

A Design Framework for a Virtual Tutee System to Promote Academic Reading Engagement in a College Classroom

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Abstract: Poor academic reading habits among students in higher education have been commonly acknowledged. Pre-service teachers are not exceptions as they do not always complete assigned course readings and frequently exhibit a shallow level of reading strategies. This paper proposes one approach to improve college students' engagement in academic reading, a Virtual Tutee System (VTS). The VTS presents a Web-based peer-tutoring environment in which students take the role of tutor and teach a virtual avatar character. According to research on peer tutoring, students are likely to develop active engagement in learning when they adopt the role of a tutor. This paper provides an elaboration of the design framework of the VTS with design examples applied to a teacher-education course. The framework consists of four design principles, including component guidelines for each principle, grounded in role theory and self-determination theory. The peer tutoring literature is briefly reviewed along with two theories that provide the foundation of the VTS. The paper concludes with a presentation of the potential for the VTS in college classrooms and directions for future research.

Keywords: Peer tutoring; Reading engagement; College course reading; Pre-service teachers; Role theory; Self-determination theory

Introduction

In many college classes, students are assigned to read course texts before class (Hilton, Wilcox, Morrison, & Wiley, 2010; Tomasek, 2009). Although college instructors provide lectures to introduce major ideas and concepts in class, they cannot cover every detail of the materials students are supposed to learn, due to limited time and resources. The instructors thus expect students to study and learn through reading textbooks and other materials in order to gain familiarity with, as well as a deeper understanding of, the topic (Bramhall, 2009). As a result, textbooks and other supplementary readings are integral components of college learning

(Berry, Cook, Hill, & Stevens, 2011; Dávila & Talanquer, 2010). This is true of most college settings, regardless of how many educators would like to see a different learning paradigm in place.

However, a low level of engagement in course readings is commonly observed in college classrooms. A low completion rate of assigned readings has been reported at all levels of higher education from community college classrooms (e.g., Burgess, 2009) to graduate classes (e.g., Clump & Doll, 2007) as well as across different disciplines including accounting (e.g., Fitzpatrick & McConnell, 2009), psychology (e.g., McMinn, Tabor, Trihub, Taylor, & Dominguez, 2009),

education (e.g., Arquette, 2010), and chemistry (e.g., Smith & Jacobs, 2003). Moreover, college students invest minimum effort to complete course readings. For example, they seldom make notes or draw inferences while reading course materials and rely on skimming (Phillips & Phillips, 2007; Taraban, Rynearson, & Kerr, 2000). Even when studying for exams, college students tend to focus on memorizing and retaining information rather than understanding materials (Barnett, 2000).

This issue of poor academic reading engagement has been reported with pre-service teacher-students in teacher education as well. Lesley, Watson, and Elliot (2007) surveyed pre-service teachers with regard to their behaviors with, and attitudes toward, assigned readings and found strongly reluctant reading behaviors. Pre-service teachers reported that they disliked completing assigned readings; they either read part of them or decided not to read them at all. Furthermore, many pre-service teachers engaged in only a superficial level of reading, such as skimming and scanning, and indeed demonstrated a minimal understanding of the text. Similarly, Akyol and Ulusoy (2010) found that the majority of pre-service teachers not only spent an insufficient amount of time on course-related reading but also exhibited a limited use of reading strategies. Such low reading engagement among pre-service teachers has apparently persisted for years, as Gupta and Saravanan (1995) reported a similar issue more than 15 years ago: "Our (teacher) trainees rarely read, could not cope with their academic readings, and were unaware of effective strategies to manage their own reading" (p. 354).

Given that reading is fundamental to all domains of learning, teachers in any area should serve as good reading models for their students. Teachers' reading habits and attitudes influence those of students. For example, teachers who are enthusiastic about reading are more likely to demonstrate practices that promote students' engagement in reading (Morrison, Jacobs, & Swinyard, 1998). These teachers may encourage students to develop positive attitudes toward reading and use effective reading strategies. Hence, the development of good academic reading habits is critical for every teacher.

Poor academic reading engagement among pre-service teachers should have an adverse influence on their own learning. Numerous studies indicate that academic engagement is closely related to quality learning (see Fredricks, Blumenfeld, & Paris, 2004).

For example, Wigfield and colleagues (2008) found that the level of reading engagement positively influenced reading comprehension. Engaged readers usually demonstrate higher reading motivation and better use of reading strategies (Guthrie et al., 2004; Guthrie & Wigfield, 2000). Considering that college reading often involves extensive academic reading (Smith, Holliday, & Austin, 2010), reading engagement in higher education should have a significant influence on learning. Given the importance of the reading behaviors of pre-service teachers, intervention is needed to help future teachers engage in their own academic reading.

This paper proposes a virtual tutoring approach to improve the poor academic reading behaviors of pre-service teachers or college students through enhancing their engagement in course reading. Our approach to promoting reading engagement involves providing students with an opportunity to teach their peers, that is, *learning-by-teaching*. Learning-by-teaching (Gartner, Kohler, & Riessman, 1971) is a promising technique that can facilitate engagement in academic tasks. Learning-by-teaching refers to a process in which students learn more and better when they teach others. The effects of learning-by-teaching have been commonly reported in the literature on peer tutoring (Robinson, Schofield, & Steers-Wentzell, 2005; Roscoe & Chi, 2007). Prior research on peer tutoring indicated that students who serve as tutors of their peers not only enhance their own academic achievement but also show improvement in psychological and behavioral outcomes of learning (e.g., motivation and attitudes) (Miller, Topping, & Thurston, 2010; Keith J. Topping & Bryce, 2004; van Keer & Verhaeghe, 2005). Likewise, an opportunity to teach peers seems to have a positive influence on the quality of students' learning, including academic engagement as well as their performance. Even greater effects of a tutoring opportunity can be expected with pre-service teachers who presumably have high motivation for teaching.

However, learning-by-teaching, or peer tutoring, is seldom applied in a higher education setting. Peer tutoring in higher education is mostly implemented outside the classroom as a part of academic support services for students in need (e.g., Vogel, Fresko, & Wertheim, 2007) or in a format in which upper-level students provide additional assistance in class (e.g., Tang, Hernandez, & Adams, 2004). College students rarely have an opportunity to learn course materials by teaching their classmates. The dearth of peer

tutoring in college classrooms could be due to the way most college classes are structured. Unlike primary and secondary school classrooms, college students do not necessarily know fellow students, and they meet for only a few hours a week rather than on a daily basis. This arrangement presents a challenge, making it difficult for students to engage in meaningful interactions and build rapport with their classroom peers. Also, many college classrooms are lecture-based and involve a large number of students, which makes it difficult for instructors to create and oversee peer-tutoring or other group activities.

Given these constraints, a Virtual Tutee System (VTS) has been developed, which implements learning by teaching in a college classroom through the affordance of agent technology. The VTS is a Web-based peer-tutoring environment in which students become the tutor of a virtual agent who is represented as a peer student. The VTS introduced in this paper was developed specifically for a teacher-education course. In the VTS, students, or pre-service teachers, are required to teach a virtual peer about what they have learned from their course texts. The main strategy for promoting reading engagement embedded in the VTS is the incorporation of a learning-by-teaching process into reading tasks as described in more detail later in this paper.

The purpose of this paper is to provide the design rationale and framework for the VTS. The framework consists of four design principles, each of which is accompanied by component guidelines. These principles and guidelines are grounded in research on learning by teaching, role theory, and self-determination theory. In the following sections, the peer tutoring literature is briefly reviewed to describe the observed effects of learning by teaching. Next, two theories underlying the learning by teaching effect (i.e., role theory and self-determination theory) are discussed. Finally, the VTS design framework and its four design principles along with design examples are presented within the context of a college course teaching pre-service teachers to integrate technology in the classroom.

Previous Research on Peer Tutoring

Peer tutoring refers to one approach to educational practice in which students provide instruction to their peer students (Topping & Ehly, 1998). Numerous studies examining the effects of peer tutoring have indicated that students who are tutored improved their academic performance (e.g., Cook, Scruggs, Mastropieri,

& Casto, 1985; Ginsburg-Block, Rohrbeck, Lavigne, & Fantuzzo, 2008). Although a majority of the studies were conducted with elementary and secondary school students, other studies have also showed the effectiveness of peer tutoring with college students. For example, Lake (1999) reported that students in an advanced physiology class achieved a higher course grade when they received peer tutoring. Researchers note that the individualized instruction and immediate feedback available through peer tutoring are believed to enhance student performance (Dineen, Clark, & Risley, 1977).

Moreover, peer tutoring is not only beneficial for students who are tutored but also for those who provide tutoring. Wright and Cleary (2006) found that advanced elementary students (3rd and 4th grade) showed a substantial improvement in their reading fluency after teaching reading skills to students in the second and third grade. Similar effects were observed with college students. After 4th year medical students facilitated classroom discussions for 2nd year students, they demonstrated significant improvement in their own knowledge and skills (Tang et al., 2004). Rae and Baillie (2005) also reported that junior-year students who taught freshmen about college study skills improved their own study skills.

Furthermore, some studies have indicated that the benefits of peer tutoring are even greater for tutors than for tutees. In an experimental study by Annis (1983), college students were assigned to one of five conditions: (i) read only, (ii) read to teach but not actually teach, (iii) read and teach, (iv) be taught only, and (v) read and be taught, with the students in each group taking approximately 30 minutes to fulfill the given activities. One week later, students in all groups completed a reading comprehension test. The study found that students who had taught peer students outperformed those who had been taught but not served as tutors. More recent studies have also reported a stronger impact of peer tutoring on the performance of tutors than on that of tutees (Robinson et al., 2005; Roscoe & Chi, 2007; van Keer & Verhaeghe, 2005). For example, Knobe and colleagues (2010) compared the effects of peer teaching with those of instructor-led teaching on 3rd and 4th year medical students. Students who had served as student teachers significantly outperformed those who had been taught by either their peers or the instructor.

In addition to enhanced academic achievement, students who serve as tutors also tend to demonstrate high engagement in academic tasks. For example, col-

lege students spent time focusing on conceptual understanding of the materials rather than on rote learning as they prepared for tutoring (Galbraith & Winterbottom, 2011). Arco-Tirado, Fernández-Martín, and Fernández-Balboa (2011) similarly reported that students improved their use of cognitive and metacognitive strategies of learning after tutoring their peer students. Student tutors also exhibited an increase in time on task, assignment completion, and class participation (Cushing & Kennedy, 1997; Lieberman, Dunn, van der Mars, & McCubbin, 2000). Furthermore, many studies have reported that students become more confident about themselves as learners and develop positive attitudes toward academic tasks after tutoring their peers (Bierman & Furman, 1981; Cohen, Kulik, & Kulik, 1982; Franca, Kerr, Reitz, & Lambert, 1990; Greer & Polirstok, 1982; Topping, Campbell, Douglas, & Smith, 2003). For example, students reported greater enjoyment with and interest toward a subject that they were to teach as compared to instances when they were not engaged in any tutoring experience (Utay & Utay, 1997). Also, students increased their self-efficacy beliefs about an academic task on which they tutored their peers (Legrain, D'Arripe-Longueville, & Gernigon, 2003; van Keer & Verhaeghe, 2005). These studies imply that a tutoring activity facilitates students' engagement in learning, which may lead to enhanced academic performance.

Several studies have indicated that the expectation of teaching by itself, without actual teaching, can lead to enhanced learning of student tutors. In the Annis (1983) study previously described, superior learning gains were observed with students who read with the expectation of teaching as well as with those who actually taught their peers. Bargh and Schul (1980) also reported a similar finding that college students who prepared to teach yielded a higher performance on a retention test than those who studied the same reading material in order to learn it for themselves. Moreover, Benware and Deci (1984) found improvement in students' academic motivation and engagement following students' expectation of teaching. In Benware and Deci's study, college students in one group were asked to read an article as if they would teach the contents of the article to another student, but they did not actually teach other students. Students in the other group were told that they would have an exam on the same article. Results of the study indicated that students who studied the assigned article in order to teach expressed a higher task interest and enjoyment and a greater will-

ingness to devote additional time to the same task, when compared with those who studied in order to be examined. Also, students with the expectation of teaching perceived themselves to be more engaged with the learning environment. Benware and Deci (1984) concluded that preparation for teaching promotes more active engagement in learning with students taking the initiative and showing greater commitment to learning.

In short, peer tutoring contributes to the learning of both those students who serve as a tutor and those who are tutored, or are tutees, and the tutor seems to benefit more than the tutee from the tutoring activity. Student tutors tend to develop positive academic self-concepts and favorable learning attitudes and motivation, which should promote active engagement and enhanced learning outcomes. Several studies have indicated that these benefits of tutors could only be achieved with an expectation of future teaching before performing the actual teaching. Recently, some researchers have found that the deeper cognitive engagement of tutors, such as integration of new and prior knowledge and elaboration of knowledge, is the main source of the learning by teaching effect (Roscoe, 2008; Roscoe & Chi, 2007). However, the mechanism by which the learning by teaching environment promoted this deep level of engagement has rarely been discussed in the literature (e.g., Robinson et al., 2005; Roscoe, 2008). In the next section, this paper discusses role theory and self-determination theory (SDT) as two aspects of a theoretical framework to explain how the elements of learning by teaching contribute to a tutor's enhanced engagement and learning.

Theoretical Foundations of the Tutoring Effects

Role Theory

According to role theory, a role is associated with a set of specific behaviors and attitudes generally determined by society (Sarbin & Allen, 1968; Turner, 2002). When individuals assume any particular role, they are likely to behave and hold attitudes consistent with the assigned role and perceive themselves constrained by the expectations of other people (Sarbin & Allen, 1968; Thomas & Biddle, 1966). In the context of peer tutoring, students who serve as tutors adopt characteristics of the role similar to those of the teacher (Allen & Feldman, 1973; Hogg & Vaughan, 2005). Students with the tutor role thus perceive a responsibility for a tutee's learning and develop a commitment to learning, finding learning materials more useful and important than students without a tutoring role

(Robinson et al., 2005). Allen and Feldman (1976) suggested that the role of tutor also implies independence and authority in that the tutor has been recognized as having the capability to help others. Therefore, by taking on the role of a tutor, students perceive a greater competence with and control over a learning situation, as the role of tutor allows for a position wherein students can choose and determine what to learn and what to teach.

Self-Determination Theory

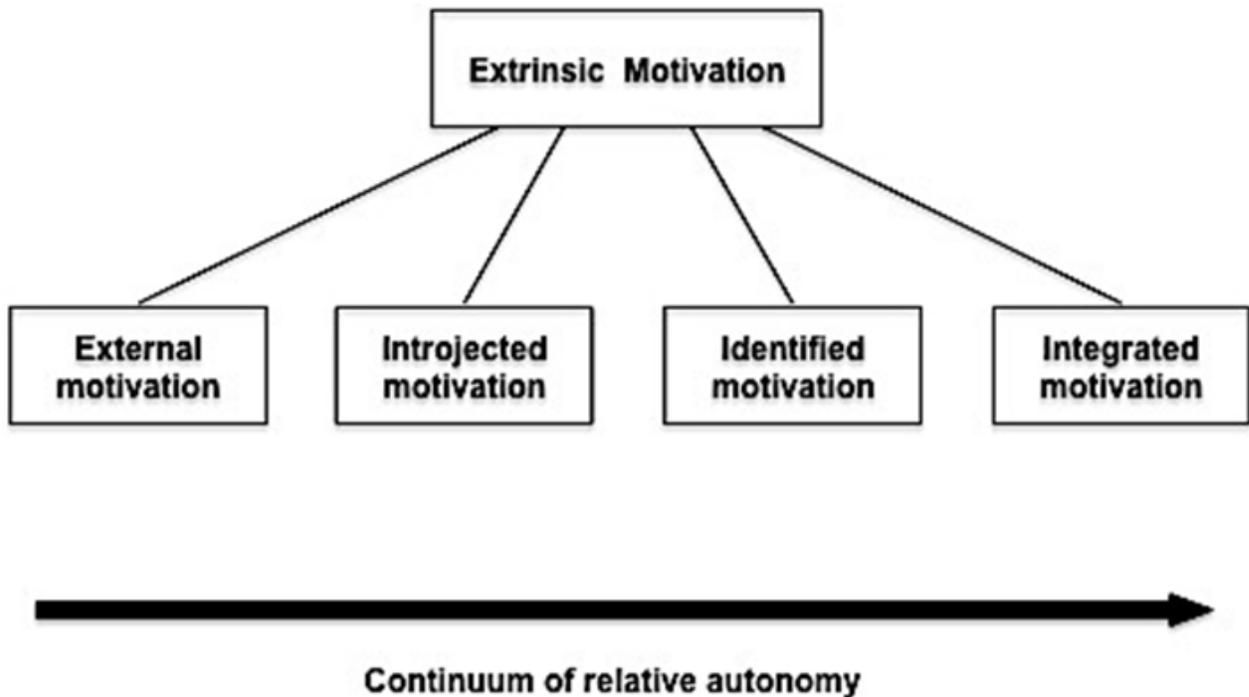
Self-determination theory (SDT), first proposed by Deci and Ryan (1985), further explicates how the adoption of the role of tutor can foster a student tutor’s engagement. According to SDT, human motivation can be categorized into different types. These diverse forms of motivation are closely related to the varying levels of engagement and learning outcomes. That is, certain types of motivation can lead to deeper engagement and learning. The two most basic types of motivation are *intrinsic motivation* and *extrinsic motivation* (Deci & Ryan, 1985). Intrinsic motivation refers to behaviors enacted for one’s inherent interest and enjoyment (R.M. Ryan & Deci, 2000). Such behaviors are thus experienced for the sake of an individual’s inner pleasure. On the other hand, extrinsically motivated behaviors are performed because they are instru-

mental to some outcomes separable from the activity itself (Ryan & Deci, 2000). For example, a student reads a textbook in order to get good grades rather than for the inner pleasure and satisfaction from reading.

It is natural for people to be likely to engage in activities in which they are interested. Thus, intrinsic motivation often results in active engagement and high-quality learning (Deci & Ryan, 2000). However, most learning-related activities are not inherently fun or interesting. For example, reading a textbook is probably not an intrinsically motivating activity for most college students. Rather, it is extrinsically motivating, for students usually read textbooks in order to receive higher scores on a test. Although not intrinsically motivated, students can show differing levels of engagement with an extrinsically motivating activity. According to Ryan and Deci (2000), “students can perform extrinsically motivated actions with resentment, resistance, and disinterest or, alternatively, with an attitude of willingness that reflects an inner acceptance of the value or utility of a task” (p.55). Self-determination theory thus introduces four different types of extrinsic motivation (see Figure 1).

The four forms of extrinsic motivation in SDT do not represent distinct categories but rather exist in a continuum (Ryan & Deci, 2000). They differ in the degree to which the motivation for one’s behavior

Figure 1. Types of extrinsic motivation (Adapted from Ryan & Deci, 2000).



arises from one's self or the motivation is self-determined. For example, *external motivation*, located at the far left in Figure 1, refers to behaviors performed in order to achieve a reward or avoid a punishment. An incentive of the externally motivated behavior thus lies outside the self, representing the least self-determined motivation. Another type of extrinsic motivation is *introjection*. *Introjected motivation* involves behaviors performed to avoid guilt or to attain a feeling of self-worth. This type of motivation is still not considered to be self-determined because the behaviors are instead initiated and controlled by internal pressure. On the other hand, *identified motivation* is signified when an individual recognizes the value of an activity and accepts it as personally important. For example, a college student might complete a textbook reading because he believes that it will help him master the course content, which is important for competence in more advanced courses. Finally, *integrated motivation*, at the far right of the continuum, is the most autonomous, self-determined form of extrinsic motivation. It occurs when the identified value of an activity is fully integrated with a part of the self. For example, a college student might apply for a study-abroad program because she can learn and appreciate the cultures of other countries, which is consistent with her deep-rooted values and interests.

Many studies have reported that greater autonomous and self-determined motivation, although extrinsic, yields deeper engagement and enhanced learning. Ryan and Connell (1989), for example, reported that the more students were externally motivated, the less they exhibited interest, endorsed the task's value, and/or exerted effort. Furthermore, identified motivation was correlated with enjoyment of school and adaptive coping styles, whereas introjected motivation was related to anxiety and negative coping strategies. Connell and Wellborn (1991) also found that elementary students with a greater autonomous motivation were rated as paying more attention, demonstrating on-task behavior, and being active in class. Black and Deci (2000) reported similar results - namely, college students who had a greater autonomous motivation for learning organic chemistry demonstrated a higher perceived competence, more enjoyment in class, and less anxiety. All of these studies indicate that the more autonomous, self-determined forms of extrinsic motivation are crucial for facilitating constructive and high-quality learning experiences.

Given these advantages of autonomous types of

extrinsic motivation, SDT is concerned with how non-intrinsically motivated behaviors can become internalized and self-determined. SDT introduces three basic psychological human needs that play a fundamental role in the development of autonomous motivation: the needs for autonomy, competence, and relatedness. In essence, greater autonomous motivation is facilitated if the learning environment is structured in a way that satisfies these innate human needs.

The need for competence refers to the need to feel efficacious. Individuals are more likely to sustain their motivation for a certain task when the task is structured in contexts that lead them toward feelings of competence. Optimal challenges and positive feedback, for example, contribute to the experience of perceived competence (Ryan & Deci, 2000). SDT further suggests that perceived competence alone does not promote internalization of extrinsic motivation; people must experience a sense of autonomy in addition to feelings of competence. A need for autonomy refers to a desire to experience one's behaviors as volitional and self-endorsed. Autonomy is closely related to a feeling of freedom to choose and determine one's own actions. Human autonomy can be supported by a provision of choices and acknowledgement of feelings but undermined by external rewards, threats, and evaluation pressure (Ryan & Deci, 2000). Lastly, the need for relatedness refers to the desire to experience a sense of belongingness and connectedness to others. People tend to engage in activities that are valued by their significant others or those to whom they want to feel connected (Deci, Vallerand, Pelletier, & Ryan, 1991). The need for relatedness can be supported when people feel respected and cared for during the activity.

Numerous studies have reported that students show more internalized extrinsic motivation and productive learning behaviors when the psychological needs for autonomy, competence, and relatedness are satisfied. For example, Chirkov and Ryan (2001) found that students who perceived autonomy support from their teachers and parents were more likely to show self-determined types of motivation. Reeve, Jang, Carrell, Jeon, and Barch (2004) also reported that high-school teachers who were trained to support students' autonomy demonstrated more autonomy-supportive behaviors and that students of these trained teachers showed a higher engagement in class. Moreover, Misrandino's (1996) study indicated the importance of support for competence. In this study, students with low perceived competence exhibited more negative

affect and lower engagement, even though they were academically high achievers in class. Furthermore, Furrer and Skinner (2003) studied feelings of relatedness among elementary-school students and their relation to academic engagement and performance. Results indicated that students who were more connected to their teachers and parents demonstrated greater engagement and higher performance. In sum, a classroom environment that supports the needs for autonomy, competence, and relatedness promotes more internalized, autonomous forms of extrinsic motivation, and accordingly, enhances student engagement and learning.

Returning to role theory, peer tutoring enables students who serve in the role of tutor to experience control over learning activities, or autonomy, as well as enhanced competence. Thus, peer tutoring seems to inherently support the needs for competence and autonomy. Benware and Deci (1984) found that when undergraduate students were expected to teach others, they were more intrinsically motivated and actively engaged with the learning environment. In addition, results of several studies have also supported that peer tutoring increases tutors' self-confidence (e.g., Cochran, Feng, Cartledge, & Hamilton, 1993; Miller et al., 2010; Top & Osguthorpe, 1987; Topping et al., 2003). For example, students rated themselves to be smarter and more competent after tutoring another student (Allen & Feldman, 1976; Bierman & Furman, 1981). These findings indicate that adopting the role of tutor promotes a sense of autonomy and competence. Furthermore, peer tutoring naturally addresses the need for relatedness. As student tutors engage in tutoring activities, they interact with their peers. Serving in the role of tutor, students may also feel respected and important. Indeed, several studies reported that students acting as tutors increased their feelings of belonging and social acceptance, a condition that fulfills the need for relatedness (Fantuzzo, Davis, & Ginsburg, 1995; Nazal, 2002). In short, peer tutoring provides an environment that satisfies the basic psychological needs for autonomy, competence, and relatedness of students who serve as tutors. Thus, the high quality engagement and learning associated with student tutors may have resulted from the satisfaction of their basic psychological needs as suggested in SDT.

Virtual Tutee System

Given the deep level of engagement of tutors reported in the peer tutoring literature, a Virtual Tutee System (VTS) was developed to improve the academic reading experiences of college students by placing them in the role of a tutor through the application of agent technology. The VTS is a Web-based peer-tutoring environment in which students take the role of tutor and teach a virtual character, or a virtual tutee, about what they read in their course texts. A *Teachable Agent* (TA) is the specific inspiration for the VTS. A group of researchers have developed the TA, which is a computer-simulated peer that students are asked to tutor (Brophy, Biswas, Katzlberger, Bransford, & Schwartz, 1999). For example, middle-school students draw a concept map about river ecology on a computer program to teach a TA named Betty (Biswas, Leelawong, Schwartz, Vye, & TAG-V, 2005). Based on whether students have correctly provided the concept map, Betty can or cannot answer quiz questions. Consistent with the peer tutoring literature, TA studies reported that students demonstrated a significant improvement in learning after teaching the TA (Chase, Chin, Opezzo, & Schwartz, 2009; Leelawong & Biswas, 2008). However, most TA research has focused on supporting knowledge and skill acquisition of students. Although the TA has been found to enhance student motivation and engagement (e.g., Chase et al., 2009), the design of a TA did not explicitly address this aspect of learning. Furthermore, a TA has been applied mostly to K-12 settings but rarely to college environments. Accordingly, the VTS is designed to capitalize on a tutor's active engagement in learning, reported in the peer tutoring literature, and to replicate such effects in the context of college reading tasks.

Based on role theory and self-determination theory, the VTS employs specific design strategies that augment support for the basic psychological needs for autonomy, competence, and relatedness of peer tutors. Some studies indicated that a peer tutoring environment with restricted support for these psychological needs yielded no learning gains with student tutors. For example, when the student tutors' autonomy was diminished, only a minimal effect for peer tutoring was observed. Rohrbeck, Ginsburg-Block, Fantuzzo, and Miller (2003) found that student tutors did not show significant improvement in learning when they were not allowed to set their own goals for the tutoring lessons. Similarly, student tutors who were frequently

Table 1. Design principles and guidelines for the VTS

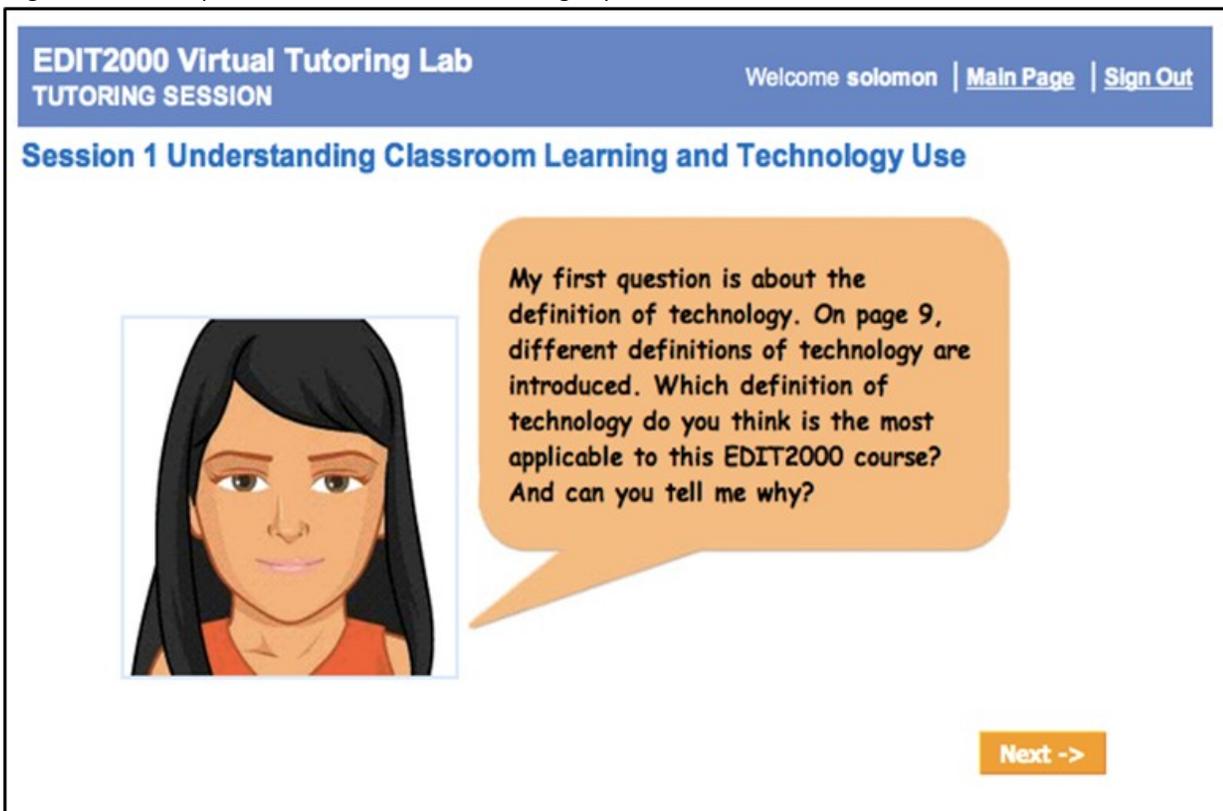
Design Principles	Component Guidelines
In order to support perceived competence and autonomy, the VTS should enhance students' identification with the role of tutor.	<ul style="list-style-type: none"> • Responsibilities of the tutor are clearly communicated to students. • A virtual tutee's performances are evaluated. • Students are able to view the progress of virtual tutees' performances.
In order to enhance student autonomy, the VTS should provide students with choices regarding tutoring activities.	<ul style="list-style-type: none"> • Students set their own instructional goals and objectives. • Students determine how to deliver a lesson. • Students choose whom they want to teach.
In order to support the need for relatedness, the VTS should emulate social interactions between tutor and tutee	<ul style="list-style-type: none"> • Virtual tutees ask students questions related to the lesson. • Virtual tutees express positive attitudes toward learning. • Interactions between students and virtual tutees continue throughout the entire semester.
In order to support individual students' motivational problems, the VTS should address the respective needs of individual students.	<ul style="list-style-type: none"> • Goal orientation: virtual tutees express their own aspirations for learning. • Task value: virtual tutees acknowledge the utility value and importance of the learning materials.

interrupted with regard to their use of resources and feedback failed to show significant learning gains (Biswas et al., 2005; Chan & Chou, 1997). Therefore, the VTS is carefully designed to fulfill each psychological need, as summarized in the four design principles and subsequent guidelines (see Table 1). The following section introduces each of the design principles and guidelines of the VTS and elaborates them with examples developed for a teacher-education course in which students, that is, pre-service teachers, learn how to integrate technology in the classroom.

A Design Framework for the Virtual Tutee System **Principle 1: Identification with the Role of Tutor**

The first design principle of the VTS concerns identification with the role of tutor. According to role theory, involvement in a role is one factor that contributes to the degree of role commitment and enactment (Sarbin & Allen, 1968; Allen & Feldman, 1976). College students must be involved in the role of tutor so that they can adopt the characteristics of the role and experience a sense of autonomy and competence. To facilitate involvement in the role of tutor, first of all, *the responsibilities of the role of a tutor should be clearly communicated to students*. In the beginning of the VTS, students (pre-service teachers) are provided with a guide video that explains what their task is (i.e.,

Figure 2. An example screen of a virtual tutee asking a question.



to teach their virtual tutees) and what virtual tutees are expected to achieve. To establish a more authentic peer-tutoring environment, secondly, *virtual tutees' performances should be evaluated*. During the tutoring session, the virtual tutee asks several questions regarding the tutored materials (see Figure 2). The accuracy of students' responses to the questions is then used as an indication of the virtual tutees' performance. Further, *the progress of the virtual tutees' performances should be monitored throughout the entire learning course*, which serves as feedback about students' tutoring. Although the current version of the VTS has not yet included this feature, the future VTS will record tutees' performance, assessed through students' responses to the tutees' questions, on each lesson and present the information graphically so that students can keep track of it.

Principle 2: Choices in Tutoring Activities

The second principle concerns the strategies that further support students' autonomy as a tutor. According to self-determination theory, providing choices enhances a sense of autonomy (Deci & Ryan, 2000). The VTS presents three different choices that students

need to make for their tutoring. First, *students should set goals and objectives for tutoring*. As shown in Figure 3, students are given a list of instructional goals pertinent to the assigned part of the course text and asked to choose one or more goals for their tutoring lesson. In addition, *VTS provides a choice about how to deliver a lesson to their virtual tutees*. For example, students may choose to create a concept map, write a summary, or provide definitions of key terms. Lastly, *students can choose whom they want to teach*. The VTS provides a list of available tutees along with their profile information. This strategy not only engages students' interest but also enhances their ownership, which in turn promotes involvement in the tutor role.

Principle 3: Social Interactions between Tutor and Tutee

The third principle is proposed to facilitate social interactions between tutor and tutee. Although virtual tutees are not identical to human peers, several studies indicated that people respond to computers as if they are social actors (e.g., Bracken & Lombard, 2004; Nass, Fogg, & Moon, 1996; Nass, Moon, & Green, 1997). For example, college students showed more favorable responses to computers that generated voice

Figure 3. An example screen of instructional goal selection.

The screenshot displays the 'EDIT2000 Virtual Tutoring Lab' interface. At the top, there is a blue header with the text 'EDIT2000 Virtual Tutoring Lab' and 'TUTORING SESSION' on the left, and 'Welcome won10 | Main Page | Sign Out' on the right. Below the header, the main content area has a blue title 'Session 1 Understanding Classroom Learning and Technology Use'. Underneath, a bold heading asks 'What do you want your tutee to learn?'. A paragraph follows: 'In this tutoring session, you will teach your tutee about what you read in chapter 1 of the textbook. Select one or more tutoring goals for your tutoring session based on the reading.' Below this is a section titled 'I want to help my tutee to' with five radio button options: 'explain how to use technology in classrooms', 'define educational technology', 'apply technology skills in their own learning', 'understand the importance of technology in classrooms', and 'develop technology skills as a classroom teacher'. At the bottom right of the form is an orange 'Save' button.

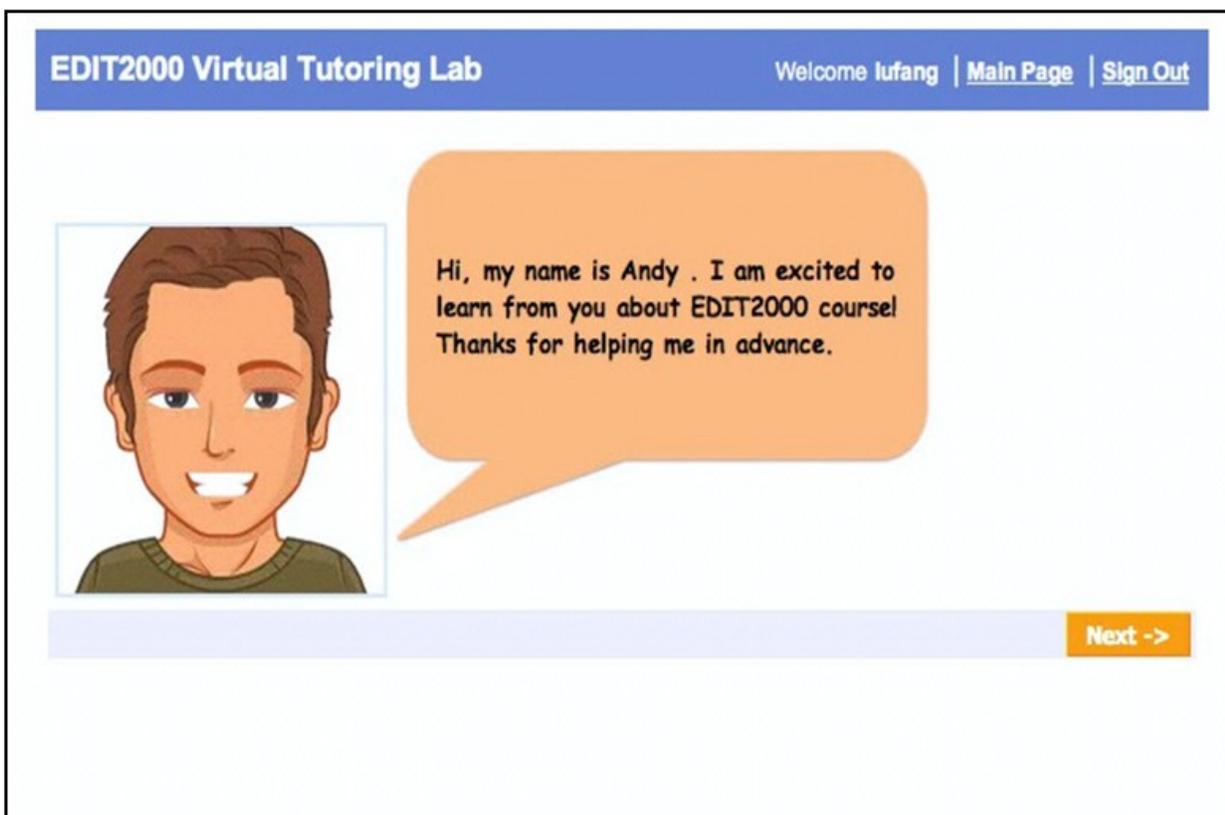
cues matching with their own personalities (Nass & Lee, 2001). Thus, the VTS is designed to simulate the experience of a human tutor-tutee interaction with the goal of satisfying the need for relatedness. Three strategies are employed to augment social interaction in the VTS. First, as shown in Figure 2, *virtual tutees ask student tutors questions*. Asking questions is a typical behavior of tutees. By responding to tutees' questions, students realize their role of tutor and become more involved. Second, *virtual tutees express positive attitudes toward learning*. For example, virtual tutees occasionally send a message expressing their interest in the tutored materials (see Figure 4). Positive attitudes may serve as positive feedback for tutoring, which can enhance student tutors' feelings of being respected and important. Student tutors may model a virtual tutee's positive attitudes as well. Finally, *interactions between students and virtual tutees should continue throughout the entire semester*. The VTS should be designed for an entire learning course rather than for a one-time intervention. Students develop relationships with their tutee for a longer period of time so that they can increase their commitment, as well as sustain

their motivation.

Principle 4: Needs of Individual Students

The three design principles discussed above focus on creating a learning environment that promotes active engagement. However, even if a learning environment is arranged to support basic psychological needs, the motivational beliefs of individual students could have an adverse effect on their engagement. Deci & Ryan (2000) pointed out that individuals' goals also influence the internalization of motivation (the autonomous types of extrinsic motivation). They argued that pursuing a certain type of goal may be conducive to the satisfaction of the basic psychological needs. That is, people who pursue intrinsic goals (e.g., personal growth, health, and affiliation) are more likely to demonstrate self-determined motivation, whereas people with extrinsic goals (e.g., wealth, image, and fame) tend to exhibit less autonomous motivation. In support of this, Vansteenkiste, Simons, Lens, Sheldon, and Deci (2004) reported that undergraduate students who were given intrinsic goals (contribution to community, personal growth, and health) showed autonomous mo-

Figure 4. An example screen of a virtual tutee's positive attitude toward tutoring.



tivation, which in turn yielded deep processing, high test performance, and persistence. Similarly, Standage, Duda, and Ntoumanis (2003) examined secondary students' motivation in physical education and found that students in a mastery-oriented classroom were more likely to experience self-determined motivation and more leisure-time physical intentions. Thus, promoting intrinsic goal orientations may lead to more autonomous types of motivation. In addition, another motivational belief that contributes to the development of autonomous motivation is perceived task value. One distinct element that differentiates between autonomous motivation (e.g., identified motivation) and less autonomous motivation (e.g., introjected motivation) is identification with the value of a learning activity. As described above, when students find a learning task to be important and personally meaningful, they exhibit self-determined motivation (Deci & Ryan, 2000). That is, students should recognize and understand the value of the activity. In fact, task value has long been recognized among motivation researchers as a critical factor in student motivation and learning (e.g., Eccles, 1984; Pintrich & De Groot, 1990; Pintrich & Schunk, 1996;

Wigfield & Eccles, 2000). All these studies support that students show active engagement, invest more effort, and achieve more when they acknowledge the value of learning activities. Several self-determination theorists have also examined the relationship between task value and the internalization of academic motivation and performance. For example, Reeve, Jang, Hardre, and Omura (2002) provided students with a rationale for why putting in an effort is worthwhile and useful during an uninteresting activity and tested the effects of the provision of a rationale on student achievement. Results showed that students provided with the rationale reported a higher task value (i.e., the importance of the activity), more internalized or autonomous motivation, and greater effort as compared with students who were not given the rationale. Therefore, it is critical that students understand the importance and usefulness of learning activities and truly value them in order to experience self-determined motivation and active engagement.

Given the critical role of goal orientation and perceived task value in promoting active engagement, the VTS will provide support to promote these two moti-

Figure 5. Individual needs assessment screen.

EDIT2000 Virtual Tutoring Lab Welcome lufang | [Main Page](#) | [Sign Out](#)

Before you enter the tutoring session, please note that our virtual tutoring lab is surveying about your belief in this EDIT2000 course. Please indicate whether you agree with each of the following statements.

Yes | No | Not Sure

1. It is important for me to read textbook chapters in this course.

2. I am confident I can understand the basic concepts taught in this course.

Save!

vational beliefs, which relates to the fourth design principle of the VTS. In the beginning of each tutoring session, as shown in Figure 5, the VTS assesses student tutors' perceived value of course reading and their academic goal orientation. For students who demonstrate an extrinsic goal orientation, *virtual tutees will express their own aspirations for learning in this course* so that students can model them. If students recognize little value for the course readings or course materials, the VTS may foster perceived task value by having *virtual tutees acknowledge the importance of textbook reading and course materials*.

Conclusion

Although it is important that pre-service teachers develop and demonstrate exemplary academic reading behaviors for their future teaching, a majority of them have exhibited poor engagement in their own academic readings. They often do not complete the assigned readings, or they only skim the course texts. In response to this particular problem, this paper proposed a Virtual Tutee System (VTS) that aims to facilitate pre-service teachers' engagement in their own course read-

ings. The VTS is grounded on findings reported in the peer tutoring literature that peer tutors demonstrated active engagement and enhanced performance with the expectation of teaching. Thus, the VTS is designed to capitalize on the mechanism of these learning by teaching effects as suggested in role theory and self-determination theory.

The major activity in the VTS involves teaching the virtual tutees about what the student tutors (pre-service teachers) have read in their course texts. The role of tutor allows students to experience a sense of competence and feeling of autonomy as well as to engage in social interactions with their virtual tutee. The specific design strategies employed in the VTS are arranged to augment support for the basic psychological needs for autonomy, competence, and relatedness of tutors. This paper summarized these strategies in the four design principles and guidelines of the VTS. With fulfillment of the three basic human needs, it is expected that the VTS will enable pre-service teachers to develop a more active engagement toward their own course readings.

Although the VTS is proposed with a strong theo-

retical groundwork, it has not yet been validated through empirical research studies. Future studies should examine the effects (or effectiveness) of the VTS as well as to refine its design framework according to study findings. For example, here we have suggested using the VTS throughout the semester so that students can establish a stronger commitment to their virtual tutee. However, it could transpire that students may become frustrated with the repetitive structure of the VTS after interacting with it for some period of time. In this case, the tutoring activities in the VTS should be varied or an intermittent use of the VTS should be considered.

The VTS is a distinctive application of peer tutoring as it employs a virtual character as an object who receives tutoring. One of the significant limitations of the VTS concerns the degree to which a virtual tutee can simulate an actual human tutee. It would strongly contribute to the success of the VTS to facilitate more authentic-like interactions between students and their virtual peers. Future studies should investigate how much simulated tutor-tutee interaction is desirable. The VTS can be further improved if it incorporates recent advances in virtual agents that are designed to have appropriate social competencies and to express and respond to emotions (e.g., Bickmore & Cassell, 2005).

The VTS offers much potential to resolve the problem of poor reading engagement among pre-service teachers, as well as to promote their academic performance. Research on the VTS has only taken the first step and there are several further studies to be completed. It is expected that future studies will not only refine the design of the VTS but also contribute to the existing literature of peer tutoring and extend the application of peer tutoring into different contexts.

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