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The Heuristic Sandbox: Developing Teacher Know-How Through Play in simSchool

SUSAN B. HOPPER
University of North Texas, Denton, TX
sbhopper@msn.com

Simschool is a game-based, virtual, and interactive tool that allows pre-service teachers to acquire new skills while constructing knowledge through experimentation with learning situations. Pre-service teachers develop know-how—or heuristic knowledge—through repeated practice in the "Personality Plus Higher-Order Thinking" module to discover insights about personality traits in teaching and instructional levels of critical thinking. This article is an introduction, overview, and example of a simSchool module. It will illustrate how pre-service teachers can construct their own knowledge through the simSchool experience with various outcomes in the development of heuristic knowledge and suggest future work to enhance the benefits of simSchool in teacher education.

Keywords: simulations, pre-service teacher preparation, personality traits in teacher education, critical thinking in teacher education, pedagogical balance

INTRODUCTION

Teachers need to know how to manage and adjust student behavior and learning to benefit all students. This knowledge does not develop in pre-service teachers through reading books or memorizing information for tests,

but develops through practice (Hettler, Gibson, Christensen, & Zibit, 2008); it is sometimes referred to as "know-how". It is knowledge of how to do a particular thing and is developed through experience. Know-how can further be defined as ingenuity, aptitude, or skill. Heuristics is derived from a Greek word that means to know, to find, or to discover, and has a similar meaning to know-how. It is a technique to find feasible solutions using previous knowledge (Russell & Norvig, 1995) such as creating an educated guess, rule of thumb, or intuitive judgment (Gibson & Kruse, 2012).

One way pre-service teachers can develop know-how is through game-based learning or simulations where they can experience classroom situations and make decisions without practicing on real students. In game-based learning, participants learn through the game as opposed to learning how to play the game. Constructivism is a theory of how one learns and is used in game-based learning (Wu, Hsiao, Wu, Lin, & Huang, 2012). As the creators of their own knowledge, constructivists experiment, ask questions, and solve real-world problems to develop an understanding of new information and know-how. Knowledge is constructed through one's own experiences in the world and reflection upon those experiences (Bruner, 1960).

In classroom environments, students look, act, and think differently. As teachers, we know students learn differently. The amount of control that teachers have over student learning and behavior fluctuates depending on the variables of the classroom. For example, the teacher may have control over the schedule, lesson plans, task assignments, expectations of student behavior, and learning objectives; however, variables change and cannot always be controlled. Schedules can be erratic, lessons do not always go as planned, students understand content at varying degrees, and interruptions can affect student behavior and learning. To reach and teach all students, teachers need to develop instructional strategies to guide and direct student learning and behavior (Darling-Hammond, 2008). Simulations can provide learning characteristics that include repeatability, automated analysis, reflective examination, and transfer of skills to the real classroom (Mayrath, Clarke-Midura, & Robinson, 2012).

The authentic and relevant scenarios in simulations model the diverse learning needs of students in both behavioral and academic situations (Badiee & Kaufmann, 2014). Two goals for the use of simulations in teacher education consist of: 1) producing better teachers, and 2) building operational models of physical, emotional, cognitive, social, and organizational theories concerned with teaching and learning (Brave & Nass, 2003).

Four advantages of simulations are identified by Badiee and Kaufmann (2014):

- practice classroom decision-making
- practice through repetition, receiving feedback, and making adjustments
- increased self-efficacy of skills
- peer collaboration and social interactions.

Through these types of experiences pre-service teachers may apply theory to learning situations and develop a realistic application of the theory in a controlled setting (Fischler, 2006).

SIMSCHOOL

Simschool is a virtual simulation where pre-service teachers construct knowledge through experimentation of learning situations and acquire new skills. It is a tool for pre-service teachers to develop know-how, or heuristic knowledge (Christensen, Knezek, Tyler-Wood, & Gibson, 2011) through repeated practice in the simulator.

Gibson and Kruse (2012) explain how participants may develop heuristic knowledge in a simulation: "People who practice with a simulator develop heuristic knowledge of the underlying theories because the immersive multimedia experience tap into physical, emotional, and cognitive pathways, heightening the sense of importance of the experience" (p. 1145).

SimSchool had more than 13,000 registered users in over 156 countries (2015). The use of simSchool has been shown to demonstrate benefits to teacher preparation candidates in the areas of classroom management (Christensen, Knezek, Patterson, Wickstrom, Overall & Hettler, 2007), teaching skills (Gibson, Christensen, Tyler-Wood, & Knezek, 2011), connecting teaching and learning (Girod & Girod, 2008), motivation (Tyler-Wood, Knezek, & Christensen, 2007), and instructional self-efficacy (Christensen et al., 2011; Knezek & Christensen, 2009).

This article will guide the reader through a simSchool experience to explore an example of the "Personality Plus Higher-Order Thinking" module where pre-service teachers play in the simulator to discover insights about their personality traits in teaching and levels of critical thinking. As a result, pre-service teachers construct their own knowledge through the experience with various outcomes of the development of heuristic knowledge.

Overview of SimSchool Module

The simSchool module was taught to two groups of pre-service teachers in an undergraduate technology integration course at a mid-southwestern university. Thirty-seven students spent six hours working on two sessions of the module. Table 1 is an overview of the simSchool module and the step-by-step process that the students experienced.

Table 1

The simSchool Module Divided into Two 3-Hour Sessions

simSchool Module			
Session 1		**Session 2**	
Activity	**Time**	**Activity**	**Time**
Registration	15 min	Teacher Talk	30 min
Introduction	30 min	Bloom's Taxonomy	30 min
Everly's Bad Day	30 min	simSchool & Bloom's	15 min
Everly's Better Day	30 min	Lesson Part 1	30 min
OCEAN Variables	30 min	Lesson Part 2	30 min
Creating Yourself	30 min	Lesson Part 3	30 min
Reflection	15 min	Reflection	15 min

SESSION ONE

The goal in Session 1 is to introduce pre-service teachers to simSchool and to connect personality traits with teaching and learning styles. A team of two pre-service teachers completed two simulations on a student named Everly. The team followed lesson plans, observed student activities, interacted with the student, and received feedback on their teaching. After the first simulation, they adjusted the lesson to improve student achievement. The learning objectives for the module are for pre-service teachers to realize that every student learns differently and for the pre-service teacher to see themselves as a student, think about their own personality, and gain awareness of how they learn. To learn about their simStudent's personality, pre-service teachers were introduced to the Five-Factor Model of Personality and took the OCEAN survey. From the survey, pre-service teachers

determined the degree to which a personality trait was present. Pre-service teachers created a simStudent using their own personality profile and taught themselves lessons. This process modeled how pre-service teachers can link personality to learning to develop patterns for exploring student personalities and the effect pre-service teachers have on learning in simSchool.

Registration

First-time users of simSchool register at www.simschool.org. Students use a classroom code provided by their instructor to sign into their specific course. The instructor has access to student activity and records in simSchool. During the registration process, students are prompted to take a short pre-test on the *Survey of Teaching Skills* (Gibson, Riedel, & Halverson, 2006). Participants rate their levels of confidence and experience in eight teaching areas using a five-item scale which includes measurements of very low, moderately low, medium, moderately high, and very high. The eight teaching areas include:

- knowledge of students
- pre-planning instruction
- making and using tasks
- making and using assessments
- re-planning instruction
- classroom decision-making
- making and using a post-assessment
- reflections on teaching.

Introduction

In the introduction the instructor gives a brief overview of a teaching experience in simSchool and the science behind simSchool. In simSchool, a teaching experience consists of the four components outlined below:

1. Teacher Observation of Student Behaviors. Student behaviors, such as body posture and verbal responses, offer clues to a student's state of attention. They are observable variables because they can be seen and read by the teacher and they give clues of a student's internal state.

2. Teacher Interaction with Students. Teachers can interact with students by assigning tasks and talking to students. The types, length, and order of tasks impact students in different ways. How a teacher interacts with students verbally can impact students as well. A teacher may ask questions or state observations or assertions through scripted responses about an academic or behavioral issue. Both tasks and teacher talk are independent variables.

3. Student Outcomes. Moment-by-moment and historical reactions of students are recorded in simSchool to create the student outcomes. Student outcomes are the dependent variables.

4. Student Personalities. These are the emotional, physical, and cognitive components that make up a student personality in simSchool. The VAK model or visual, auditory, and kinesthetic theory, represents the physical dimensions of the personality. The cognitive or academic dimension of a student is represented by expected academic performance. The Five-Factor Model of Personality or the OCEAN (mnemonic of the five factors described in Table 2) model represents the emotional personality. The specific OCEAN variables and values are hidden variables, but teachers will see potential actions and preferences by students which embody aspects of the particular OCEAN variable values.

Psychological Characteristics of SimSchool Personalities

The psychological characteristics of simStudents are known as the OCEAN model (McCrae & Costa, 1996) based on the Five-Factor Model of Personality (Digman, 1990). Each of the factors has a high and low end on a continuum. For example, the “E” stands for extraversion or the degree to which a person can tolerate sensory stimulation from people and situations. On the high end of the continuum, a person prefers to be around other people and involved in many activities. On the low end of the continuum, a person prefers to work alone and is more serious, skeptical, quiet, and private. SimStudents fall into a range from -1 to +1, with 0 at the center for each of the personality traits. The psychological characteristics are presented to the simSchool players in the form of a narrative that divides the characteristics into one of five positions. For example, with extraversion, a simStudent could be described as extraverted or introverted, moderately extraverted or moderately introverted, or balanced in extraversion. Table 2 describes the OCEAN personality traits illustrating the low and high end of each trait. The table is adapted from Howard & Howard, 2000 and Gibson 2007.

Table 2
The Low Degree and High Degree of the OCEAN Personality Traits Used in simSchool

Personality Trait	Low Degree	High Degree
Openness	conservative, practical, efficient	varied interests, embraces change, curious, gets bored easily
Conscientiousness	spontaneous, multitasker, flexible, less organized	disciplined, task and goal oriented, dependable, organized
Extraversion	introverted, private, reserved, inhibited	social, involved in many activities, likes to be around people, active, outgoing
Agreeableness	questioning, competitive, proud	tolerant, accepting of others, kind, gentle, trustworthy
Neuroticism	content, controlled, easy going,	more negative emotions, increased stress, less satisfaction

SimSchool Teaching Experience

A teaching experience is part of a learning module with specific lesson objectives that can involve any number of students from 1 to 18. Participants begin by reading student reports that detail the starting state of the student personalities. The reports are updated (and hidden during play) by teacher choices of tasks and talking, learning preferences, and academic records. Tasks or groups of tasks, based on hierarchical thinking skills similar to Bloom's Taxonomy (Krathwohl, Bloom, & Masia, 1964), include recall, skills and concepts, strategic thinking, or extended thinking activities. Students respond differently to assorted tasks through body language and comments that represent various states of attention. Participants interact with students by negotiating power and affiliation using the Interpersonal Circumplex, a model used for teacher comments in simSchool. These interactions are recorded as feedback and participants receive feedback on their teaching experience that measures academic gains and losses of student learning. The feedback report examines the moment-to-moment changes to

evaluate how individual decisions affected the learning outcomes. Validation studies have shown reasonably good tracking of the simulation model to real student outcomes (Gibson, 2014; Knezek, Christensen, Wickstrom, & Hettler, 2008). These moment-to-moment changes reflect feasible impacts of the decisions that teachers make in a real classroom.

Everly's Bad Day

Following the brief introduction to simSchool, participants initiate their first teaching experience in the simulator. In teams of two, participants work together on one computer. One participant is in simSchool while the other is reviewing the lesson plans. Together, they familiarize themselves with the simulated classroom, discuss the background of their student Everly, and review the lesson objectives.

Simulated classroom. The simSchool classroom offers a variety of tools and resources for participants to use to simulate a teaching experience. The classroom shown in Figure 1 is easy to navigate and provides an intuitive learning environment for pre-service and in-service teachers.

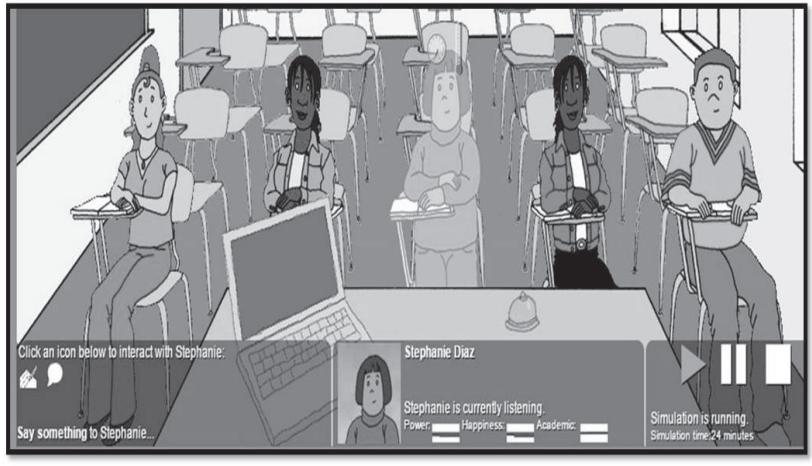

Figure 1. The simSchool classroom allows participants to begin, pause, and stop the game, view feedback reports, talk to students, assign tasks, and monitor students.

Student Background

The information contained in the background report is generated in simSchool using the Five Factor Model of Personality, VAK model, and expected academic performance. An example of a background report is illustrated in Figure 2.

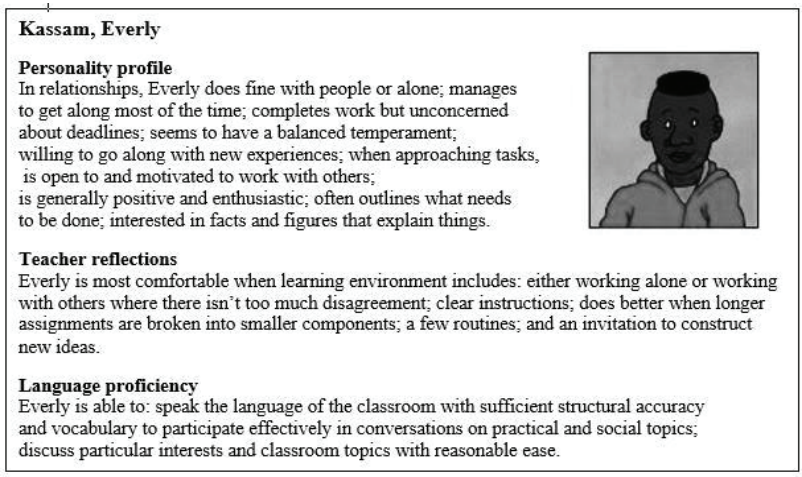

Figure 2. Student background report for teacher use.

Lesson objectives. After the participants familiarize themselves with the student records, they check their lesson plans. The plan for this lesson was predetermined for Everly and contains the following instructions:

- go over last week's lessons (15 simMinutes)
- take notes during lecture (15 simMinutes)
- take an oral quiz (15 simMinutes).

The simulated classrooms have room for up to 18 students; however, lessons with smaller groups of students allow participants to experiment with several variables in lessons. Everly is being taught in a classroom with other students, but the pre-service teachers are concerned only with Everly, and monitor his learning and behavior. To begin the simulation, the participants select the first task for Everly to go over last week's lesson for 15 minutes (one simMinute is equal to 10 seconds of real time).

While Everly is going over last week's lesson, the pre-service teachers can monitor his power, happiness, and academic changes. They can check

the thermometer to see how well the task is suited to Everly and the speedometer to see his progress with the task. After 15 minutes, the pre-service teacher will change the task to take notes during a lecture. In the final 15 minutes of class, Everly will take an oral quiz. Now the lesson is complete. The pre-service teachers view the feedback report to see the outcome of the lesson.

The feedback report is divided into sections by tasks and shows the length of each task in simMinutes (10 seconds = 1 simMinute) on the x axis and academic gain or losses (changes over time from starting position) on the y axis, as shown in Figure 3.

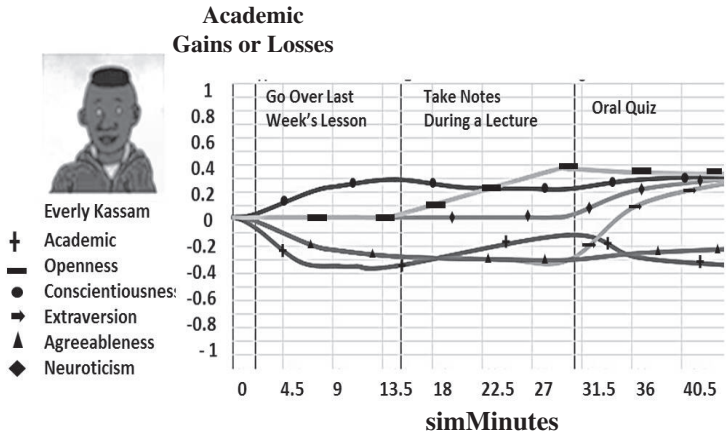

Figure 3. Everly's feedback report.

Task characteristics are described in *SimMentoring: Guiding Development from Virtual to Real Virtual to Real Teaching* (Hettler et al., 2008):

> Tasks exert performance requirements independently on each student, causing some to learn and others to be stymied or get bored. The six task dimensions align (1:1) with the personality and academic performance dimensions of the simulated students (p. 51).

Pre-service teachers need to examine the feedback to conjecture why Everly performed as he did and what the teacher could do to improve his learning. Everly's academics were low through most of the lesson and only slightly increased while taking notes. Everly was persistent through most of the lesson. His agreeableness was extremely low. Criteria—such as the length of a task, the order of the tasks, and the types of tasks—impact Everly's performance. If the student had more time on a task, would the student

learn the lesson quickly, and then become bored? If the tasks were presented in a different order, would the lesson be more effective? At this point in the module, pre-service teachers are asked to review the feedback report, re-read Everly's background report, and review the types of tasks in simSchool. Based on feedback and student team discussions, pre-service teachers make adjustments to improve learning for the next lesson.

Tasks. The simSchool tasks are grouped by four skill levels and as the level of tasks increase, the level of critical thinking required of students increases. Four skill levels are described (Hettler, et al., 2008).

- Level 1: Recall – identify, recognize, recall (p. 50)
- Level 2: Skills/Concepts – classify, organize, estimate, make observations, collect and display data, collect data, explain, describe, interpret (p. 50)
- Level 3: Strategic Thinking – explain thinking, draw conclusions from observations, cite evidence, develop logical arguments, explain phenomena in terms of concepts, use concepts to solve problems (p. 50)
- Level 4: Extended Thinking – design and conduct experiments, make connections between a finding and related concepts and phenomena, combine and synthesize ideas into new concepts, critique experimental designs (p. 51).

Table 3

Illustration of Tasks Taught in Each Skill Level

Level 1 - Recall	Level 2 - Skill/Concept	Level 3 - Strategic Thinking	Level 4 - Extended Thinking
Do nothing Take an oral quiz Take a pop quiz Give a brief presentation from memory Recite a lengthy poem Take a written test	Read silently Participate in whole-class oral response Do a team worksheet Apply a formula	Take notes Play a game Analyze text Create a graphic Compare and contrast Design on multiple criteria	Lead class discussion Make a creative product Develop a project plan Develop a hypothesis

Everly's Adjusted Lesson

In this activity, pre-service teachers were asked to:

- review the different types of tasks and consider how to improve Everly's academics and performance in a 30-minute simulation
- compare the adjusted lesson plan to Everly's bad day.

How did his performance improve or not improve? Why do you think it improved or didn't improve? What would you do next with Everly and

why? An example of a feedback report of an adjusted lesson by a team of two pre-service teachers is shown in Figure 4.

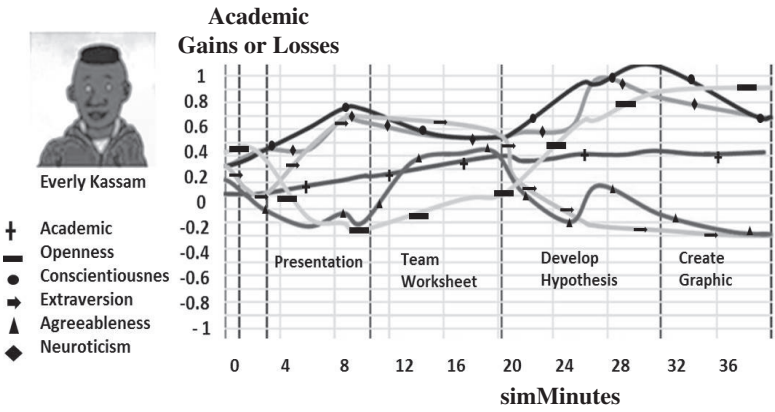

Figure 4. Everly's adjusted feedback report.

Questions were answered individually, as shown in the example text. Team A pre-service teachers shared their reflection from the simulation:

> Everly's overall performance improved. I think this is because I tried to choose activities that I felt he would be more interested in. I had him do a presentation from memory, team worksheet, hypothesis, and graphic design. I chose these activities because on the computer it said that Everly liked talking with others, being creative, and making new ideas. I also tried to correct his behavior when he was distracting others which I did not do in the bad day simulation. The teacher effectiveness (a score that summarizes the impacts of interactions on the student's academic change over time) increased instead of decreasing like it did on the bad day. He also showed an increase in academics, intellect, persistence, and emotion. These had mostly decreased on his bad day. However, his agreeableness and extraversion decreased more during this simulation than it did on his bad day. I think this may be because at one point I told him to get back to work now which seemed to upset him. Also, I think the activities that I gave him were very challenging, and I did not prepare him enough for them which is why most task performances were far above his ability and he received low grades.

In simSchool, pre-service teachers become aware of the trade-offs between academic outcomes and social/behavioral issues. In the example above, the pre-service teacher experienced a trade-off when making a classroom decision, which prompted reflection about the value of balancing the impacts of a teacher's interaction with a student.

OCEAN Personality

The purpose of the OCEAN section of the module is to familiarize pre-service teachers with the Five Factor Model of Personality (OCEAN), and for:

- pre-service teachers to gain insight into their own personality traits to connect personality with learning
- pre-service teachers to gain insight into individual personality traits of students to connect personality with teaching.

Participants complete an online OCEAN survey to discover significant traits in their own personalities. In simSchool, pre-service teachers create a simulated version of their personality based on the results of the survey. They choose two tasks to teach themselves. Through this activity, pre-service teachers develop a connection between personality traits, their own learning, and how students learn.

OCEAN Survey. The OCEAN survey functions as a self-report measure of one's openness, conscientiousness, extraversion, agreeableness, and neuroticism. It is a 30-item instrument that measures the five personality traits based on how much of the trait is present in one's personality (Gibson, 2011). Participants rate their personality traits using a five-item scale ranging from strongly disagree to strongly agree. The responses are weighted numerically with strongly disagree as 1 and strongly agree as 5. The survey includes six questions in each of the five constructs as shown in Table 4. The range of scores in each construct varies from 6 to 30.

Table 4

Questions from the OCEAN Survey

	SD - D - N - A - SA (Strongly Disagree - Disagree - Neutral - Agree - Strongly Agree)	
1.	I waste a lot of time before settling down to work	SD - D - N - A - SA
2.	I tend to assume the best about people	SD - D - N - A - SA
3.	Poetry has no effect on me	SD - D - N - A - SA
4.	I like to be where the action is	SD - D - N - A - SA
5.	I often feel helpless and want someone to rescue me	SD - D - N - A - SA
6.	I'm highly productive and usually get everything done	SD - D - N - A - SA

Create a Custom Student

Nearly 2 million different student personalities can be generated in simSchool. In addition, participants can create a custom student to simulate a student they may be teaching, or in this case, to simulate themselves. After completing the OCEAN survey, pre-service teachers define settings for their virtual selves. They enter gender, race, name, and laterality; choose a picture; and write a description based on the way they learn. They estimate their cognitive characteristics in academic and language proficiency and enter their affective and physical characteristics. A low affective trait does not mean the absence of a trait, but represents the opposite spectrum of the trait. For example, the low end of extraversion indicates the participant is more introverted than extroverted. This may translate into a student description that the student prefers working alone and not in groups. Because a student is more introverted, experimenting with group activities for that student can generate interesting outcomes. Keep in mind that simSchool assumes that all students desire to learn. If a student is introverted and has to complete a team worksheet he may be more extroverted in his performance with less anxiety outcomes because he feels comfortable with the group of students. In contrast, he may not choose to fully participate in the team worksheet and feel more anxiety in his performance outcomes if he is not comfortable with the group of students. Depending on the performance outcome, the pre-service teacher can adjust the task, groups, or talk more with the student during the activity to improve student learning. These are the type of intuitive judgements that are made throughout simSchool modules.

The student background report is generated from the information entered on this form. The report does not state personality traits; rather, it states actions that emulate a personality trait. For example, “Everly prefers to work alone on projects” as opposed to “Everly is introverted.”

Teach Yourself

Participants selected two 15-minute (simTime) tasks—one they think they will excel in, and another task that may be more challenging. Pre-service teachers reviewed the performance outcomes and explored questions. Based on their responses, pre-service teachers adjusted the tasks and repeated the simulation. The purpose of the activity was for the pre-service teacher to see themselves as a student, think about their personality, and gain awareness of how they learn best. This process models how pre-service

teachers link personality to learning and develop a pattern for exploring student personalities and the effect they have on learning in simSchool.

Reflection

Pre-service teachers expressed examples in their reflections of know-how that they acquired through their Session 1 simSchool experience. One example reads:

> In both simulations, I observed the significance of positive student-teacher communication because helpful and encouraging comments helped each student do better with the activity assigned to them. SimSchool improved my teaching skills by helping me determine what methods work and what methods do not work. Also, I learned how to adjust lesson plans that did not go over well with certain students, as well as making assessments throughout the activity to see if a student is grasping the material, and how to use comments to encourage students and increase their ability to learn a certain concept. Finally, I learned to make sure to plan activities that support each student's behavior, interests, and academic abilities.

Summary of Session One

In Session 1, the class compared and contrasted the lesson outcomes of their proposed lesson adjustments for Everly. Through this dialogue, pre-service teachers were able to determine several effective lesson plans to try next for Everly. These mini-experiments allowed pre-service teachers to examine feedback from their teammate, class peers, and the instructor to make their own educated guesses about adjusting the student scenario. Pre-service teachers realized that there is not one right answer that each teacher should discover, but there are many different options that will help Everly to learn, and the discussion allowed pre-service teachers to share those options to think about ways to improve learning.

In addition to being introduced to the simSchool classroom, the overall objective in Session 1 is for pre-service teachers to connect personality with teaching and learning and to realize that every student is different, and therefore learns differently. Interaction between the teacher and the students has just begun in the simSchool classroom and pre-service teachers are beginning to discover strategies for teaching. This can be a moment of excitement for the pre-service teachers because they are developing some

know-how and may begin to feel empowered. Yet, at the same time, it may be extremely frustrating because they recognize the complexities of teaching; with so many students and so many personalities, how is it possible to plan instruction to benefit all learners? This is where Session 2 begins.

SESSION TWO

Session 2 builds upon the skills that the pre-service teachers learned in Session 1 to consider how student personality traits influence student academic outcomes of teacher-planned lessons. The learning objectives in Session 2 are to structure activities that engage and challenge the learners through the use of curriculum resources to purposefully create lessons that include remembering, application, and creativity. Pre-service teachers receive feedback and compare how students responded differently to each lesson. They analyze student performance and then adjust the lessons to improve student achievement. In Session 2, pre-service teachers increase their level of interaction with students through mini-lessons. They experiment with the two components of interaction that they can control by learning more about teacher talk and task development using ordered thinking.

Teacher Talk

Teacher talk allows the teacher to verbally communicate with the students and can set off all types of reactions in students. A kind word about student performance can encourage a student to work harder, whereas a harsh comment could shut a student off to learning. How teachers interact with students through the words they choose and the tone they use directly affects student performance. SimSchool provides a classroom where pre-service teachers can experiment with different types of comments from dominant-friendly to aloof-submissive.

Exploring the Interpersonal Circumplex as shown in Figure 5 provides pre-service teachers practice of know-how to balance power and affiliation when interacting with students.

The Interpersonal Circumplex is explained in the *SimMentoring: Guiding Development from Virtual to Real Teaching* (Hettler et al, 2008):

> Teacher conversations are organized into 16 categories arranged along two axes of the Interpersonal Circumplex: power (dominant – submissive) and affiliation (hostile – friendly). The player decides whether the conversation should be warm or cool (affiliation), and wielding power or empowering the student (power) each time they interact with a simStudent. (pg. 30).

Examples of the actual behavioral and academic assertion comments available in simSchool are shown in Figure 6.

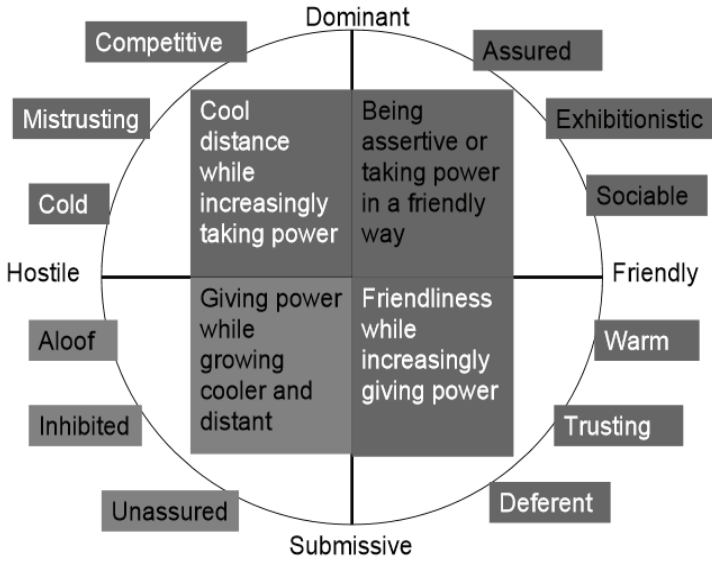

Figure 5. Interpersonal Circumplex model used for teacher comments in simSchool.

AVAILABLE COMMENTS in SIMSCHOOL

B! = Behavioral Assertion	A! = Academic Assertion
GREEN	**GREEN**
Get back to work now.	Evaluate the question first
You just earned two point toward the pizza party	You can understand this
I need your attention	Look at this example
You're setting a good example for others	Let's think about what we did
BROWN	**BROWN**
You're being so good, it makes me feel great.	Your restatement was clear
I don't really want to make you stay after school.	Great! I couldn't have explained it better
I am sure you can get your work done on time.	Your idea seems valid
RED	**RED**
Do you want to lose your recess?	I never would have thought of that
If I tell you one more time to stop...	Tell me what you need to get started
Go to the office.	Maybe I should go over it again
I can't believe you are still acting this way!	Can't give you that information
BLUE	**BLUE**
You just lost your privileges.	That report can't be your best
Move your seat.	Stop it right now
Detention for you, see you after school.	You need to recall those details
Put your head down on your desk.	I don't think you get it
Stop that!	Pull out your rubric sheet

Figure 6. Behavioral and Academic Assertion comments in simSchool.

Comments are color-coded with the Interpersonal Circumplex to indicate the degree of power and affiliation. Green emphasizes being assertive or taking power in a friendly way. Brown emphasizes friendliness while increasingly giving power. Red emphasizes giving power while growing cooler and distant and blue emphasizes cool distance while increasingly taking power (Hettler et al., 2008).

The actual words in the comments are not as important as the tone of the comment. The tone that the teacher uses to convey the comment influences the student response. The tone is expressed by where the comments lie on the Interpersonal Circumplex as shown in Figure 5.

Ordered Thinking

Bloom's Taxonomy, developed by Benjamin Bloom in 1956, is a multitiered model of six cognitive thinking levels that provide a framework for educators to plan instruction. It is a classification of student behaviors or the ways in which a student should act, think, or feel, as a result of an instructional unit (Bloom, 1956).

The original taxonomy states each skill as a noun to illustrate the ordered thinking process. The revised taxonomy states each skill as a verb and is arranged from lower-order thinking (LOTS) to higher-order thinking skills (HOTS); the skills increase in critical thinking and build on the previous skills. The six skills are remembering, understanding, applying, analyzing, evaluating, and creating as shown in Figure 7.

Norman Webb's Depth of Knowledge (DoK) levels measure the complexity of tasks and, like Bloom's, uses a common language to describe each level (Webb, 2002). DoK is divided into four skill levels (as covered in the tasks section of this text) and are used to classify tasks in simSchool.

Each level is associated with a number of verbs that further explains the types of activities implemented from lower to higher levels of thinking. Pre-service teachers learn to use both ordered thinking processes to plan lessons to meet learning objectives. Some overlap exists between DoK skill levels in simSchool and Bloom's Taxonomy as shown in Figure 7.

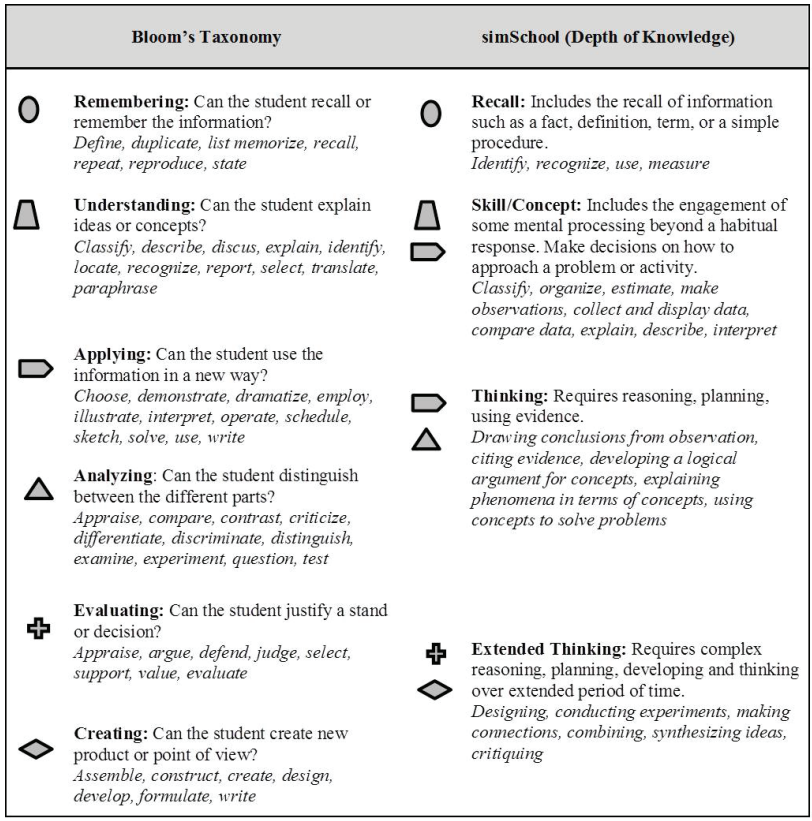

Figure 7. Comparison of traits of Bloom's Taxonomy and simSchool (DoK).

In the module, pre-service teachers worked in teams of two on a three-part lesson to teach a virtual class of five students using a collaborative wiki to record their results. Pre-service teachers taught recall lessons and extended thinking lessons to compare and contrast student outcomes, and then combined thinking levels to create the best lesson for the two students. This required pre-service teachers to consider the two components that they could control in simSchool: teacher tasks and teacher talk. The types of tasks, lengths of tasks, order of tasks for two students with varying abilities, personalities, interests, and behaviors needed to be planned by the pre-service teachers. In addition, teacher comments that included behavioral and academic assertions, questions, and observations had to be thought out. How do teacher comments encourage or discourage students with varying abilities, personalities, interests, and behaviors?

The process required the pre-service teachers to observe, interact, and make quick decisions about student behaviors. They had to compare, analyze, adjust, and design activities to improve student learning. The learning process in the module had a dual-layered outcome for the pre-service teachers and modeled the skills used in higher-order thinking activities. Pre-service teachers planned lower- and higher-order thinking activities for their students and also participated in activities that required them to use strategic and extended thinking skills. The first activity involved a recall/skill and concept lesson.

Lesson 1: Recall/Skill and Concept

An example of a team of pre-service teachers' teaching outcomes will be illustrated in each lesson to demonstrate the process they used. In Lesson 1, pre-service teachers chose two students to teach and reviewed their personality, teacher reflections, language proficiencies, and academic comments found on the background report as shown in Table 5.

Table 5

Example of Student Personality, Teacher Reflections, Language Proficiencies, and Academics of Two simStudents

Student	Personality	Teacher Reflections	Language Proficiencies	Academics
Marcus Arnold	Good student, self -confident, outgoing, and follows instructions	Small group activities, outside stimulation, and social interaction	Native speaker	Mainly A's
Linda Jenkins	Likes her private space, usually outgoing, follows instructions, likes to work alone on one thing at a time, and good self esteem	Likes a quiet classroom, likes to work alone, and is ok with small groups	Occasionally mixed errors on pronunciation and grammar	All B's

The more background information that a teacher knows about a student, the more the teacher can help them learn. If the learning objective is to complete an oral presentation, there may be many students that do not like speaking in front of the class. Some students may be completely out of their comfort zone, i.e., the oral presentation may be uncomfortable for some students. By understanding background information about the students, the teacher is equipped with knowledge that provides the foresight to encourage those students through the activity to try to set them at ease. Students will not always like every activity and that is where know-how will provide the pre-service teacher with strategies to turn a disagreeable student into one who grows through engagement in an activity. In simSchool, just as in a real classroom, simStudents change over time and may become more comfortable with an activity, depending on the type of teaching that takes place in the simClassroom.

Pre-service teachers chose two to three recall/skills and concept activities. The Bloom's Taxonomy equivalency thinking levels are remembering, understanding, and applying. Silent reading, an oral presentation, and an oral quiz were the activities chosen for Marcus and Linda. The feedback report in Figure 8 illustrates the outcomes of Lesson 1.

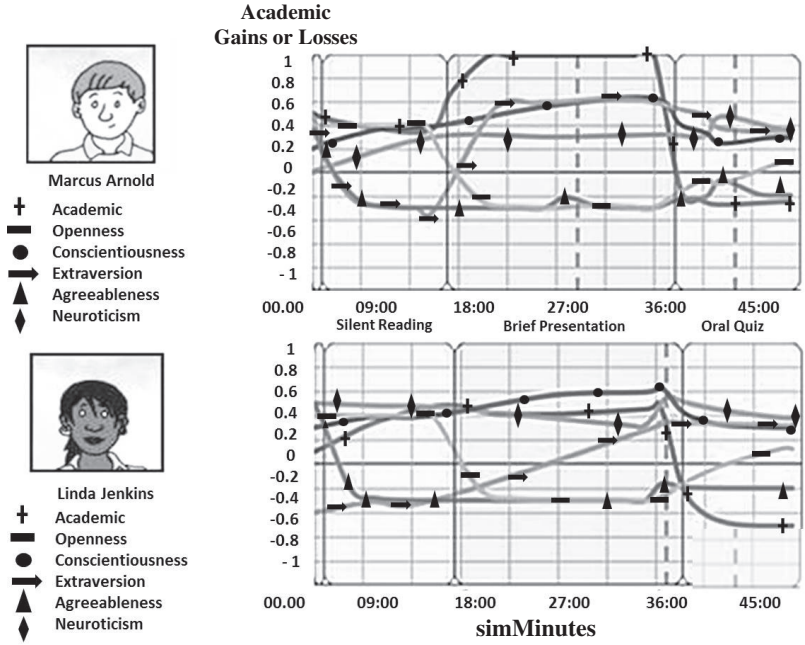

Figure 8. Feedback report for Marcus and Linda from the recall activity in simSchool.

The time, represented on the x axis, shows the entire lesson was 45 minutes. Students performed silent reading for 18 minutes, a brief presentation for 18 minutes, and an oral quiz for 9 minutes. The y axis represents the academic gains or losses. Gains take time to evolve; therefore, a player has to find the right balance between the length of an activity and learning outcomes. If an activity is too short, the student may not have enough time to improve learning; however, if an activity is too long, a student may get bored. An effective length of time for an activity may differ for various students. The midline of 0 on the y axis represents an expected performance, -1 represents below expectations, and +1 represents above expectations. Take into consideration when viewing the graph that some lines overlap. For example, on Marcus's graph agreeableness and extraversion overlap during the first part of the silent reading activity. The teacher comments and observations are shown in Table 6.

Table 6

Example of Pre-Service Teacher Team of Comments and Observations from the Recall Activity

Student	Teacher Comments	Observations
Marcus Arnold	• You earned 2 points for the pizza party. • I'm sure you can get your work done on time.	He finishes his work quickly, but then gets bored. Academics super high. When we did the oral quiz, he was distracting others and did not get back on task.
Linda Jenkins	• You are setting a good example for others.	She finished the silent reading very quickly, but took a little longer on the presentation. When we did the oral quiz, she was distracting others, but then got back on task.

Conclusions About the Lesson

The oral presentation was successful for both students and their academic levels stayed high throughout the activity. The oral quiz was not very effective. Both students performed poorly. The silent reading activity for Marcus made him use his intellect but intellect went down with the next two tasks, probably because they were too easy. Marcus doesn't like change and did not like the experience. His conscientiousness went up, his agreeableness was way low, but it was a good activity for him because he learned and was stable. Linda, on the other hand, did not like any of the activities. However, her academics, persistence, and extraversion increased with the first two activities. The oral quiz was not a good activity for Linda because most of her levels dropped.

Table 6 shows that this pre-service team chose friendly taking power and friendly giving power comments. They made the observation that Marcus gets bored easily based on his academics being extremely high and his agreeableness and openness decreasing to below average during the oral presentation. He can complete an oral presentation even though he is not open to the activity. In his background report, it states that he likes social interaction, but based on his feedback report he is not fond of speaking in front of the class. He is a conscientious student as well, so even though he does not like the assignment, he performs it well. When he got to the oral quiz, the teachers observed that he was distracting other students, and this is evident in his feedback report as both his conscientiousness and academics decreased.

Linda was engaged in the oral presentation as her conscientiousness was high, and like Marcus, her agreeableness and openness were low. She, too, did well on the presentation as her academics were above average. The pre-service teacher may conjecture that oral presentations are not the type of activity students are open to or agree to. However, conscientious students can perform well in this activity when taught how to do so, whereas, on the oral quiz, a pre-service teacher may surmise that the high academic students do not do well on an oral quiz. The teacher would check lower level students, as well, and then decide if an oral quiz is the best way to assess the class. Perhaps next time with this lesson, the teacher may try integrating hand-held clickers into the activity.

At the end of the recall lesson, the pre-service teachers have a better understanding of Marcus and Linda's academic performance and decide that they need to challenge them more with higher-level thinking activities.

Lesson 2: Strategic/Extended Thinking

In Lesson 2, pre-service teachers chose three strategic and extended thinking tasks to teach to Marcus and Linda. In Bloom's Taxonomy, these would be creating, evaluating, and analyzing. Teacher observations and comments are shown in Table 7.

Table 7
Pre-Service Teacher's Comments and Observations from the Strategic/Extended Thinking Activity in simSchool

simSchool Strategic and Extended Thinking Activities		
Student	**Teacher Comments**	**Observations**
Marcus Arnold	• Thumbs up	Marcus is participating. May need something more challenging. He liked the thumbs up. Marcus doesn't look happy while doing the team worksheet, but he is doing it. Marcus is doing homework for another class.
Linda Jenkins	• Smiles at Linda • How are you doing on the team worksheet?	Linda is not happy with the compare and contrast activity, but her academics are increasing. Linda is distracting others while analyzing the text.
Conclusions About the Lesson		
Overall, it went pretty well. Marcus and Linda performed well in the first and second task. Their intellect went down on the team worksheet. They did not like analyzing a text, even though they were academically engaged.		

The feedback for the 42-minute lesson is illustrated in Figure 9.

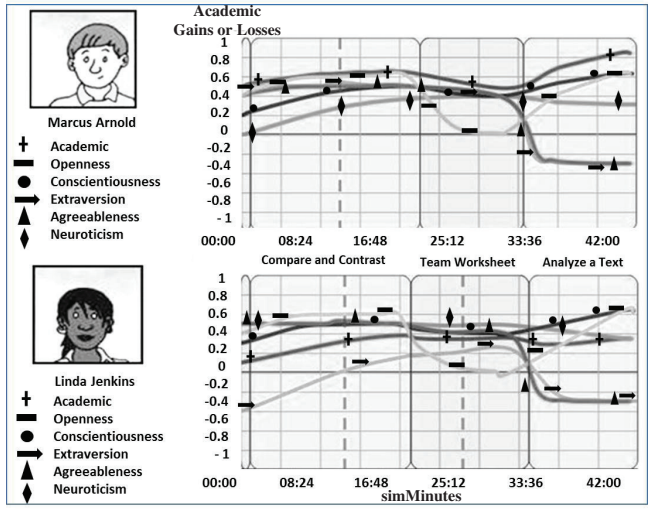

Figure 9. Feedback report for Marcus and Linda for the extended thinking activity in simSchool.

The tasks they chose were a compare and contrast (20 minutes), a team worksheet (13 minutes), and analyze a text (9 minutes). The pre-service teacher team continued to use friendly taking power and friendly giving power comments to encourage Marcus and Linda. Marcus performed well academically on all three tasks. He improved in every area during the compare and contrast activity. His openness decreased during the team worksheet and began to increase when analyzing a text, whereas his agreeableness and extraversion decreased. Because his academics and conscientiousness remained high, these three activities challenged and engaged him. Linda had a similar learning experience to Marcus, demonstrating good academic performance on all three tasks. In comparing the recall activities with the extended thinking activities, both students were higher in academics in the recall activities, yet lower in openness and agreeableness. In the extended thinking activities, both students were high in academics, openness, and agreeableness. This could suggest that the higher thinking activities engaged the students more.

Dialogue took place among the pre-service teachers as they compared the different tasks they assigned and student performance levels. These discussions emphasized the many teaching options for students, and that collaboration among peers and future colleagues may reinforce know-how in choosing the best pathway to student learning.

At this point in the module, the pre-service teachers reviewed the background information, the feedback graphs, and task options to plan their mixed thinking level lesson.

Lesson 3: Mixed Activity

In Lesson 3, pre-service teachers chose three activities at various levels of Bloom's Taxonomy to teach to Marcus and Linda. The tasks chosen by the pre-service team are listed in Table 8 and matched with the simSchool thinking level and the Bloom's Taxonomy thinking level.

Table 8

Mixed Activity Tasks Matched with simSchool and Bloom's Taxonomy Thinking Levels

Task	simSchool	Bloom's Taxonomy
Brief Presentation	Recall	Remembering
Creative Project	Extended Thinking	Creating
Design on Multiple Criteria	Strategic Thinking	Creating

The pre-service team chose one task that was previously performed successfully by Marcus and Linda and two new higher-level thinking tasks. They knew the students previously were not open or agreeable to the oral presentation, but performed it well. They also wanted to challenge Marcus and Linda with more creative activities. Table 9 illustrates comments used by the pre-service teacher team.

Table 9

Pre-Service Teacher's Comments and Observations from the Mixed Level Thinking Activity in simSchool

simSchool Mixed Level Activities: Brief Presentation, Make A Creative Project, Do A Design on Multiple Criteria		
Student	**Teacher Comments**	**Observations**
Marcus Arnold	• I need your attention • I can see how thorough your work is.	Marcus is distracting others while doing the first activity. After we made the first comment, Marcus was still distracting others. His academic is super high. Marcus liked the design on multiple criteria activity.
Linda Jenkins	• Do I need to show you? • I can see how thorough your work is. • Do you need help?	Linda is distracting others while doing the first activity. After we made the first comment, Linda started listening. She is finishing very quickly with the creative project. Linda does not enjoy the design on multiple criteria activity, but her academic is going up.
Conclusions About the Lesson		
They both did really well because their academic and conscientiousness stayed high throughout the activities. They both enjoyed designing multiple criteria even though Linda was distracted the whole time.		

The feedback for the 52-minute lesson is illustrated in Figure 10. The tasks they chose were a brief presentation (20 minutes), creative project (10 minutes), and design multiple criteria (22 minutes).

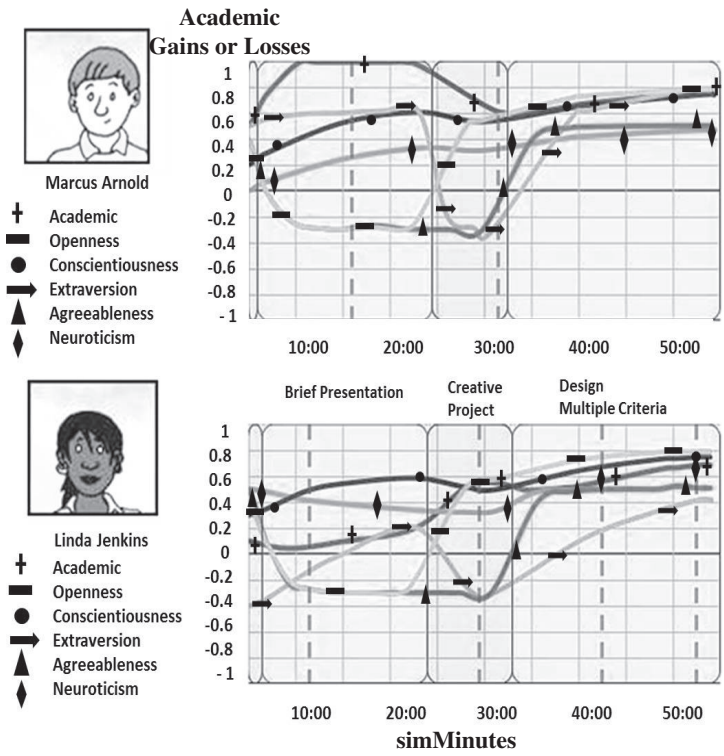

Figure 10. Feedback report for Marcus and Linda for the mixed level activity in simSchool

Marcus performed well in the brief presentation, decreased in academics during the creative project, and excelled in all areas of the design multiple criteria assignment. The length of the creative project was shorter than the other two tasks. Instruction time and focus can be lost when switching tasks so experimenting with the length of tasks when using higher thinking levels may improve learning and, given more time, Marcus may have performed higher on the creative project.

Linda's academics and conscientiousness improved throughout all the activities. The teacher observations noted that Linda did not appear to enjoy the design multiple criteria activity and was distracted; however, performance outcomes improved in all areas. Of all the activities she completed, including recall and strategic thinking activities from previous lessons, she performed her best on designing multiple criteria. This may suggest that

students can be learning even when they appear not to be. The reverse can be true as well. Students can appear to be learning when actually, they are distracted. Teacher interactions such as viewing work, asking questions, and commenting on behavior influences the student's performance levels.

The pre-service team wrote their final conclusions for Linda and Marcus:

> Linda and Marcus both have the ability to do well on the activities. If the activities were too easy, they were not engaged enough but seemed to perform well when we assigned them something more challenging. The level of extraversion does not directly relate to the academic level and they both were very persistent throughout all the activities. They performed better when the tasks were higher-level. We adjusted the tasks to fit their personalities so we would get a better outcome. The teacher effectiveness increased the more we interacted with the students. We tried to balance group and individual tasks as well with the individual personalities. When the activities were challenging, our students were more engaged and their academic levels went up, but if tasks were too easy they would lose interest and become off task. Based on the mixed ability graph we would implement something creative because they responded well to higher-level thinking. Bloom's Taxonomy helps the teacher to give a variety of different level tasks. Simschool challenges teachers to rethink their curriculum and their responses to students.

At the end of Session 2, pre-service teachers compared performance outcomes on the same students. For example, many pre-service teams taught Marcus, Linda, and Mary. They may have taught Marcus with Mary or Marcus with Linda. From the shared comments, Mary was harder to teach because she had difficulty with new information. Marcus was very conscientious when in class with Linda, but pre-service teachers observed that he was not conscientious in many activities in the class with Mary. Conversations moved towards how students are grouped and how all students in the class impact learning. Many organic discussions evolved from sharing and comparing performance outcomes. The insight gained from the discussions was valuable in the development of know-how of the pre-service teachers in simSchool.

CONCLUSION

Session 1 introduced pre-service teachers to the simSchool classroom. In addition, it provided knowledge for pre-service teachers to connect personality with learning from the role of a teacher and a learner. Session 2 introduced pre-service teachers to ordered thinking and provided teaching experiences for pre-service teachers to explore the thought processes used to plan, instruct, and analyze student performance. Session 2 built upon the skills that the pre-service teachers learned in Session 1 to consider how the personality traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism in students influence their academic outcomes of teacher-planned lessons. Structuring activities that engage and challenge the learner through the use of curriculum resources such as Bloom's Taxonomy and Depth of Knowledge provides pre-service teachers with strategies to create lessons that guide and direct student learning and behavior to impact different personalities of learners.

FEEDBACK

At the end of the module, pre-service teachers answered four questions about their simSchool experience and completed a post-test.

This section presents the questions with the student responses.

1. How engaging was simSchool?

Pre-service teachers had five choices ranging from very engaging to not very engaging. In the six hours that the pre-service teachers used simSchool, 84% of the students found simSchool to be either sufficiently engaging or very engaging and 16% found simSchool to be somewhat engaging.

2. How difficult were the simSchool modules?

Pre-service teachers participated in three modules during the two sessions of simSchool. One of the modules was a simSchool-created module and the other two modules were created by the simSchool trainer. Five responses to the questions were offered ranging from easy to very difficult. The findings show that 73% of the pre-service teachers thought the modules were neutral (not too easy or too difficult), 16% thought the modules were easy, and 11% responded that the modules were difficult.

3. Was simSchool worth the effort?

Responses from pre-service teachers show that 97% found simSchool to be worth the six hours of effort they put forth to complete the modules.

4. Would you recommend simSchool to a friend?

Responses from pre-service teachers show that 97% would recommend simSchool to a friend.

Most of the pre-service teachers found the simSchool modules to be engaging, not too easy or too difficult, worth the effort, and would recommend simSchool to a friend. A comment box was available for pre-service teachers to enter what they learned in the simSchool module and listed below are a few examples:

- We learned how different tasks affect different students. It was interesting how some students were being distracting and not participating, but they were actually learning, and vice versa.

- Comments made to one student affects all the other students in the class. I also learned that every student learns differently and that the effectiveness of the teacher comments depended upon the students' personalities.

- I learned how to adjust tasks to better fit individual needs.

- I learned how to apply different ways of teaching students who have different personalities and different needs in a classroom.

These comments show new insights about teaching that these pre-service teachers acquired during simSchool and may be evidence of the development of heuristic knowledge.

Conclusions from the Personality Plus Higher-Order Thinking Module

The learning process in the module had a dual-layered outcome for the pre-service teachers and modeled the skills used in higher-order thinking activities. Pre-service teachers planned lower- and higher-order thinking activities for their students and participated themselves in activities that required them to use strategic and extended thinking skills. Experiential interactions between the teacher and the virtual students provided constructivist learning activities to assist pre-service teachers in the discovery of new teaching strategies and the development of teaching know-how.

Implications

The "Personality Plus Higher-Order Thinking" module for use in teacher education programs may be far reaching. Pre-service teachers may develop new knowledge about themselves based on personality traits in the following ways:

- learn about their own personality traits and how those traits impact them as a learner
- learn about their own personality traits and how those traits impact them as a teacher
- make connections between the Five-Factor Model of Personality and experimentation with simStudents
- transfer theory into practice in an actual classroom.

In addition, pre-service teachers can develop new knowledge about how to interact with students based on personality traits, and can:

- impact student learning
- differentiate learning based on individualized needs
- group students based on personality traits and learning objectives
- teach their students about personality traits to empower them as learners.

Since teaching the "Personality Plus Higher-Order Thinking" module additional research on pedagogical balance has developed further findings on the benefits of simSchool. Research indicates that 6 to 8 hours of purposeful activities in the simulator may improve pedagogical balance of pre-service teachers (Knezek, Hopper, Christensen, Tyler-Wood, & Gibson, 2015). Pedagogical balance is defined as the difference between a teacher's confidence ratings and experience ratings for teaching (Hopper, Knezek, & Christensen, 2013; Hopper, Knezek, Christensen, Tyler-Wood, & Gibson, 2014). The pedagogical balance score may assist teacher educators by facilitating an understanding of candidates' perceptions of their teaching preparedness (Knezek et al., 2015).

Findings from these research studies support the following conclusions:

- pre-service teachers may overrate their confidence levels at pre-test time.
- pre-service teachers seem to gain teaching experience in simSchool.
- experience and confidence measures seem to become more balanced as a result of simSchool use.

- pre-service teachers seem to gain awareness of their teaching skills (or lack of) through the use of simSchool.

Future Work

In this paper, an in-depth overview of the "Personality Plus Higher-Order Thinking" module illustrated the processes pre-service teachers used to develop heuristic knowledge about personality traits and critical thinking skills in teaching. Future work to enhance the module with the addition of a pedagogical balance unit has been explored. Hopper (2015) created an overview of a new module "Personality plus Pedagogy: An Online Course for Pre-Service Teachers' Perception of Teaching Preparedness in a Simulated Classroom" that focuses on personality and critical thinking skills (as illustrated in this paper) and adapts pedagogical balance research. In the module, pedagogical balance is used as proficiency indicator for pre-service teachers to enable them to understand their individual alignment of teaching confidence and teaching experience, and address their perceptions of teaching preparedness. The development and use of this module could provide valuable insight for teacher education programs in the preparation of pre-service teachers.

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Susan Hopper is now an educational consultant in Dallas, Texas. Correspondence concerning this article should be addressed to Susan Hopper, sbhopper@msn.com. Acknowledgements to Linda McSwain for editing this article.

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