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Free and Open Source Tools (FOSTs): An Empirical Investigation of Pre-Service Teachers' Competencies, Attitudes, and Pedagogical Intentions

Joyce G. Asing-Cashman and Binod Gurung
New Mexico State University

Yam B. Limbu
Montclair State University

David Rutledge
New Mexico State University

This study examines the digital native pre-service teachers' (DNPSTs) perceptions of their competency, attitude, and pedagogical intention to use free and open source tools (FOSTs) in their future teaching. Participants were 294 PSTs who responded to pre-course surveys at the beginning of an educational technology course. Using the structural equation modeling, the data obtained from the Likert-type questionnaire were analyzed. Results showed that computer competency was a significant predictor of attitude toward using technology. Although PSTs scored high on their computer competency, this did not mean that they have strong stances towards using FOSTs in the classroom. However, the more skilled PSTs with FOSTs, the possibilities of using FOSTs in the classroom were higher. The results also suggested that DNPST's attitude toward using technology was a significant determinant of their attitude toward using FOSTs.

Today's pre-service teachers were born and grew up in the digital era (Lei, 2009), and they are considered to be the digital learners (Warschauer, 2006), who are often termed as the "digital natives" (Prensky, 2009). Although it is contentious whether this new generation of pre-service teachers is the digital native pre-service teachers (DNPSTs), they are adept at using technological tools and have the potential to adopt technology more quickly and dynamically (Levin & Arafeh, 2002). DNPSTs are comfortable using various technology tools on a day-to-day basis for communication, interaction, and socialization. They engage in using technology for texting, "Facebooking," and multimedia creating and sharing. Thus, based on the notion mentioned above (i.e., the digital nativity), the DNPSTs are sought to develop competencies—substantial knowledge and skills—about integrating emerging technologies into their future teaching (National Council for Accreditation of Teacher Education, 2007; International Society for Technology in Education [ISTE], 2008).

With the pervasive use of technology in teaching and learning (Arnone, Small, Chauncey, & McKenna, 2011; Dede, 2008), it is essential for DNPSTs to have the ability to access, evaluate, process, produce, share, and communicate information, ideas, and knowledge using a variety of media tools so that they can communicate and connect with their future students (ISTE, 2008; Schrum & Levin, 2009). However, pre-service teachers' technological knowledge and skills alone do not guarantee the effective integration of technology in classrooms. Along with competencies, equally important factors are the teachers' self-efficacy beliefs including their own beliefs and attitudes toward their technological competencies and the perceived effectiveness of technology use in classrooms (Bai & Ertmer, 2008). Teachers' existing beliefs and attitudes influence the development of technology beliefs about both potential technology integration and related practices. Studies show that the teachers' technology beliefs and attitudes determine their pedagogic intention, including the likelihood of using technology in their future classrooms (Anderson & Maninger, 2007; Choy, Wong, & Gao, 2009; Teo, Lee, Chai, & Wong, 2009).

Technology self-efficacy beliefs and attitudes are considered to be even more important when teachers have to use new and emerging technologies such as free and open source tools (Kumar, 2005; Pan & Bonk, 2007; Pfaffman, 2008; van Rooij, 2009), Web 2.0 (Greenhow, Robelia, & Hughes, 2009; O'Reilly, 2005) and social media. This study examines how computer and free and open source tools (FOSTs) competencies and attitudes of pre-service teachers (PSTs) determine their pedagogic intention to use FOSTs in their future teaching. Briefly, the FOSTs are the web-based, end-user tools that are made available as free or open-source software and tools to download, study, use, or modify by the users for individual, educational, and commercial purposes. However, FOSTs are not always available for free: only the basic functions are free, but a fee is incurred if the users want to use the advanced features and functions of the FOSTs. FOSTs, also the foundations of Web 2.0 and social media, are emerging, pervasive, and user-friendly, and they offer new affordances such as creating, publishing, and sharing capabilities that are suitable for harnessing for teaching and learning purposes (Gurung & Chávez, 2011; Richardson, 2007; Solomon & Schrum, 2007).

Technology integration into teaching is still a "messy" process (Zhao, Pugh, Sheldon, & Byers, 2002), but at the same time, technology, if used wisely and effectively, has the potential to offer an array of meaningful learning activities (Howland, Jonassen, & Marra, 2012). Meaningful learning activities are activities designed to be intentional, active, constructive, cooperative, and provide authentic learning (Howland et al., 2012). Technology has the potential to transform teaching and learning (National Educational Technology Plan, 2010).

Technology can be used as devices for communicating with people, as tools to create instructional materials, or as presentation devices to provide information. Many successful users of technology-based materials say that students find strong motivation in the feeling that they are in control of their own learning (Neo, 2005). Current learning theories suggest that students need to construct their own knowledge (Driscoll, 1994; Newby, Stepich, Lehman, & Russell, 2000), and technology could assist in accomplishing this. Technology provides learning opportunities that support a highly interactive environment. This type of environment emphasizes reflection and discussion with peers that aid in the construction of knowledge (Goodson & Skillen, 2010; Sinclair, 2010). Dwyer (1996) stated that "significant and mounting evidence shows that technology improves students' mastery of basic skills, test scores, writing, and engagement in school" (p. 24). Goldberg, Russell, and Cook (2003) found a stronger relationship between computers and quality of writing. Students who use computers during writing instruction produce written work that is about 0.4 deviations better than students who develop writing skills on paper.

Technology also helps teachers address the issue of different learning styles by providing different types of software to enhance different learning environments. For instance, the Internet is a tool with the potential to transform traditional teacher-directed instruction into powerful, student-led, inquiry-based learning (Jonassen, Howland, Moore, & Marra, 2003; Marri, 2005).

Therefore, in an effort to prepare tomorrow's teachers to effectively integrate technology into teaching practices, it is a goal of teacher preparation programs to facilitate positive beliefs and attitudes toward technology. Future teachers' awareness of technology and specifically their awareness of FOSTs could shape the integration of FOSTs in the classroom. This study is significant to the planning and implementation of the teacher education course—the Educational Learning Technology (EDLT 368) course and similar courses—and to modeling the usage of FOSTs that PSTs will later emulate in their own K-12 classroom.

Literature Review

Technology Competencies

Teachers' knowledge of technology is "a critical factor determining the level of success for any technology-based project" (Groff & Mouza, 2008, p. 29). Feiman-Nemser (2001) explained:

> What students learn depends on what and how teachers teach; and what and how teachers teach depends on the knowledge, skills, and commitments they bring to their teaching and the opportunities they have to continue learning in and from their practice. (p. 1015)

Therefore, a teacher's computer competency—substantial knowledge and skills—is essential in the process of integrating technology in classrooms. Thus, any study into teachers' practices should involve an investigation into teacher technology competency, as competency greatly influences teacher technology use (Hew & Brush, 2007).

This study examines the role computer and FOST competencies have on attitudes toward FOST and the intention to use FOST. FOST competency is defined as the ability to locate, use, and integrate FOSTs into teaching by harnessing their features and affordances.

Technology Beliefs and Attitudes

Teachers' existing beliefs can influence the development of beliefs about both technology integration and related practices. Richardson (1996) noted, "attitudes and beliefs are a subset of a group of constructs that name, define, and describe the structure and content of mental states that are thought to drive a person's actions" (p. 102).

However, it is not always the case that teachers' technology use in classrooms is necessarily aligned with their reported beliefs. Teachers can hold conflicting educational beliefs about how to integrate technology into instruction. One study suggested that despite the strong positive beliefs in technology of digital-native pre-service teachers, there is a reserved attitude in using technology (Lei, 2009). Therefore, it is important that we further examine how the digital native pre-service teachers' existing technology attitudes and beliefs influence their learning of new technologies such as FOSTs and their potential use in classrooms.

Pedagogical Intention

In social psychology, intention is a planned behavior, as a part of self-prediction caused by current ongoing behaviors and changes, to perform a certain action in future (Ajzen, 1991; Ajzen & Madden, 1986). Pedagogically, it is the teachers' attitudes toward implementing competence-oriented teaching as they are expected from professional training and education (Jones & Carter, 2007). In this study, FOST intention is defined as the thoughts and plans of digital native pre-service teachers to operationalize their FOSTs competencies and attitudes toward the potential integration of these tools in their future teaching.

Free and Open Source Tools (FOSTs) in Teaching and Learning

The proliferating production of free and open source tools—including the Web 2.0 tools and applications such as blogs, wikis, and many other Web content creating and sharing tools— around the world by millions of open source software developers and users on an everyday basis is expanding (O'Reilly, 2007; Solomon & Schrum, 2007). Despite the prevailing concerns about the instability and unreliability of FOSTs, there is enough evidence to indicate that many FOST projects can produce high quality and sustainable open software and tools, sometimes surpassing the affordances of rival propriety or commercial software, for instance, Firefox Mozilla, OpenOffice, and Moodle (Chao, 2008; Mockus, Fielding, & Herbsleb, 2002; Pfaffman, 2008; Stallman, 2002). Currently, there is a significant emergence of Web 2.0 tools and applications based on the open source movement that can be used for classroom purposes (Solomon & Schrum, 2007). As end-user tools, the Web 2.0 tools and applications have offered vast opportunities in the field of education while requiring minimal or no additional expertise to use these tools (Asselin & Doiron, 2008; Gurung & Chávez, 2011; Richardson, 2007). Much research has shown that Moodle (Beatty & Ulasewicz, 2006), blogs (Churchill, 2009; Lankshear & Knobel, 2006), YouTube (Mullen & Wedwick, 2008), wikis (Wheeler, Yeomans, & Wheeler, 2008), social bookmarking such as delicious.com (Oliver, 2007), and concept mapping and collaboration tools such as Cmap (Oliver, 2007) have been successfully used for teaching and learning purposes (Churchill, 2009).

Along with the computer competencies as stated by Bai and Ertmer (2008), it is also necessary to examine and develop positive attitudes toward the use of emerging technologies such as FOSTs. Among these technologies, the examination of FOST related competencies, attitudes, and beliefs are important in several ways. First, FOSTs are available for free with the basic but essential features. Second, FOSTs are user-friendly, and they offer new affordances such as creating, publishing, and sharing capabilities that are suitable for harnessing for teaching and learning purposes. Third, FOSTs are the foundations of pervasive and emerging Web 2.0 and social media. Finally, today's PSTs are digital natives who have the potential to adopt technology more quickly simply because they grew up in the digital era (Iding, Crosby, & Speitel, 2002; Lei, 2009). Thus, these PSTs can effectively harness the features and affordances of FOSTs to teach in their future classrooms. A review of literature shows many studies have been conducted focusing on PSTs beliefs and attitudes towards using technology, but not FOSTs specifically. Therefore, we feel that there is a need to examine PSTs' beliefs and attitudes towards using FOSTs in their future classroom.

This study sought to examine how DNPSTs, based on their technology self-efficacy beliefs and computer competency, build their pedagogic intention of using emerging technologies such as FOSTs in their future teaching. The research question for this study was: How do the perceived technology competencies, beliefs, and attitudes of DNPSTs influence their pedagogic intention of integrating FOSTs in their future teaching?

Theoretical Framework

The technology acceptance model (TAM) developed by Davis, Bagozzi, and Warshaw (1989) was used in this study as a model to examine PSTs' perceptions of integrating technology and specifically integrating FOSTs in their future teaching. In this study, the TAM was adopted because it is a theoretical model designed to understand the user, the factors influencing the user's decisions, and the impact these has on the user acceptance to technology tools. It was, therefore, deemed the best fit to answer the study's research questions. The TAM has been used to understand and predict how users accept and use a technology within their perceived usefulness, ease of use, attitude towards technology use, and intention to use (Davis et al., 1989; Hubona & Kennick, 1996; Venkatesh & Davis, 2000). The TAM can also be used to evaluate how pre-and in-service teachers accept, use, and build perceptions about the usability and self-efficacy of a FOST, as well as how they develop a pedagogical intention to use a technology in their future classrooms within their perception of a FOST's usability (Holden & Rada, 2011; Teo, Lee, & Chai, 2008). Additionally, the theory of technology self-efficacy beliefs (Bandura, 2006) is used to examine how the DNPSTs transform their technology acceptance, perceptions, and attitudes into building their technology self-efficacy beliefs, which leads to a pedagogical intention of using technology in their future teaching.

Technology Self-Efficacy Beliefs

Bandura (2006) stated, "self-efficacy is concerned with people's beliefs in their capabilities to produce given attainments" (p. 2). Self-efficacy represents a performance capability of a person based on beliefs, values, and perceived abilities to do a certain task. It is the teachers' "self-perception of capability [that is] instrumental to the goals they pursue" (Pajares & Shunk, 2002, p. 17) and a powerful determinant to indicate their future performance including making instructional decisions, as well as organizing and executing classroom practices (Bandura, 1986; Pajares, 1992). Teachers' technology self-efficacy can be described as perceived competencies, abilities, values, beliefs, and intentions to use technology tools and software in their future classrooms (Anderson & Maninger, 2007). Building positive self-efficacy beliefs are important, as Bai and Ertmer (2008) stated, "to better prepare pre-service teachers, it is necessary to examine their beliefs in relation to teaching and learning as well as their attitudes toward technology" (p. 94). Similarly, Abbitt and Klett (2007) suggested that perceived comfort with computer technology is a significant predictor of self-efficacy beliefs towards technology integration. The efficaciousness of integrating technology in classrooms comes along with one's comfort, beliefs, and attitudes towards using technology. Thus, teachers' self-efficacy beliefs are important factors to shape up their attitudes toward technology and influence their classroom use (Myers & Halpin, 2002; Yildirim, 2000).

Studies in the past show that pre-service teachers' technology self-efficacy beliefs are built with the psychological and behavioral components including their technology competencies, technology beliefs and attitudes, and intentions for use in future teaching (Anderson, Groulx, & Maninger, 2011; Angeli, 2005). Using the attributes derived from the TAM and the findings reported from the above literature, hypotheses listed below were constructed. These hypotheses were divided into three categories: (a) the influence of computer and FOST competency on attitudes toward technology and FOST, (b) the influence of attitude toward technology and attitude toward FOST, and (c) how PSTs' attitudes shape their intention to use FOSTs.

- Relationship between competency and attitudes:
  H1: Computer competency is positively related to attitude toward using technology.
  H2: Computer competency is positively related to attitude toward using FOSTs.
  H3: FOSTs competency is positively related to attitude toward using FOSTs.
- Relationship between attitude toward technology and attitude toward FOSTs:
  H4: Attitude toward technology is positively related to attitude toward FOSTs.
- Relationship between attitudes and intention to use FOSTs:
  H5: Attitude toward FOSTs is positively related to intention to use FOSTs.

Method

Setting

Participants were enrolled in two sections of an Educational Technology course titled EDLT 368 (Integrating Technology into Teaching) during three consecutive semesters. This is the only course focusing on technology integration into teaching that is required in the teacher preparation program, and it is offered every semester. Activities in this course include completing assignments that utilized free and open source tools. For example, written assignments are completed using OpenOffice Writer, a digital learning portfolio is completed using OpenOffice Impress, a video project is completed utilizing video tools such as VideoThang, and manipulating and editing images is completed using GIMP. A major project for this course is developing a Webquest® of five lessons plans that includes content areas such as: mathematics, science, language arts, social studies, history, reading, writing, and physical education. The Webquest® project is completed using Google Sites. In these five lessons, students were required to create activities in each subject area incorporating free and open source tools introduced and used throughout this course.

Participants

The participants of this study consisted of undergraduate students enrolled in the EDLT 368. A survey instrument was administered to participants using a link to an online questionnaire created through the Survey Monkey website in the beginning of the three semesters. A total of 294 surveys were collected; out of which 282 were complete and used for the final analysis. The description of the participants is shown in Table 1.

Measures

In this study, a 48 item questionnaire was designed using multiple sources, namely the Technology Integration Confidence Scale (TCIS; Brown, 2008); Mankato Survey of Professional Technology Use, Ability and Accessibility (Mankato Public Schools, 2003); the National Technology Standards for Teachers (NETS-T; ISTE, 2008); and the Computer User Self-Efficacy Scale (Cassidy & Eachus, 2002). These sources were modified to suit the study; however, out of the 48 total questionnaire items, only 21 items were pertinent to this study and were utilized. The survey consisted of several sections: (1) Part 1 included questions that elicited demographic information, (2) Part 2 examined the respondents' access and general computer and Internet use, (3) Part 3 sought information about DNPSTs'

Table 1
Description of the Sample

Category	Attributes	Percent
Sex	Male	24.3
	Female	75.6
Age	Below 18 years	0.0
	18-23 years	76.0
	24-28 years	12.7
	29-33 years	6.3
	Above 33 years	5.0
Major or academic programs	Pre-k or Kindergarten	17.6
	Elementary	50.3
	Middle School	11.7
	High School	20.4
Computer and Internet access	Have a personal desktop or laptop computer	95.4
	Have shared access to computers at home	21.9
	Do not have computer access from home	2.1
	Have access to the internet from home	44.7
Frequency of computer use	More than 15 hours a week	29.1
	6 to 15 hours a week	50.4
	1 to 5 hours a week	12.4
	Less than 1 hour a week	1.1
Have been using the computer for	More than 10 years	39.0
	Between 6 and 10 years	47.1
	Between 1 and 5 years	14.2
	Less than 1 year	0.4

perceptions regarding the importance of integrating technology with teaching, and (4) in Part 4 DNPSTs were asked about their knowledge about, and experiences with, using FOSTs. Additionally, they were asked to indicate their perceptions in using FOSTs in their future teaching. The items were on a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*).

The items with statistically poor (i.e., below the cut-off value of .5) and insignificant factor loadings ($p > .05$) were deleted. Table 2 shows final items and factor loadings. The factor loadings for the measures ranged from .54 to .88. The alpha coefficient was between .69 and .89. All measures demonstrated acceptable reliability above the recommended level of .70 (Bagozzi & Yi, 1988) and factor loadings above the cut-off value of .50 (Hair, Back, Babin, Anderson, & Tatham, 2005).

Analysis and Results

The following section provides the description of data analysis (i.e., measurement and structural models) and results. Data were analyzed within the hypotheses that were derived from the TAM and technology self-efficacy beliefs. The analysis was conducted to examine the relationships between FOST competency, computer competency, attitude toward FOST, and attitude toward technology (see Figure 1). The examination of these relationships revealed the DNPSTs' pedagogical intention of using FOSTs.

Measurement Model

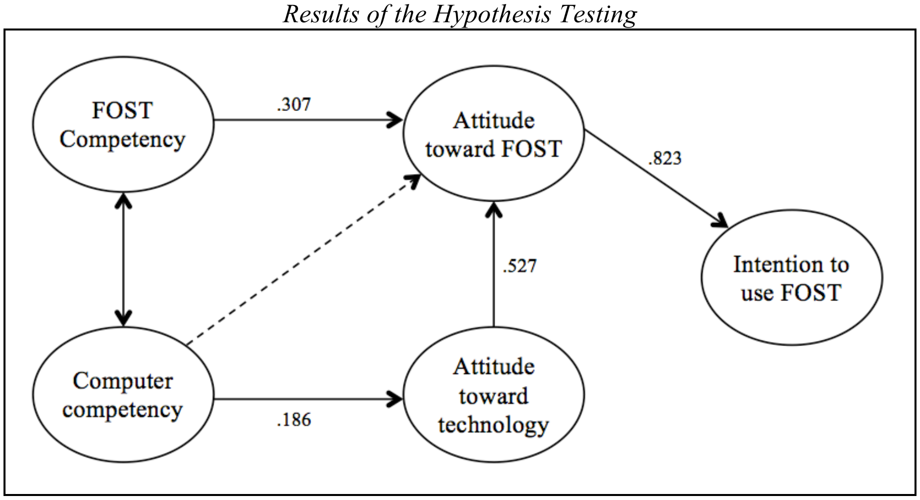
This study used AMOS 18 to test the theoretical model shown in the Figure 1. Based on Gerbing and Anderson (1988), this study used the two-step approach of structural equation modeling: first, a confirmatory factor analysis that provides the assessment of the measurement properties of the latent contrasts, and second, a structural model analysis that tests the hypothesized relationships.

The measurement model showed acceptable fit ($\chi^2_{(169)} = 219.88$, $p < .01$; GFI = .94; AGFI = .91; RMSEA = .033; TLI = .98; NFI = .94; CFI = .98). The normed chi-square value ($\chi 2\ /df = 1.301$) fell within the recommended value of three or below (Fornell & Larcker, 1981). The value of goodness-of-fit index (GFI) was higher than .90 (Hair et al., 2005). The values of Tucker-Lewis index (TLI) and comparative fit index (CFI) were above the cut-off value of .95 that was suggested by Hu and Bentler (1999). The root

Table 2
Measurement Items and Factor Loadings

Scale	Items	Factor Loading
Computer Competency	I would like to rate my computer proficiency in word processing skills (e.g., edit, copy, change color and fonts, insert pictures and tables, insert diagrams).	0.687
	I would like to rate my computer proficiency in preparing PowerPoint presentations.	0.768
	I would like to rate my computer proficiency in preparing multimedia presentations.	0.878
	I would like to rate my computer proficiency in computer troubleshooting.	0.777
	I would like to rate my computer proficiency in the familiarity with basic computer system parts and concepts (e.g., hard drive, RAM).	0.782
	I would like to rate my computer proficiency in installing computer software/programs.	0.843
	I would like to rate my computer proficiency in fixing hardware problems.	0.606
Attitude toward Technology	I believe computer technology is essential for increasing student achievement (e.g., grades).	0.638
	The use of computer motivates students more than the traditional classroom teaching does.	0.765
	Computer is an essential tool for today's classroom teaching.	0.758
	The use of computer increases students' interest in learning.	0.753
	Teaching with computer is more efficient.	0.686
	Computer technology is useful for students of all type of abilities and learning styles.	0.741
	I am interested in using technology in future teaching.	0.705
	Using the Internet is better than using the library for researching teaching materials/resources.	0.614
FOST Competency	I would like to rate my Free and Open Source Tools proficiency in creating websites and sharing or linking with the Social Networking Sites such as MySpace, Facebook, YouTube, or Twitter.	0.538
	I would like to rate my Free and Open Source Tools proficiency in using Web 2.0 tools such as wikis, blogs, podcasts, or Flickr.	0.881
Attitude toward FOST	I think Free and Open Source Tools and applications are easy to use and adaptable to my needs.	0.881
	For instructional purposes, schools should provide access to students with Free and Open Source Tools (e.g., social networking tools and applications such as blogs, wikis, YouTube, or Flickr, Facebook, Ning, MySpace, Twitter, or Second Life)	0.703
Intention of Using FOST	In my future teaching, I'm willing to use Free and Open Source Tools more often that the commercial software.	0.711
	There are plenty of Free and Open Source Learning Tools that I intend to use for my classroom teaching.	0.815

Figure 1
Results of the Hypothesis Testing



Note. Solid lines represent statistically significant paths. Dashed line indicates a non-significant path.

mean square error of approximation (RMSEA) was below the suggested cut-off value of .08 (MacCallum, Browne, & Sugawara, 1996).

As shown in Table 2, the standardized loading estimates were higher than .5 and thus provided initial support for the convergent validity (Gerbing & Anderson, 1988). Table 3 shows the inter-construct correlations, average variance extracted (AVE), construct reliabilities, and descriptive statistics. The AVE estimates were higher than .50 and construct reliabilities exceeded .60, satisfying the recommended cut-off values (Bagozzi & Yi, 1988; Fornell & Larcker, 1981). On the whole, they provided a support for the convergent validity of the measurement model. The discriminant validity was also evident as the AVE by each latent variable's measures was larger than the squared inter-construct correlation (Fornell & Larcker, 1981).

Structural Model

The fit indices for the hypothesized structural model were acceptable: $df = 173$, $\chi^2 = 226.236$, $\chi^2_{(173)} = 226.236$, $\chi^2/df = 1.308$, GFI = .93, AGFI = .90, RMSEA = .033, TLI = .98, NFI = .94, CFI = .98, IFI =.98, normed chi-square = 1.308, $p < .00$. The values of fit indices were close to or above recommended levels. Table 4 and Figure 1 present results of the hypothesis testing, including path coefficients and t values for each structural path. Hypothesis 1 predicted that computer competency would be positively related to attitude toward using technology. Results show that computer competency was a significant predictor of attitude toward using technology ($t = 3.178$, $p < .01$). Thus, Hypothesis 1 is supported. Contrary to the prediction in Hypothesis 2, computer competency was not positively related to attitude toward using FOST ($t = .637$, $p > .05$). However, providing a strong support for Hypothesis 3, FOST competency was positively related to attitude toward using FOST ($t = 2.133$, $p < .05$).

Hypothesis 4 predicted that attitude toward using technology would be positively related attitude toward using FOST. Results reveal that attitude toward using technology was a significant determinant of attitude toward using FOST ($t = 6.045$, $p < .001$). Thus, Hypothesis 4 is supported. As predicted in Hypothesis 5, attitude toward using FOST strongly influenced intention of using FOST ($t = 11.68$, $p < .001$).

Discussion and Recommendations

Results showed that DNPSTs' computer competency is a significant predictor to their attitude toward using technology. In other words, if DNPSTs perceived that they are skilled in using computers, they are more comfortable to use technology in their

Table 3
Interconstruct Correlations, Average Variance Extracted, Construct Reliabilities, Descriptive Statistics

	1	2	3	4	5
1. Intention to use FOST	1.00	--	--	--	--
2. Attitude toward FOST	0.74	1.00	--	--	--
3. Attitude toward technology	0.49	0.41	1.00	--	--
4. FOST competency	0.23	0.28	0.12	1.00	--
5. Computer proficiency	0.19	0.24	0.22	0.73	1.00
AVE	0.59	0.64	0.51	0.55	0.60
Construct reliability	0.74	0.75	0.89	0.69	0.91
M	4.246	3.871	4.676	2.255	2.766
SD	0.817	0.826	0.706	0.982	0.778

Note. All correlations were significant at the .05 level.

Table 4
Structural Parameter Estimates and Fit Indices

Structural path			Estimate	*SE*	*CR*	*p*
Attitude toward technology	←	Computer proficiency	.186	.058	3.178	**
Attitude toward FOST	←	Computer proficiency	.078	.123	.637	.524
Attitude toward FOST	←	Attitude toward technology	.527	.087	6.045	***
Attitude toward FOST	←	FOST competency	.307	.144	2.133	*
Intention to use FOST	←	Attitude toward FOST	.823	.070	11.680	***

Note. ***$p < .001$. **$p < .01$. *$p < .05$.

classroom. Similar results were reported in a study by Abbitt and Klett (2007). Abbitt and Klett (2007) suggested that perceived comfort with computer technology is a significant predictor of self-efficacy beliefs towards technology integration.

This study also investigated whether the level of perceived competency towards computer use could predict PSTs' attitudes in using FOSTs in the classroom. If DNPSTs are skillful in using computers, would this mean that they have positive orientation towards using FOSTs in their classroom? The results suggest that, although DNPSTs scored high on their computer competency, this does not mean that they have strong stance towards using FOSTs in the classroom. One possible reason for this could be that students, at the beginning of the semester (when the survey was conducted), were not yet exposed to FOSTs and their capabilities and possibilities when used in an educational setting. However, in terms of whether perceived competency with FOSTs would strengthen PSTs' attitudes toward using FOSTs, the results suggest that, as DNPSTs become more skilled with FOSTs, the possibilities of them using FOSTs in the classroom are higher.

Pedagogically, the teachers' attitudes toward implementing competence-oriented teaching, as they are expected from professional training and education, are important (Jones & Carter, 2007). The results suggest that PSTs' attitudes toward using technology are significant determinants of their attitudes toward using FOSTs. Similarly, DNPSTs' attitudes toward using FOSTs strongly influenced their intention of using FOSTs. In other words, what types of FOSTs and to what degree they will be integrated in the DNPSTs' classrooms depend on PSTs' beliefs. Teachers' technology self-efficacy can be described as perceived abilities, values, beliefs, and intentions to use technology tools and software in their future classrooms (Anderson & Maninger, 2007). Building positive self-efficacy beliefs is important because "to better prepare pre-service teachers, it is necessary to examine their beliefs in relation to teaching and learning as well as their attitudes toward technology" (Bai & Ertmer, 2008, p. 94). Further, teachers' self-efficacy beliefs are important factors to shape their attitudes toward technology and influence their classroom use of it (Myers & Halpin, 2002; Yildirim, 2000).

Pedagogical Implications

FOSTs are emerging technologies that could potentially cater meaningful learning projects and activities. FOSTs are also foundational to currently emerging Web 2.0, social media, and cloud computing. FOSTs, as the name suggests, are free and open source tools that are widely accessible, user-friendly, and both desktop- and web-based. FOSTs (e.g., blog, video imaging tools, Google Drive) are widely used in schools and classrooms. Also, the new generation of digital learners are already using FOSTs (e.g., Facebook, Flickr, YouTube) in their everyday lives for communication and interaction purposes. Within the technology comfort zone of today's digital learners, schools can harness these freely available tools to meet their teaching and learning needs, often with no or minimal cost. Therefore, it is important that DNPSTs develop FOST related competencies and attitudes to better prepare themselves to integrate emerging technologies into their pedagogies.

This study highlights how technology beliefs and attitudes, computer competency, FOST competency, and pedagogical intention are intricately intertwined. When computer competency is positively related with attitude toward using technology in general, the computer competency alone does not foster a positive attitude toward using FOSTs. In other words, it is essential that DNPSTs need to develop specifically FOST competency in order to use the FOSTs in their future teaching. Given the user-friendly and collaborative features and affordances of FOSTs, it is imperative that we teach the DNPSTs to develop FOSTs related competencies and attitudes.

Pedagogically, teachers' attitudes toward implementing competence-oriented teaching, as they are expected from professional training and education, are important (Jones & Carter, 2007). In this study, FOST intention is defined as the thoughts and plans of DNPSTs to operationalize their FOSTs competencies and attitudes toward the potential integration of these tools in their future teaching.

The findings of this study indicate that, the more skilled DNPSTs are with FOSTs, the more likely they are to use FOSTs in the classroom. These findings are aligned with previous studies (Fleming, Motamedi, & May, 2007; Lever-Duffy, McDonald, & Mizell, 2005; Richardson, 1996). Fleming et al. (2007) surveyed 79 PSTs about their training experience and computer technology skills. They reported that the more extensively PSTs observe models, and the more hands-on experience they have with computer technology, the more proficient they perceived their skills to be. These PSTs observed models in virtually every training setting, and they applied their own skills in their student teaching environment.

The development of DNPSTs' FOST related competencies and attitudes can be cultivated in several ways. One way to develop substantial knowledge, skills, beliefs, and attitudes about FOSTs is by helping DNPSTs feel comfortable in using FOSTs as future K-12 teachers. In doing so, instructors should model technology in their teaching, specifically in educational technology courses, and help DNPSTs to construct positive learning experiences that can be emulated in the their future classroom teaching. Instructors can also include a technology-related field experience assignment in their course that requires students to use FOSTs in completing the assignments, learning projects, and activities. The instructional modeling done by faculty provides the foundation, and DNPSTs use these same or similar teaching models when they become teachers (Lever-Duffy et al., 2005).

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JOYCE G. ASING-CASHMAN, PhD, is adjunct faculty at New Mexico State University and the University of Texas at El Paso. Her research interests include instructional technology modeling, technology in mathematics education, Free and Open Source Tools (FOSTs)/Web 2.0 tools, technology and active learning, and technology and preservice teachers. Her publications have appeared in the *Journal of Social Studies Research* and *Journal of Internet Banking and Commerce.* Dr. Asing-Cashman can be contacted by e-mail (jcashman@nmsu.edu) or mail: Department of Curriculum and Technology, New Mexico State University, P.O. Box 30001, Las Cruces, New Mexico 88003-8001.

BINOD GURUNG holds a PhD in Curriculum and Instruction with a specialization in Learning Technologies and Critical Pedagogy. His research interests include educational technologies—particularly free and open source tools including Web 2.0, social media, and cloud computing—and online multicultural education. His publications have appeared in the *National Social Science Technology Journal*, *Multicultural Education*, and a chapter in Kurubacak and Yuzer's (2010) book, *Handbook of Research on Transformative Online Education and Liberation: Models for Social Equality.* Dr. Binod Gurung can be contacted by e-mail (binod@nmsu.edu) or mail: Department of Curriculum and Technology, New Mexico State University, P.O. Box 30001, Las Cruces, New Mexico 88003-8001.

YAM B. LIMBU, PhD (New Mexico State University), is Assistant Professor of Marketing at Montclair State University. His research interests include consumer behavior, Internet retailing and ethics, healthcare management, and instructional strategies and assessment. His publications have appeared in the *Journal of Entrepreneurship Education*, *Marketing Education Review*, *Journal of Research in Interactive Marketing*, and *Journal of Business to Business Marketing.* Dr. Limbu can be contacted by e-mail (limbuy@mail.montclair.edu) or mail: Marketing Department, Montclair State University, Montclair, New Jersey 07043.

DAVID RUTLEDGE is Associate Professor of Curriculum and Instruction at the College of Education, New Mexico State University. He is also the Interim Co-Chair of the Department of Curriculum & Instruction, and the Coordinator of Learning Technologies. His areas of specialization include learning technologies, ESL/Bilingual education, and international comparative education. His publications have appeared in the *AACE Journal* and numerous other national and international peer-reviewed journals. Dr. Rutledge can be contacted by e-mail (rutledge@nmsu.edu) or mail: Department of Curriculum and Technology, New Mexico State University, P.O. Box 30001, Las Cruces, New Mexico 88003-8001.