape. The theories section of KWeb currently consists of about 100 densely interlinked Web pages that contain explanations and other text instruction for important learning sciences concepts, such as *metacognition, knowledge construction* or *attentional capacity*. These pages are intertwined and linked with the 100+ minicase segments in the case library that illustrate varied instances of learning science concepts at work in the classroom. Hence, while viewing any case or related minicase in the KWeb cases library, the learner can easily link to relevant learning science concepts in the theories network. This helps guide learners so that they create appropriate mental connections between learning science concepts and highly perceptual visions of practice. For example, from a case on the teaching of Huckleberry Finn, shown as Figure 1, learners can access a range of learning science concepts in the theories net, which can be combined in various ways to help interpret the case. Also, on every learning science page within the theories net, there are links, not only to other related concept pages, but also to minicases that illustrate that page's learning science concept. This is shown in Figure 2, where the page on social knowledge construction contains a list of minicases from the case library that illustrate a range of situations in which that concept is experienced in actual practice.

Insert Figures 1 and 2 about here

The theories network is organized as three interlinked idea families: cognitive theory sociocultural theory, and cross-theory ideas. The cognitive theory family has two main branches: information processing and sociocognitive (developmental) theory. Each idea family and its main branches also have several major family branches. As an aid in navigation, the family metaphor helps prevent disorientation in hyperspace (Diaz, Gomes, & Correia, 1999), since from any entry point within the theories network the user can identify the major theory and idea families to which that page belongs. The family metaphor also supports site maintenance: When a new node is added, only its parents and relatives need be specified, then its position in the network with respect to all other nodes is automatically generated. And, while the family relationships metaphor is an apparent hierarchy at superordinate levels, it is a *loose* family metaphor that affords creation of partially non-directional graph structures specifying complex interrelationships among pages (there can be three or more parents, for example, and relational links can be either directional or non-directional). Thus, the structure is valid for representing complex, conceptually messy domains, such as that of the learning sciences applied to teaching.

Instruction Supported with eSTEP Knowledge Web

The KWeb supports varied forms of hypertext instruction, such as the contrasting cases approach mentioned previously, but it was specifically designed to support approaches based on Cognitive Flexibility Theory (CFT) (e.g., Spiro, Collins, Thota, & Feltovich, 2003). CFT approaches include *domain crisscrossings* and *small multiples instruction*. We believe these strategies are very good for creating schemas that overlay the conceptual systems of the learning sciences and the perceptual landscape of teaching practice. These strategies attempt to compact experience and so are expected to accelerate development beyond what might be accomplished through traditional instruction combined with field-based professional placements.

CFT strategies assume that students come to the instruction with some prior knowledge of the conceptual and perceptual domains. The domain crisscrossing strategy guides students in studying a large number of varied real-world cases that represent the landscape of practice contexts in which concepts are to be conceptualized. For example, one of our domain crisscrossing assignments asks students to view the case library and collect minicases into conceptual categories that represent how *transfer* is seen in practice. Such instructional strategies are supposed to help students develop patterns of understanding representing varied ways in which practice is meshed with key subject-matter concepts, as theoretically suggested by Wittgenstein (e.g., 1953). Domain crisscrossings are combined with the small multiples strategy, in which students are asked repeatedly to bring concepts together, in different blends, to provide varied and complex interpretations of a single case. This might be done during a class discussion supported by the KWeb. The purpose is to encourage habits of mind associated with a particular form of transfer referred to as *cognitive flexibility* (e.g., Feltovich, Spiro, Coulson, & Feltovich, 1996), the ability to flexibly see situations in multiple complex ways.

eSTEP Problem-Based Learning (PBL)

In eSTEP classes, CFT and contrasting cases instruction are combined with PBL online, to help improve the probability of flexible conceptual transfer to future practice. Originally developed for medical education (Barrows, 1988), the purpose of PBL is to help students bring domain knowledge, usually scientific knowledge, to bear on the solving of the kinds of real-world problems they will eventually encounter. In Barrows' original method, medical students solve problems collaboratively under guidance of a facilitator, who encourages them to reflect on many possible approaches and ways of viewing the problem. Similarly, the purpose of PBL in eSTEP is to help learners develop cognitive schemas in which learning science concepts are encoded with many perceptual visions of, and many different plans for, future professional activity. As with Barrows' approach, our version also includes steps in which students reflect on their learning, with the aim of insuring that schemas for future practice will incorporate reflective habits of mind.

Originally, eSTEP PBL problems were face-to-face small-group activities supported by the KWeb but carried out primarily in classrooms with teaching assistants (TAs) as facilitators. The eSTEP team decided that PBL should go online for a number of reasons (Steinkuehler, Derry, Hmelo-Silver, & DelMarcelle, 2002). First, we wanted to distribute some of the facilitation responsibility to the system and the preservice teachers themselves, lightening the responsibility for teaching assistants, who usually lack experience with this complex instructional method. Second, the eSTEP community is growing, and an online system facilitates larger course management. Finally, the online environment facilitates data collection and analysis for our research on professional learning and transfer.

The eSTEP PBL system supports either online small-group instruction or a hybrid model in which students meet face-to-face in small groups during class and then extend their work outside of class through online interaction. In both online and hybrid models, students are guided by a human facilitator, typically a teaching assistant, and are required to complete and submit individual and group artifacts, products related to and documenting various stages of instructional design, through the online system. The online system collects and displays data on student performance and affords detailed monitoring of both individual and group work, permitting comprehensive (and powerful) formative assessment throughout the course.

To support eSTEP, we developed a course management system that allows us to configure PBL activities in many different ways. Although we have experimented with many versions, a typical eSTEP PBL activity involves a phase of individual study and preparation, followed by a phase of facilitated small-group design work, followed by a final phase in which the individual analyzes, extends, and reflects upon the group's work and how much the individual gained from it. These phases are scaffolded online by the eSTEP system, which guides students through the series of steps within the assignment. The number of steps and required activities for each step may vary from problem to problem, as desired by the course manager/designer. An example of such scaffolding is given below, in the description of a specific experimental course.

An Experimental[3] Course

Similar eSTEP courses were offered in the fall of 2002 at both Rutgers University and UW-Madison. During these courses, learning science materials were introduced through readings and occasional lectures that were accompanied by CFT-type instructional procedures using the KWeb. At both sites, much of the students’ time was spent in extended (2–3 week) facilitated PBL activities in which they used and acquired learning science knowledge as they designed assessments and learning activities. Although students continued to attend some classes to hear occasional lectures and meet face-to-face with their groups, most individual and collaborative work took place and was submitted online through the course Web site, which guided individual students and groups through the steps for completing each activity.

Sample Activity

A sample online PBL activity used at UW-Madison in fall 2002 consisted of nine steps. Figure 3 displays the task bar that guided the students through the Web site while they worked on a design problem. Although the problem that will be described was designed specifically for mathematics majors, all students at both sites participated in multiple problems with identical activity structures.

Insert Figure 3 about here

In Step 1, individual students signed on and read their problem, to work with their group to design a “bridging instruction” lesson for a secondary mathematics concept of their group’s choice. Before beginning their group design problem, students individually studied an online video case depicting a bridging instruction lesson taught by an experienced teacher. In Step 2, individual students used online personal notebooks to develop preliminary observations about the case and lessons learned, as well as a proposal for their group lesson. This work was shared with fellow students in Step 3. In Steps 4–6, students worked with their group to complete a lesson design using a *group whiteboard*, a tool designed to facilitate group design online. The group whiteboard tool with examples of student work is shown as Figure 4.

Insert Figure 4 about here

The structure of this tool can be manipulated, and in this eSTEP course, developers set it up so that learners were required to use a backward design process and justify all decisions with learning science concepts. Using different spaces within the group whiteboard, students first developed their instructional goals, then assessments, and finally learning activities for their lesson. The group whiteboard was set up to require individual students to submit justified proposals for their group's lesson, researching their ideas in the KWeb. Students and online facilitators (teaching assistants) were expected to discuss and comment on each others' proposals, and the authors of the proposals were encouraged and expected to modify their submissions in response to feedback. Students voted to determine which proposals were included in their final group product, which was automatically generated based on group voting results. In Steps 7 and 8, students reflected on their work and their group processes and explained how they would work and learn differently in the next PBL assignment. In Step 9 they rated the instructional activity, each step in the activity, and how well the different system tools used during the activity supported their learning.

Assessment Instruments

In addition to tool and activity ratings, our experimental eSTEP course offerings have typically produced the following categories of data[4]: [illegible] group instructional plans developed online during PBL activities; (b) online discourse related to group work during each PBL activity; (c) individual reflections, adaptations, and analyses of group work from PBL activities; (d) pre- and post-course analyses of teaching/learning video cases; (e) pre- and post-course self-reports of beliefs and attitudes related to teaching and learning; and (f) log data that can be analyzed to determine individual students' patterns of use of Web site tools and learning resources.

To evaluate the work in the first four items above, we developed *concepts-in-use* rubrics for judging and scoring pre- and post-video analyses and other student products in order to measure the level of sophistication manifest in students' spontaneous[5] embedded uses of target learning sciences concepts, such as *understanding*, *metacognition*, and *transfer*. All rubrics in our research are being designed for use across multiple types of learner products, documents, and classroom performances. All include features to help coders determine what to focus on when judging the learner's work, and all are calibrated to a single scoring scale. The psychometric properties of the rubrics are being assessed and improved through validity and reliability studies.

As an example, the features of our rubric for the concept *understanding* (or *understanding of understanding*) and the scoring scale to which it is calibrated are shown in Tables 1 and 2. Inter[illegible]r reliabilities for this rubric in repeated uses have consistently exceeded .90.

Insert Tables 1 and 2 about here

Selected Results

Student evaluations. Students' evaluative ratings of the online activities overall, specific steps in the activities, and the system tools used in implementing the activities online, were generally positive, ranging from 3.78 to 4.52 on a 5-point scale. The data showed that most students favored collaborative over individual steps in the learning activity.

Although a few students' comments reflected a struggle with technology (this type of comment is becoming less common with increasing availability of high-speed Internet connections), characteristic quotes from students, taken from their reflections about the experience (Steps 7 and 8), were positive, as illustrated by the following quotes:

> . . . this lesson that we have designed as a group is definitely something I could see myself using down the road when I have my own classroom. I feel it is a well thought out lesson that can be easily modified to meet the needs of whatever type of class "make-up" that I may have.

> I will attempt to use this method when creating lessons plans for next semester. I think it is a valid model that helps the teacher keep objectives clear and plan meaningful activities which cater to the objectives.

> I would use the unit itself. It was a good final product. I would also use this method of creating lesson plans.

> The plan that we made up as a group will be something that will be extremely useful for me as a teacher. I also learned the value of input from others' viewpoints on the same unit because you are able to see different perspectives that can give you some new and different ideas.

Learning outcomes and correlates. Table 3 shows mean scores from students' pre- and post-course video analyses, based on data from the fall 2002 implementation and the understanding-of-erstanding rubric previously described. Essentially, these means reflect gains in the college students' abilities to apply their psychological knowledge about the cognition of understanding to carry out a critical analysis of videotape showing actual classroom teaching and resulting student performance on an instructional interview. This is an important outcome variable, and the gains made in the eSTEP course were substantial and meaningful in two contexts. There are learning effects with an advanced student population enrolled in a selective teacher education program at UW-Madison; and there are substantial learning gains at Rutgers, a heterogeneous group of students taking a general educational psychology course as a prerequisite to applying for admission to teacher education.

We also conducted exploratory stepwise regression analyses to help generate hypotheses about possible relationships between college students' experience in the online environment and their actual learning outcomes (based on the understanding-of-understanding score), as well as their *perceptions* about how much they learned (based on an overall self-report rating). In the first analysis, the understanding-of-understanding score (previously described) was the dependent variable. Predictor variables allowed to enter into the regression equation were various "successful tool use dices, which combined students' ratings of system tools with other data on system use, such as number of times a student logged on. The set of independent variables that best predicted successful performance on the video analysis, scored with the understanding rubric, were: (a) entering pretest performance, (b) site (Rutgers versus UW), (c) successful use of the group whiteboard for collaborative online design, (d) successful use of links between video cases and the KWeb which scaffolded video viewing, and (e) overall number of Web hits (R^2 = .38). However, when self-reported *perception* of learning (e.g., students' ratings of how much they believed they learned) was the dependent variable, the best predictor set comprised success with tools and resources designed for individual study (R^2 = .42). A strong predictor was successful experience with the KWeb, which was designed in accordance with cognitive flexibility theory (Spiro et al., 1992) and was often used by individual students to explore personal interests.

We also conducted a factor analytic study in which items from a pre-course questionnaire were factored with the understanding score. At both sites, understanding of understanding loaded negatively with items comprising a factor that we feel measured belief that the cause of learning is primarily external context. For example, a person holding this 'contextualist' point of view would tend to respond "strongly agree" to an item such as "teachers (or the home environment) are the main determinant of student learning." From this finding, which was consistent in separate analyses across two sites, we hypothesized that helping college students develop an appreciation of the role of cognitive processes in teaching and learning may require challenging strong incoming beliefs that only contexts external to the child are responsible for success in school. We hope students leave our course with the view that learning environments are complex systems involving coordination of both internal and external factors.

Insert Table 3 about here

Next Steps, Future Directions

In summary, we have achieved the following major accomplishments:

1. Developed a theory-based model for online instruction that addresses a continuing major problem: the failure of most college classrooms to teach conceptual content in ways that ensure its use in students' future professional lives. Our approach integrates text-based instruction with video case study and authentic problem-based learning (PBL).
2. Developed extensive online video cases and text materials and related instructional methods and online tools for supporting this instructional model to teach learning sciences to future teachers. The materials and tools are available through eSTEPWeb.org and include the eSTEP knowledge Web, an online multimedia textbook on learning science, integrated with a video case library, and a system for setting up and managing collaborative problem-based learning activities online.
3. Using the resources above, we designed, offered, and tested innovative, experimental online learning science courses for preservice teachers, demonstrating the effectiveness of our approach in variations adapted to two contexts. This entailed developing theoretically valid and psychometrically sound rubrics for scoring student work collected from eSTEP courses, which can be generalized to evaluation of teaching beyond the current project.

We acknowledge that there are limitations in the work we have reported here. We know there are many improvements to interface design that might be accomplished given adequate time and funding. For example, we want to improve our asynchronous discussion environment and our interface for supporting video case study. We recognize that we have not conducted controlled studies to experimentally examine the effectiveness of our approach. And although we have developed some authentic assessments, we have not studied the impact of our course design on actual teaching practice, much less on how that practice affects student learning.

And yet our work so far represents a pioneering step in an emerging science, as exemplified in recent NSF funding trends, of Web-based course design that is informed by cognitive theory and that blends online video case study with collaborative problem solving. Our work has been institutionalized: The two eSTEP teacher education course offerings at Rutgers and the University of Wisconsin have stabilized as regular curricular offerings. We continue to improve our general tool (STELLARLab – a Sociotechnical Environment for Learning and Learning Activity Research) that allows researchers and developers from any discipline to design, offer, and closely monitor courses and activities representing variations on the eSTEP model. We have experienced facilitators and are developing programs for training new ones. Several generalizable assessment instruments and other data collection procedures have been validated and standardized, and new ones are under development. A new theory of instructional design and transfer has emerged from our work and is currently being tested extensively in both design-based and experimental studies that employ STELLARLab. Many faculty and researchers are currently requesting access to STELLARLab. We hope to secure support that will enable us to offer workshops and develop a STELLARLab user community that will collaborate on scientific studies of learning and transfer with Web-based instruction in higher education. To obtain current information on this continuing work, readers are referred to the STELLARLab Web site: http://www.wcer.wisc.edu/stellar/.

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Footnotes

[1] The phrase *learning sciences* refers to the current theoretical and empirical scientific knowledge base about student learning and development in educational settings.

[2] The term *concept* is broadly defined to include categories of skilled response (e.g., elaborative questioning, challenging misconceptions).

[3] The term *experiment* is used in the sense described by Brown (1992) in her classic article on design experiments.

[4] The exact data collection plan may vary from semester to semester.

[5] Students' uses of target learning sciences concepts are considered spontaneous in that students are not required to adopt particular concepts and are unaware that particular concepts are targeted for evaluation.

Table 1

Features Considered in Judging Ability to Use the Concept Understanding in Planning and Analyzing Instruction

Points are not awarded for use of the term *understanding*. Judge whether products or explanations explicitly or implicitly represent knowledge that:
1. Understanding is actively constructed knowledge. 2. Understanding builds on prior knowledge. 3. Understanding in context is an active process of comprehension that involves constructing a situation model. 4. Understanding supports the making of inferences and/or application in new contexts. 5. There are different depths or forms of understanding. 6. Understanding involves grasping the underlying principle, theme or big idea. 7. Understanding is socially negotiated and distributed in *communities of practice* (broadly defined to include classrooms and groups).

Table 2

Scoring Scale for Student Understanding of Understanding

Number Score	Descriptor and definition
0	**“Knows nothing.”** Observations or products contain no evidence that any aspect of the concept is understood or attended to, or there is evidence that the concept is rejected or not understood. The concept is very unlikely to be used correctly in planning or implementation unless the student teacher receives and is open to *intensive assistance.*
1	“**Needs substantial scaffolding**.” Observations or products indicate that there is some limited understanding and acceptance of the idea and that a limited range of acceptable implementation of the idea is occurring. However, there are major omissions, weaknesses, or misunderstandings in relation to the idea, and the student teacher will probably need *substantial assistance* to help him or her design and implement the idea successfully.
2	"**Demonstrates early expertise**.” Observations or products indicate the idea is likely understood with some range and depth and is being implemented with at least moderate success as conceptualized. However, there are some weaknesses or omissions that should be addressed, and this part of the student teacher’s work could be improved in important ways with *some assistance.*
3	“**Expert**.” Observations or products provide evidence that the idea is well conceptualized in depth and detail and over a range of uses (given limits of current assessment context—type of assignment, word limits, etc.) and is being implemented successfully and reflectively with sophisticated understanding, even though improvements might still be possible. Encouragement and positive feedback but *little assistance* would be appropriate.

Table 3

Pre- and Post-Course "Understanding in Use" Means (and Standard Deviations) for Students at UW-Madison and Rutgers

	UW	Rutgers
N	N = 60	N = 33
Level and course	Learning Sci required in final year of Teacher Ed	Ed Psy prerequisite for entering Teacher Ed
Pre-course score	Mean = 0.65 (.46)	Mean = 0.42 (.55)
Post-course score	Mean = 2.09 (.63)	Mean = 1.56 (.63)

Figure Captions

Figure 1. A web page from the case library.

Figure 2. A page from the theories net.

Figure 3. eSTEP task bar.

Figure 4. Entry in group whiteboard.