# Cognitive Apprenticeship as a Framework for Teaching Online

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**Abstract**

For many nurses, especially those in remote areas, underdeveloped countries, active military service around the world, and even working practitioners with families, online education is their only avenue to pursue a graduate degree and to acquire the skills necessary for success in leadership positions. A major challenge for faculty is to create an online environment that encourages working professionals to remain actively engaged and focused on achieving course competencies throughout their master's program as they struggle to balance school, employment, and personal responsibilities. This article describes how effective instructional strategies found in the cognitive apprenticeship framework and the use of innovative software tools can be applied in an online learning environment to facilitate rapid learning of essential skills necessary to achieve course competencies. Using screen capture software to teach the Statistical Package for the Social Sciences (SPSS) is the exemplar used for implementation of the framework components. Adobe Captivate, a screen capture software program, is used to model the step-by-step process for using the basic functions of SPSS. When supplemental coaching is required, Dimdim, a free open-source computer screen-sharing program, is used as a real time environment for tutoring individual students as they conduct statistical analyses using SPSS.

**Keywords:** Online education, SPSS, cognitive apprenticeship, modeling, coaching, scaffolding, fading, reflection, articulation, exploration

For many students, especially those in remote areas, underdeveloped countries, active military service around the world, and working professionals, online education is their only option for pursuing graduate level education and to acquire the skills necessary for success in leadership positions. Unique teaching and learning strategies are required to present complex concepts and applications in an online environment. An additional challenge for faculty is to create an online environment that encourages working professionals to remain actively engaged and focused on achieving course competencies throughout their master's program as they struggle to balance school, employment, and personal responsibilities. This environment, where faculty act as facilitators but students are in control of the learning process, demands vigorous participation and stimulating activities to foster continued involvement in course activities (Billings, 2007; Cuellar, 2002; Koeckeritz, Malkiewicz, & Henderson, 2002).

## An Apprenticeship Framework for Teaching Online

Practice disciplines, such as nursing, have always used traditional apprenticeship learning methods where the expert facilitates transfer of practice skill sets to novices (Benner, 2002). With an apprenticeship approach to learning, novices essentially learn cognitive and physical skills through a progression from pure observation to coached practice as they attempt to develop the thinking necessary to address complex situations within their discipline and eventually move to independent practice. An important corollary of apprenticeship is that learning is situated in the actual subculture in which the student is a member, making it easier for the student to transfer knowledge to the real world. Cognitive apprenticeship differs from traditional apprenticeship learning in that it focuses on the development of cognitive and metacognitive knowledge rather than the development of physical skills. When apprenticeship learning is applied to the development of cognitive skills, it requires that thinking processes that often remain implicit become explicit. Another requirement is that students have ample opportunity to practice this new way of thinking while receiving feedback on performance. Using the cognitive apprenticeship framework, faculty develop effective ways to facilitate the development of higher level thinking skills. Accordingly, the use of cognitive apprenticeship as a framework for presenting complex concepts and applications online provides a venue where faculty (the expert) and student (the apprentice) collaborate and interact in a virtual setting, actively supporting the progressive process of learning (Ding, 2005).

Seven teaching strategies are adopted from the cognitive apprenticeship framework to support students in the development of strategic thinking to learn and apply complex concepts in the online environment. Modeling, first proposed by Bandura (1977), is an instructional strategy in which an expert or teacher demonstrates a new concept or approach to learning and by which students learn by observing. Modeling requires that an expert demonstrate to a novice “how to think” about a task or problem in a context that closely approximates the real world setting. Experts or teachers can use a variety of methods to model complex problem solving including talking aloud as they solve a problem. Talking aloud protocols require teachers to explain how they approach situations including why they chose to focus on certain characteristics of the problem. A second method is for the expert to use an inquiry approach whereby students are encouraged to answer important questions that lead them to discovery of a strategy for approaching problems. Regardless of method, what is most important is that the *cognitive process or strategy* for problem solving is made visible to learners.

Collins, Brown, and Newman (1989) define coaching as assistance from a master. Parsloe and Wray (2000) indicate that it is important to distinguish between the role of coach and mentor where a coach is one who focuses on assisting learners to meet a specific goal while a mentor is one who provides on-going support. Coaching consists of providing students with opportunities to attempt problems relevant to everyday life, observing them in practice and providing feedback on their performance. The goal is to help the student develop thinking that is more closely aligned with that of an expert. Coaching is most effective when learning is situated in the context of a real world environment and the practice problems closely approximate actual problems or situations. Coaching can take the form of directing the student’s attention to a characteristic of the situation or a reminder of an important step in addressing a complex situation. Coaching should be interactive and immediate to ensure learners receive feedback on performance in a timely manner and while they are actively thinking about their problem-solving strategies.

Scaffolding, as an instructional strategy, was introduced by Wood, Bruner, and Ross (1976) and further discussed by Vygotsky (1978). Scaffolds are tips and techniques that help learners remember how to approach a problem or situation in a given discipline. Scaffolds can take the form of verbal suggestions (i.e. mnemonics) or physical aids such as cue cards. Scaffolding is used when learners have not fully mastered the problem solving process in a discipline and the teacher or expert provides support for the learner by cooperating with the learner in solving a problem. For scaffolding to be effective, the expert teacher must perform an accurate assessment of the student’s current skill level or difficulty with the task at hand. Too much scaffolding may interfere with learning while too little may not provide a rich enough learning environment.

Fading consists of gradually relinquishing the help provided to learners as they attempt to solve complex problems or address complex situations. As the expert fades from the problem situation, the student is responsible for more and more of the thinking required to address the task. As with the use of scaffolding, expert teachers need to accurately assess the level of competence of a student before fading, otherwise a student may not receive the necessary support required to complete learning.

Reflection requires learners to think deeply about how they approach a situation within a discipline and to compare their approach to that of the expert or to a standard. Reflection is a cognitive process which, when executed, enables the ideas, understandings, and experiences of a learner to be reviewed (Preskill & Torres, 1999). Reflection allows use of memory, understanding, imagination, and feelings to grasp the essential meaning and value of how one is proceeding. According to Mezirow (1990), reflection allows individuals to correct distortions in their beliefs and critique "the presuppositions on which their beliefs have been built" (p. 1). When reflection is applied in the learning environment, teachers better understand the mental models of their students. Watkins and Marsick (1993) believe reflection is an instrumental component of continuous learning through which students are enabled to correct flaws in thinking.

Articulation refers to any method that requires students to share their thinking in terms of *how they approached a situation and what they took into consideration and why.* Lave and Wenger (1991) observe that the ability to speak the vocabulary and share thinking within a culture of practice (articulate one's ideas within the context of a discipline) is fundamental to learning. Through articulation, an expert can view the thinking of students as well as the strategies and processes they use to approach tasks, problems, and complex situations. Articulation can take the form of writing assignments or an inquiry whereby teachers ask students questions aimed at making visible the learners metacognitive knowledge. Learners may also engage in a cooperative process of articulating knowledge whereby one student interviews another regarding their approach to a problem or situation.

Exploration involves asking students to imagine other ways in which they might enhance their approach to solving tasks or problem situations. Enkenberg (2001) describes exploration as a cognitive activity whereby students generate hypotheses which are then tested in order to construct new ideas and viewpoints. Exploration occurs once the learner is competent enough to solve problems and, through reflection, becomes aware of how they think through the problem solving process. Exploration encourages students to take problem solving to the next step, to begin to ask meaningful questions beyond those that have been addressed.

The cognitive apprenticeship instructional strategies offer a rigorous and robust approach to teaching complex problem-solving skills and to developing important competencies within a discipline. While some teachers choose to include some of the strategies in their teaching practice, the cognitive apprenticeship framework is most effective when all seven strategies are employed in learning.

**Tools and Applications: An Exemplar for Using Cognitive Apprenticeship**

At the graduate level, the Statistical Package for the Social Sciences (SPSS) is one of the key software applications that students must become skilled in to manage and analyze data. For example, in the health professions, utilization of informatics to reduce errors, manage information, make decisions, and facilitate communication is one of the five core educational competencies recommended by the Institute of Medicine (2003). Because many students entering graduate programs have had little exposure to SPSS, it is an opportunity to employ innovative approaches for teaching the essential functions of SPSS so that students can remain focused on achieving the primary course competencies rather than on mastering the software.

Using the cognitive apprenticeship framework, innovative and successful software tools can be employed that enable students to quickly learn the essential SPSS (17.0) functions necessary to be successful in analyzing outcomes data. In this exemplar, Adobe Captivate (4) a screen capture software program, is used to create narrated Flash movies (tutorials) of the SPSS demonstrations designed to navigate online students through the basic step-by-step functions of the program. The Captivate tutorials explicitly illustrate and explain (model) each SPSS function by using automatic on-screen mouse-tracking accompanied by text captions that elucidate and explain each click of the mouse (Huettner, 2008). It should be noted that other free and commercial screen capture software programs, such as ALLCapture (3.0) and Camtasia Studio (6) can also be used to create tutorials.

Dimdim (Dimdim.com), a free open-source computer screen-sharing program, is used to supplement the tutorials for individual students by simulating the live classroom experience and instructing students online in real time as they conduct statistical analyses using SPSS. The instructor's computer can be shared with the student to provide additional instruction or the student's computer can be shared with the instructor to demonstrate how the function is being performed. Unlike other Web conferencing products, Dimdim does not require users to install software on their computers to attend Web meetings. Users can start or join meetings with just a few clicks. Dimdim easily integrates with popular learning management system (LMS) software such as Blackboard (9.0) or Moodle (1.9.7) to further engage students in learning process.

**Modeling.** When in an on-campus computer lab setting, faculty interact with students in person, providing detailed demonstrations and explanations (modeling) for each SPSS function so that students can easily view and understand the required steps to complete the statistical operation. In the online environment, the observation by the novice of skill demonstration by the expert is compromised by distance and lack of real time interaction. To compensate for the lack of physical proximity in the online environment, special tools and methods are needed to accomplish modeling for students at a distance.

Adobe Captivate tutorials are developed to explicitly illustrate and explain (model) *only* the SPSS functions necessary for beginning outcomes analysis. When creating an Adobe Captivate tutorial, the recommendations of Smith-Stoner and Willer (2003) for producing demonstrations of software applications online are followed:

- Each function of the SPSS program is presented in a narrated Flash movie, going through the steps slowly and deliberately. Even though there may be shortcuts that can save students time, each step is demonstrated entirely and explained completely so that the underlying rationale for the function is explicit. Written instructions for each step in the function presented are posted prior to the Captivate presentation so that students can prepare beforehand and follow along as the demonstration proceeds.
- During the demonstration, the mouse is moved very slowly from function to function, making it easier for students to follow along. The student is further guided through the steps by Captivate's mouse tracking and text captioning functions. Students watching a Captivate tutorial have the opportunity to stop, rewind, and replay all or part of the demonstration.
- After each step in the demonstration, the instructor pauses briefly so that the student has time to think and assimilate the rationale for each step.
- Tutorials are generally limited to 10 minutes or less so as not to overwhelm students learning this very powerful software application. If it takes longer to present a particular SPSS function, the function is broken up into multiple presentations, each covering a segment of the function.

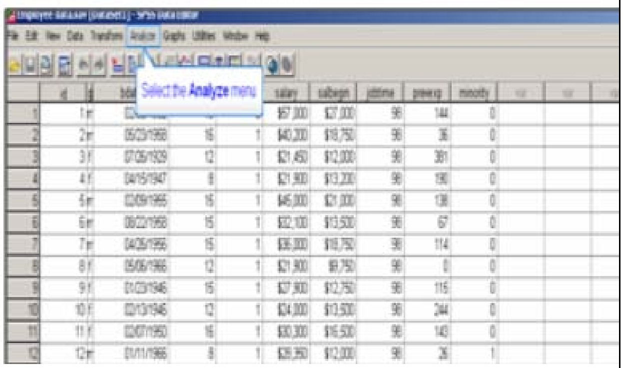
Figure 1 illustrates representative screen shots from an Adobe Captivate tutorial created to demonstrate the frequency distribution function in SPSS.

**Coaching.** Faculty in an on-campus computer laboratory have the ability to see and mentor students, providing feedback (coaching) in real time as they attempt to apply their new skills. In the online environment, students are coached through assigned exercises utilizing data derived from the real world health care environment to perform the specific SPSS functions demonstrated in the Captivate tutorials. Students are encouraged to coach one another through cooperative peer problem solving to complete the exercises. Peer collaboration reduces frustration and feelings of isolation as students learn this very challenging software application. Thus, students are encouraged to engage in reciprocal learning, exchange of ideas, support for one another, and in building a sense of online community (Ding, 2005).

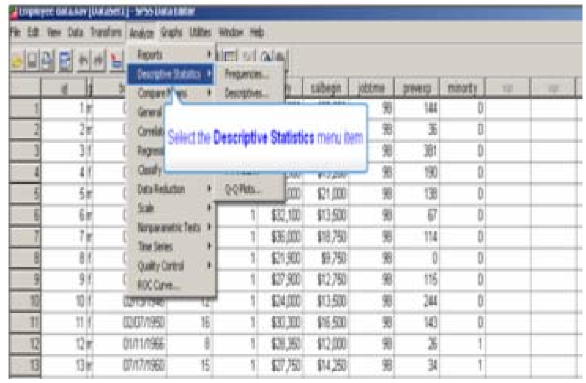
When students complete the exercises and submit their SPSS output files for feedback from the instructor, the output files are examined to determine if the student appropriately completed each step in the assigned SPSS functions. In keeping with the cognitive apprenticeship model, the instructor offers prompt feedback and reminders that might focus the student's attention to a previously unrealized aspect of the steps in the statistical function (Collins, Brown, & Newman,1989; Ding, 2005).

Occasionally, there are students who require more than written feedback on their assignments in order to grasp the SPSS functions. In these instances, Dimdim (Dimdim.com), an open-source computer screen-sharing program, is used to simulate the live classroom experience. The opportunity for instructor and student to share their computer screens provides additional individualized coaching opportunities. The faculty and student communicate verbally using DimDim's online audio conferencing function or by telephone. Typically, when a student is having difficulty performing an SPSS function, the problem is as simple as a missed step or the use of the wrong variable (i.e. age categories [nominal data] instead of age [ratio level data]). These simple errors are easily identified when the instructor can view the student performing the function. This coaching method provides a very personal touch for the online student who is having difficulty, saving time and frustration on the part of everyone involved.

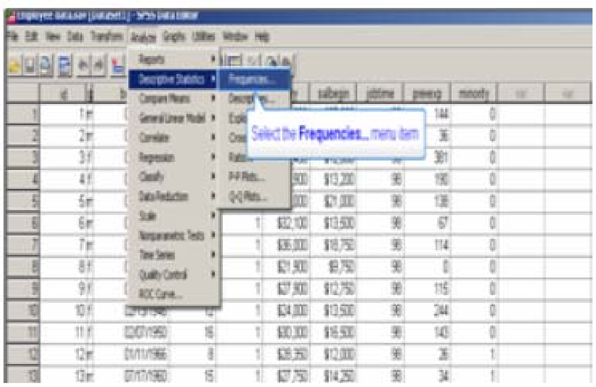
**Scaffolding.** *Scaffolding* is used in cognitive apprenticeship to empower students to perform independently (Ding, 2005). The use of guides and narratives are gradually removed as students demonstrate the effective problem-solving strategies they have incorporated through modeling and coaching. In the place of definitive guides, subtle reminders and hints are used to support the performance of new skills. The student is asked to assume as much of the task as possible but with the knowledge that cooperative problem solving remains available (Collins, Brown, & Newman, 1989). In addition, students are always able to return to the Captivate tutorials that remain available to them online throughout the course.



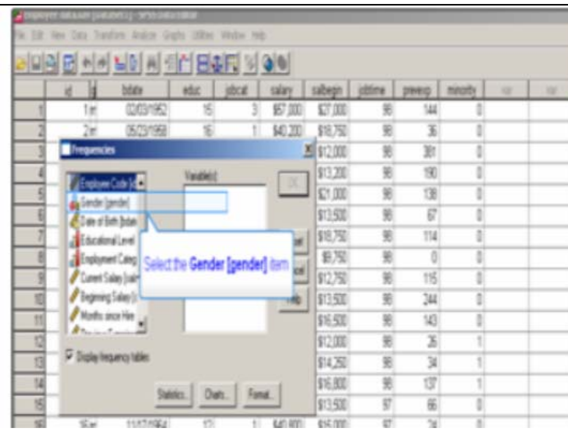

Directs Student to “Select Analyze” function from menu



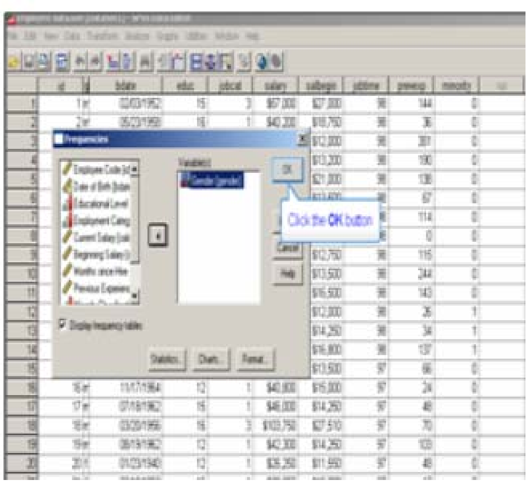

Directs student to “Select Descriptive Statistics”



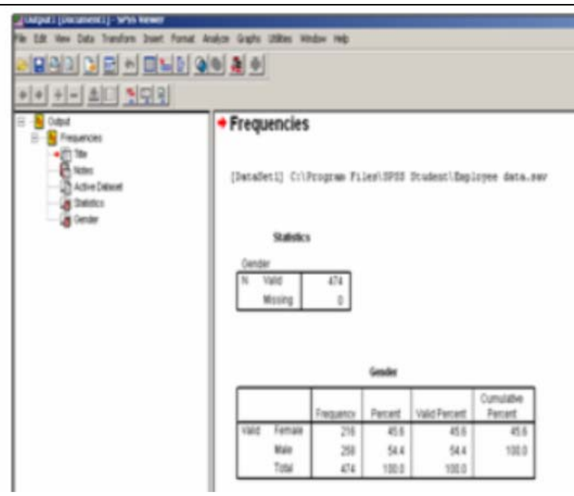

Directs student to “Select Frequencies” function




Directs student to “Select Gender” from list of variables




Directs student to “Click OK”




An output box opens displaying frequency distribution

*Figure 1. Sample screen shots illustrate an Adobe Captivate Flash movie demonstration of the SPSS frequency distribution function for the variable “gender”. The movie, accompanied by on-screen text captions and an explicit “talk aloud” audio narrative, model each step of the SPSS statistical function for the viewer.*

Scaffolding is evident as students use SPSS to assess and analyze data or to incorporate statistical analyses into a full outcomes management project. As students work through their analyses, faculty provide tips or suggestions for alternative approaches for students to consider as they assess their data.

**Fading.** *Fading*, as a cognitive apprenticeship method, gradually removes overt supports. Once the student has demonstrated effective use of the assigned SPSS software functions, the instructor begins to withdraw (fade) participation, providing only very limited hints and feedback to the student (Collins, Brown, & Newman, 1989). Fading is evident as students prepare to submit their final project paper with its accompanying data analysis.

**Reflection.** *Reflection* is used as students thoughtfully consider how the findings from their outcomes analysis project compare or benchmark with similar outcomes studies in the research literature. The reflective experience encourages contemplation about alternative and possibly more effective methods for obtaining meaningful results.

**Articulation.** Students use *articulation* in building their outcomes analysis project as they provide written explanation for selection of the statistical tests utilized for analyzing outcomes. Articulation is also used when students coach one another in online discussions throughout the outcomes analysis process. By articulating processes and concepts by either writing or discussing, students gain conscious access to the knowledge and skills they have used in analyzing the assigned data (Collins, Brown, & Newman, 1989).

**Exploration.** Once students are nearing completion of their outcomes analysis project, they use *exploration* to consider other means for testing their data and the impact that might have on their findings. Students are asked to think about whether different approaches to data analysis might result in different health care interventions as well as the clinical, financial, and humanistic consequences of such. Table 1 summarizes the use of cognitive apprenticeship as a model for incorporating software applications to teach SPSS in a web environment.

*Table 1. Cognitive Apprenticeship Model to Teach SPSS in a Web Environment*

| Strategy | Description | Application |
|---|---|---|
| Modeling | Demonstration by the expert of “how” to think about a problem in the real world setting. | Adobe Captivate tutorials explicitly demonstrate (model) SPSS functions. |
| Coaching | Provision of interactive opportunities to attempt real world problems with immediate feedback on performance. | Cooperative problem-solving to complete statistical exercises using Dimdim (Dimdim.com). |
| Scaffolding | Reminders and hints used to support performance of new skills. | Alternative approaches to statistical analyses are suggested by faculty and colleagues. |
| Fading | Faculty gradually relinquish overt support as students assume more responsibility for problem solving. | Faculty provide diminishing support as students conclude their data analyses for their final course project. |
| Reflection | Students compare their problem-solving approach to that presented by experts. | Students compare the findings of their analyses to findings in the literature. |
| Articulation | Students share their thinking about methods used to solve complex problems. | Students document their rationale for selection of statistical functions to assess outcome achievement. |
| Exploration | Students explore alternative approaches to solving problems. | Students explore the impact of different statistical analysis approaches on outcomes and resultant interventions. |

## Conclusion

Teaching SPSS online while keeping students engaged and focused on achieving the broader course competencies associated with outcomes analysis is challenging. Cargile Cook and Grant-Davie (2005) state that, "as in the traditional onsite classroom, online instructors' underlying learning theories and pedagogical goals may vary, but the better the fit between the instructors' theoretical foundation, pedagogical goals, and available technologies, the more easily attainable the goals will be" (p.54). By incorporating the cognitive apprenticeship framework as a pedagogical teaching framework whereby Adobe Captivate software and Dimdim are used as tools for teaching the essential functions of SPSS, students are encouraged to focus on the broader implications of data analysis for improving health care or other outcomes.

Research conducted by Sapp and Simon (2005) suggests that there are multiple, latent issues introduced by the typical online environment. The absence of non-verbal clues may cause faculty to have a more difficult time determining student engagement and understanding. Less social interaction may interfere with learning. The increased time commitments associated with teaching online may pressure instructors to skimp on their obligations to students. The use of new technologies may enable at least the semblance of physical presence and the use of verbal and non-verbal cues. As additional online pedagogies and technologies are developed to enhance the online environment, additional research is needed to validate the effectiveness of these methodologies. Descriptive research is needed on the facets of online environments that facilitate successful learning at a distance. Interventional research is needed to discover strategies and applications that enhance mastery of competencies as well in the online and the classroom setting. Comparative studies of the two environments will also be helpful and is definitely encouraged to build a larger and more scientific body of knowledge in the area of effective learning strategies for both the synchronous and asynchronous environment.

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