Promoting Pre-service Teachers' Multimedia Design Skills through Collaborative Multimedia Service-Learning (CMSL)

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Introduction

Service-learning offers an opportunity for students to develop knowledge and skills through curriculum-based service activities (Brown, & Purmensky, 2014). Students can acquire content knowledge while being engaged in real-world, authentic learning experiences that support a reciprocal relationship with the community. Service-learning has been recognized as an important pedagogical approach that brings students meaningful learning that is otherwise not possible in a classroom setting (Conway, Amel, & Gerwien, 2009). A well-designed service-learning project in teacher education can help pre-service teachers gain positive learning experiences and outcomes, such as increased learning and satisfaction (Freeman & Swick, 2000).

In pre-service teacher education, the service component of a collaborative service-learning project can foster participating teachers' understanding of teaching practice in an authentic teaching setting. This notion is supported by several evidence-based learning strategies for improving learning (Fiorella, & Mayer, 2015). For example, by participating in service-learning activities, pre-service teachers can learn how to teach and how to interact with students in the classroom through the "learning by teaching" approach. While preparing and teaching instructional materials to K-12 students, pre-service teachers follow the three stages of the learning by teaching process (Figure 1), i.e., preparing learning

ABSTRACT

The Collaborative Multimedia Service-Learning (CMSL) model, based on the "learning by teaching" approach, was created in an effort to design a pedagogical intervention to promote pre-service teachers' multimedia design/development skills. This paper reports on the development of the CMSL and presents the findings of the implementation of the CMSL in a partnership between a pre-service teacher training program in a 4-year university and area elementary and middle schools. Sixteen pre-service teachers participated in a series of multimedia design trainings as a part of their undergraduate curriculum and completed the service-learning component of the CMSL by teaching nine sixth-grade classes in local schools using MacBook multimedia authoring tools. The findings show that the CMSL model was effective in improving pre-service teachers' multimedia design skills and attitudes toward the CMSL. Follow-up interviews indicated that participating in the service-learning component of the CMSL was beneficial and a satisfactory experience.

materials, being involved in teaching activities, and interacting with K-12 students in an authentic classroom setting (Fiorella, & Mayer, 2015).
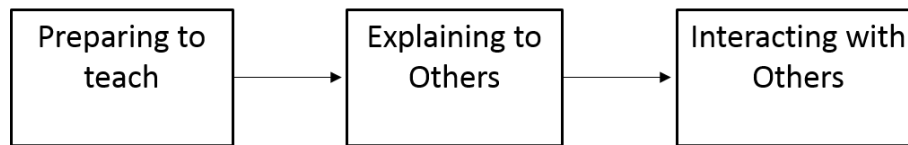
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┌─────────────┐      ┌─────────────┐      ┌──────────────┐
│ Preparing to│─────▶│ Explaining to│────▶│Interacting with│
│    teach    │      │   Others    │      │    Others     │
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Figure 1. The three stages of learning by teaching (Fiorella, & Mayer, 2015, p.155)

Bringing technology-integrated lessons into the K-12 classroom as part of service-learning provides pre-service teachers with the opportunity to test technologies and to practice skills and knowledge that they learned in the classroom. Technology integration in the classroom is an essential skill for pre-service teachers to learn (Park & Son, 2008) because K-12 students are exposed to new technologies every day. Pre-service teachers are in need of continuous technology trainings to stay up to date on the new advancements in technology. Now more than ever, pre-service teachers are expected to be competent in integrating technology into the classroom to work with students. One of the technology integration competencies required for pre-service teachers is to know how to design and develop instructional multimedia materials to meet students' different learning styles and unique learning needs in the classroom. Many current teacher training programs require an educational technology course as an essential part of the training curriculum. However, unlike pedagogical content knowledge, multimedia design training requires a series of hands-on practices using multimedia tools and resources. Although classroom learning can afford these hands-on activities, pre-service teachers still remain passive learners primarily because of their lack of access to relevant technological tools and resources. Furthermore, classroom learning offers very limited opportunities for pre-service teachers to apply learned skills in a real classroom setting. The lack of relevant resources reduces pre-service teachers' motivation and learning outcomes.

In an effort to promote pre-service teachers' multimedia design skills, this paper introduces the collaborative multimedia service-learning (CMSL) model, which emphasizes two pedagogical approaches: learning by teaching and peer tutoring. The researchers then report the findings of the implementation of CMSL to improve pre-service teachers' multimedia design skills while being engaged in service-learning activities in area schools. This paper argues that incorporating service-learning activities into the teacher training curriculum promotes pre-service teachers' multimedia design skills and attitude.

Learning by Teaching

The concept of "learning by teaching" was first introduced by a German professor, J. Martin, in the early 1980s. Applying the learning by teaching approach in a French language class, he found that students' motivation and language speaking performance dramatically increased after asking his students to act as teachers (Skinner, 1994). Although it first started as an instructional method for language classes, a survey study from Barnbeck and Neumann (2006) reported that learning by teaching is an instructional strategy that can be used in all subjects and is not limited to certain learning fields. They also listed the pros and cons of the learning by teaching strategy as summarized in Table 1.

Table 1. Pros and cons of the learning by teaching strategy (Barnbeck, & Neumann, 2006)

Pros of implementing "Learning by teaching"	Cons of implementing "Learning by teaching"
• triggers students' need to communicate • creates an authentic learning environment • involves everyone in the classroom • supports equal participation of both weak and strong students • encourages fluency and self-evaluation. • can be transferred to "real life" • enables students to share responsibility and cooperate • encourages students to experiment and be creative	• cannot be applied in lower grades because of the lack of ability to work independently • cannot be applied in lower grades because of the lack of self-confidence • could be imitating teacher's behavior • could fail if students do not have enough background information

Barnbeck and Neumann (2006) reported that the basic purpose of the learning by teaching approach is to assign traditional functions of a teacher to the students so that they can teach new skills and knowledge to their classmates. They also suggested that students who are in charge of a lesson should think about appropriate instructional methods to teach the assigned topic. Consequently, students become responsible for the quality of a lesson (Skinner, 1994). For the learning by teaching strategy to be successfully implemented, the following conditions must be met (Shelfhout et al., 2006). First, pre-service teachers must possess content knowledge of the subject they plan to teach. Second, pre-service teachers need to be familiar with both pedagogical knowledge and teaching methods knowledge to properly teach. Third, pre-service teachers must have practical teaching experience in an authentic context within school classrooms. Fourth, pre-service teachers must acknowledge the shortcomings of their educational approaches and attempt to improve their teaching (Dochy, Segers, & Sluijsmans, 1999).

However, first year teachers often stress that teacher training is not enough to provide them with sufficient skills and knowledge for practical use (Sprinthall, Reiman, & Thies-Sprinthall, 1996). Moreover, pre-service teachers do not apply what they have learned from teacher training programs into their teaching practices (Rust, 1994). This is

because of the gap between teaching in authentic contexts and teaching in simulated contexts. To minimize the gap, it is critical to provide pre-service teachers with opportunities to practice teaching in authentic classroom contexts through service-learning activities.

Peer Tutoring

The concept of learning by teaching is closely related to peer tutoring (Katzlberger, 2005). According to Katzlberger (2005), tutoring can be defined in two different ways: peer tutoring and cross age tutoring. Peer tutoring takes place when the tutor and tutee are of the same age, while tutors in cross age tutoring are usually advanced and older students. There are many benefits of being tutors. A tutor takes the responsibility of preparing lessons to convey knowledge and skills to tutees. As Biswas and Schwartz et al. (2001) noted, this sense of responsibility has motivated individuals of all age groups. Additionally, a tutor needs to brainstorm effective instructional strategies to communicate the learning content, have time to reflect upon their own teaching practice, and find alternative ways of delivering knowledge and skills based on learning styles and individual differences. Cohen mentioned that "preparing to teach facilitates long-term retention, as well as aiding in the formation of a more comprehensive and integrated understanding" (As cited in Katzlberger, 2005). Gaustard also found that student tutors often benefit as much or more than their tutees (As cited in Katzlberger, 2005). Research on both the learning by teaching method and on peer tutoring provide a firm foundation for the collaborative service-learning model for pre-service teachers.

Design framework for the collaborative service-learning model

To develop the collaborative service-learning model in this paper, Howe et al. (2014)'s three-phased model for service-learning was used as a framework (Table 2).

Table 2. Three-Phased Model for Service-Learning design and considerations (Howe, Coleman, & Hamshaw, 2014)

Course Consideration	Phase 1: Exposure	Phase 2: Capacity Building	Phase 3: Responsibility
Instructor Role	*Primary Manager*	*Facilitator*	*Coach or Consultant*
Level of Responsibility	*Participation*	*Contribution*	*Full Responsibility*
Extent of Teamwork	*Class Project*	*Individual Project/Role*	*Small Group Project*
Intensity/Duration of S-L Project	*One-Time/Discrete*	*Course-basis*	*Long-Term Commitment*

Community Contact	*Hypothetical/ Non-Direct*	*Indirect*	*Direct*

According to Howe et al. (2014), the model for service-learning course design consists of three phases: exposure, capacity building, and responsibility. The goals of phase 1 include introducing students to service-learning, building initial skills, introducing the process of academic reflection, and beginning to build cultural and interpersonal competencies (2014). The second phase focuses on increasing expectations for students to take responsibility for outcomes, practicing professional skills, and becoming more adept reflective thinkers. Lastly, the goals of phase 3 are moving students toward high-level ownership of projects, mastering skills, and demonstrating high-level critically reflective thinking and expression. Howe et al. (2014) emphasized the flexibility of each phase so that the transition between each phase addresses the needs of the students, the instructor, and the institution. Using Howe et al.'s model as a service-learning design framework, the researchers incorporated two pedagogical approaches, learning by teaching and peer tutoring, to define pre-service teacher roles in service-learning tasks.

CMSL for pre-service teachers

Using the three-phased model for service-learning design, we developed the Collaborative Multimedia Service-learning (CMSL) model (as shown in Figure 2) to specifically address a service-learning activity that supports pre-service teachers' multimedia development skills. Conditions for the successful learning by teaching approach were also considered in the development of the CMSL (Shelfhout et al., 2006). The two pedagogical approaches of "learning by teaching" and "peer tutoring" were implemented in the CMSL process as described below.

- *Preparation (Multimedia design skill training):* Before being involved in service-learning activities, pre-service teachers must acquire the necessary content knowledge and skills they plan to teach. A series of "multimedia design skills" training needs to be provided to help equip pre-service teachers with skills such as basic multimedia design principles, design tools, and design processes.

- *Level 1 (Pre-service teachers teaching peer pre-service teachers)*: After completing the multimedia design skill trainings, pre-service teachers form small groups to complete several group projects in which they can practice the skills they learned during the training sessions. While working on the group project, pre-service teachers are encouraged to exchange ideas on instructional materials, to provide comments and feedback, and to complete a group project by teaching each other. Interactions among groups are facilitated by the instructor. Level 1 uses the peer tutoring strategy.

- *Level 2 (Pre-service teachers teaching students):* After completing the group project, pre-service teachers participate in collaborative service-learning to teach K-12

students in the area schools what they learned from the training sessions and the class projects. Area schools are contacted to develop a partnership between the university and the schools. The team of pre-service teachers works with the area schools to deliver multimedia design skills to K-12 students. Level 2 uses the cross age tutoring strategy.

- *Level 3 (Students teaching peer students):* After pre-service teachers complete the service-learning activities in the area schools, K-12 students collaborate with each other to develop an individual multimedia design project. As with level 2, design ideas, comments, and feedbacks are shared among students through verbal or visual interactions. Level 3 supports the peer tutoring strategy.

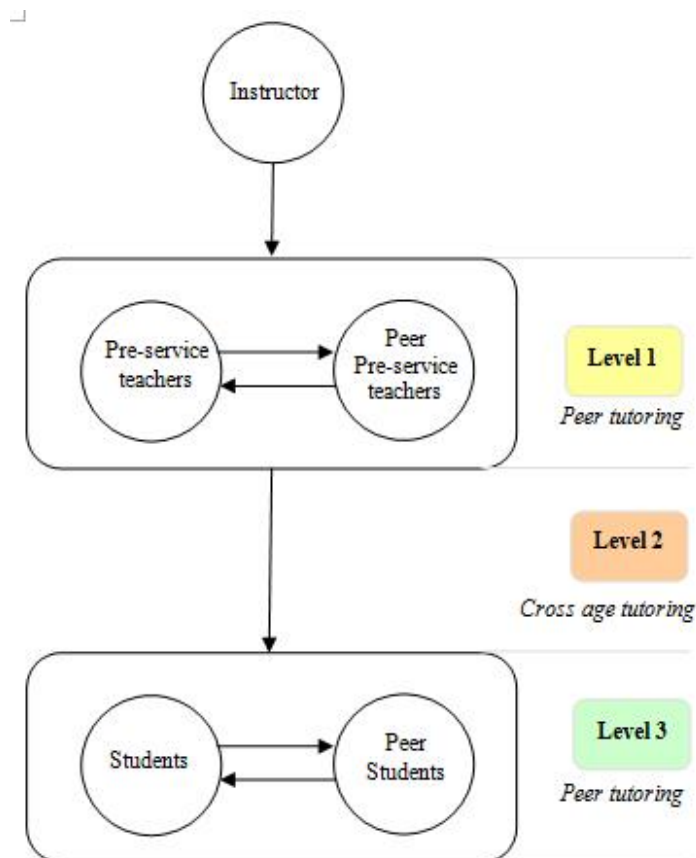Figure 2 depicts the process and the scope of the Collaborative service-learning model for pre-service teachers.

Figure 2. A collaborative multimedia service-learning for pre-service teachers

In the next section, the researchers describe a case study in which the CMSL was implemented in area schools that were in partnership with the university and report

the findings of pre-service teachers' service-learning experiences, in particular their learning of multimedia design skills and motivation.

Method

Background

CMSL was designed to improve pre-service teachers' multimedia design skills in an authentic teaching environment based on an established partnership between three area schools and a university located in the southern United States. Specifically, pre-service teachers participated in the CMSL to improve their understanding of basic MacBook operation skills and instructional multimedia design skills across subject areas. "Instructional multimedia" was defined as a collection of digital artifacts designed to support pre-service teachers' critical thinking, problem solving, and decision-making skills on a certain topic in science, social studies, or mathematics. Creating multimedia artifacts in the form of images, movies, music, spoken word, and text, pre-service teachers were able to share his/her instructional multimedia project with other teachers by sharing it on a website. A suite of digital multimedia programs was presented to participating pre-service teachers as part of the MacBook laptop program that would allow them to create and share their digital project. Pre-service teachers were trained on how to use the multimedia authoring programs, including the photo editing, movie editing, and Web design tools to create their own instructional multimedia projects. The pre-service teachers then visited three area schools to teach sixth grade students how to create a sharable instructional multimedia project in science, social studies, or mathematics.
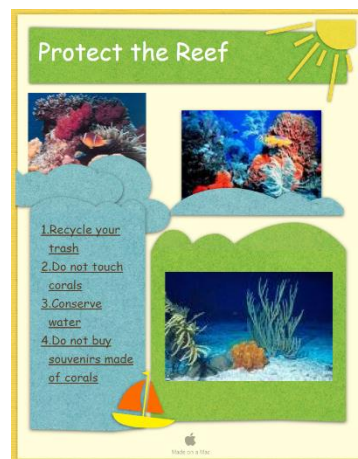
Participants

The participants of the CMSL were 16 pre-service teachers enrolled in two sections of an "instructional methods" class in a four-year public university located in the southern United States. As this course was one of the required courses for study participants, participating in the "multimedia design" training was mandatory. At the end of the training, pre-service teachers were given completion certificates and attendance points as compensation. Only participants who agreed to participate in the study were included in the data analysis. All of the 16 participants were undergraduate students. Their ages ranged from 19 to 22. Among the 16 participants, 11 were Caucasian and five were African American. There was one male student and 15 female students. The majority of the participants were juniors and seniors. To separate the effects of the collaborative service-learning model from other confounding factors such as prior knowledge or prior teaching experience, this study only included participants who were new to multimedia design tools on MacBook computers and had very little experience in teaching others.

CMSL training

The following three levels describe the implementation of the CMSL process.

• Level 1: The 16 pre-service teachers were trained to use multimedia authoring programs to design and develop an instructional multimedia project. Four groups were formed to encourage peer tutoring within and between groups. Each pre-service teacher group produced its own instructional multimedia project to meet instructional goals and enhance learning in a content area (as shown in Figure 3).

Pre-service teachers work together to learn how to create an instructional multimedia Web site
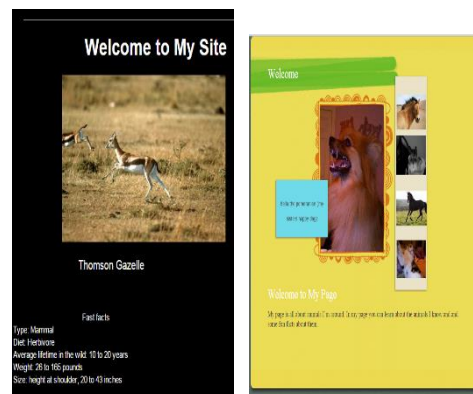
Sixth grade students' final outcomes

Figure 3. Students participating in the project.

• Level 2: The 16 pre-service teachers visited three area schools to teach nine classes how to produce instructional multimedia projects. Four pre-service teachers taught classes as lead instructors and 12 pre-service teachers taught classes as facilitators.

• Level 3: The students in area schools collaborated to help each other create his/her own instructional multimedia project (as shown in Figure 3). Students were allowed to share their ideas and skills to help other students.

Outcomes of the CMSL service-learning

The two outcomes of interest of the CMSL were pre-service teachers' multimedia design skill acquisition and their attitude toward the overall training and service-learning experience. "Multimedia design skills" in this study was defined as the earned score on the pre-selected performance assessment checklist of three multimedia authoring tools: the photo editing program, movie editing program, and Web design program. Performance assessment measures a student's knowledge and skill based on

observing their completion of different tasks, such as activities, exercises, or problems that require them to show what they can do (Popham, 2008). The checklist items were selected from the three multimedia authoring program tutorials. The number of items on each performance assessment checklist was 13, 9, and 7 for the photo editing, movie editing, and Web design programs, respectively. The participants were asked to demonstrate given tasks, and the trainer checked "yes" if the participants completed the given tasks successfully or "no" if the participants failed to complete the given tasks. Tasks in the iPhoto performance assessment included "importing photos," "cropping a photo," and "creating a slideshow." Examples of tasks for the iMovie performance assessment included "Importing from a camcorder," "Adding music," and "Adding voice over." Tasks for the Web design performance assessment were "Adding hyperlinks and navigation," "Creating a photo album page," and "Publishing your site." Prior to beginning the training, one hour of orientation session was provided. During the orientation, study participants were asked if they had used a MacBook before the training. No participants reported prior experiences using MacBook computers or MacBook multimedia authoring tools. The training session was the participants' first exposure to MacBook multimedia authoring tools. After completing the training, from level 1 through level 3, performance assessment on the three multimedia authoring tools was conducted to measure participants' multimedia design skills acquisition. These skills were not measured before the training because none of the participants reported prior experience using MacBook multimedia authoring tools.

The pre-service teachers' attitudes toward the CMSL were measured using Keller's Instructional Material Motivational Survey (IMMS) (Keller, 1993). The IMMS includes 36 items and is intended to be a situational measure of students' motivational reaction to instructional materials and was designed with the theoretical foundation represented by the ARCS model (Keller, 1987). The four components of the ARCS model, which are Attention, Relevance, Confidence, and Satisfaction, were measured. The original statements were changed based on the context. For example, an original item, "There was something interesting at the beginning of this lesson that got my attention" was revised to "I found something interesting at the beginning of the project that got my attention". The responses ranged from one to five on a Likert scale with 12 attention component items, nine relevance component items, nine confidence component items, and six satisfaction component items. The reliability of the IMMS based on Cronbach's alpha was .89 for the Attention subscale, .81 for Relevance, .90 for Confidence, and .92 for Satisfaction.

Results

Multimedia design skill acquisition

Of the 16 pre-service teachers who participated in the "Multimedia design," 15 (93.75%) demonstrated all of the 29 performance assessment skills, successfully showing multimedia design skill acquisition. One participant completed 25 out of the 29 performance assessments, although she had not attended the training sessions (preparation). However, she did work in a group to create a group project by collaborating with other participants and participated in the service-learning activities (levels 1-3).

Attitude

The mean score for overall attitude using the IMMS was 3.50 / 5.0. Specifically, the mean score for the Attention subscale was 3.47 ($SD = .55$), Relevance was 3.27 ($SD = .82$), Confidence was 3.67 ($SD = .49$), and Satisfaction was 3.48 ($SD = .96$). The overall motivation level was fairly moderate to high. The results indicated that confidence was the highest of the four motivation components. This shows that students were able to acquire a higher level of confidence after participating in the CMSL.

Interview findings

Follow-up interviews were conducted with individual pre-service teachers after the CMSL was completed. Overall, participants had positive comments about the opportunity to visit area schools and work with sixth grade students as part of the service-learning activities. In their reflective responses, many pre-service teachers reported somewhat negative experiences while participating in the classroom training sessions prior to the service-learning activities, yet shared the benefits of having the teaching experiences in area schools and working with sixth grade students directly through the service-learning activities.

With regard to training experiences, many students expressed that their learning experience was meaningful once they proceeded to level 2 and level 3 of the CMSL. Initial training sessions were often viewed as not satisfactory; however, students reported that participating in the service-learning component of the CMSL was both beneficial and satisfactory:

- *"Training was time consuming, but overall it definitely helped me by offering opportunities to participate in different classroom experiences with students. I felt like I learned more from the classroom experience than I did in training."*
- *"I wasn't thrilled about the TOTL program being deemed mandatory. However, once we visited the schools, it really was an awesome experience. The information used on multimedia design training was broad, but it all fell into place once we were in the classrooms. Overall, I was satisfied with the outcome of the program.*
- *"I felt like this training was important. It is likely that we will be working with this program in the future. I liked the hands-on teaching with the students"*
- *"I felt like I learned more from the classroom experience, than I did in training."*

- *"Some of the training was pointless and wasted my time but I really enjoyed going into the classroom and working with the kids"*
- *" I felt like this multimedia design training was important. It is likely that we will be working with this program in the future"*

Several students further elaborated that participant awareness and sharing expected goals were factors that made the overall CMSL experiences successful:

- *"It allows for total control from all aspects of learning and development for the people involved with it, as well as the people who get the shared information"*
- *"I liked the openness of the whole group involvement for the purpose of instruction and learning"*

However, other students noted three areas of improvement for further implementation of the CMSL: time, supporting tools and resources, and an individualized training option.

- *"The time it took to dedicate to the training sessions."*
- *"We could have prepared for that in just a few hours on one Wednesday not 3 weeks of Wednesdays"*
- *"Using one computer for group project was hard for us all to learn the program as well as we needed to."*
- *"I liked the hands-on teaching with the students, but I felt like the training would have been more effective if we would have had more computers and supporting centers available"*
- *"The information is definitely worth knowing. Still, I think that a more hands on, exploratory learning environment would work better by allowing us to work at our own pace."*

Discussion

The findings from using the CMSL with local schools show that pre-service teachers acquired all of the necessary competencies in designing and developing multimedia materials using Macbook applications. Additionally, all participants showed a positive attitude and motivation to participate in future service-learning projects. Furthermore, all participants reported that the strengths of participating in service-learning activities were building reciprocal benefits and obtaining positive performance outcomes. After completing the CMSL, the following five critical success factors were suggested to further design and implement a successful CMSL service-learning program.

First, all stakeholders and parties involved in the CMSL, such as university faculty, staff, and pre-service teachers, need to understand and further agree upon the value of service-learning activities for all participating groups. If there were clear goals in mind for each phase, pre-service teachers would show higher interest in learning technology integration skills for classroom learning and consequently acquire essential knowledge and skills to teach sixth grade students.

Second, the appropriate infrastructure has to be established. For example, university-wide optical networks, a multimedia resource center, and technical support for pre-service teachers and faculty are necessary to provide high quality training.

Third, professional development training sessions need to be designed in a systematic way to address pre-service teachers' learning needs and motivation. Fourth, to support individual learning, online resources have to be available to support pre-service teachers' learning progress as they continue to work on producing sharable digital projects. Online tutorials can serve as a resource to scaffold the process of each participant's individualized learning.

Lastly, ongoing technical and instructional support have to be ensured to continuously support service learning. For example, pre-service teachers should have access to multimedia programs and devices as well as uninterrupted access to networks and the Internet.

Conclusion

Considering the lack of motivation and the difficulty in providing an authentic learning context in the classroom, the findings of this paper show a systematic approach to design and conduct multimedia service-learning for pre-service teachers. The CMSL model can be applied to different levels of teaching and subject areas. By providing an authentic "learning by teaching" environment through collaborating with area schools, pre-service teachers can be trained with a high level of contextual information and motivation.

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