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TEACHER PREPARATION PROGRAMS AND TECHNOLOGY INTEGRATION: BEST PRACTICES FOR CURRICULUM DESIGN

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ABSTRACT

Differences in teacher preparation program design were investigated by researching conceptions of technology integration for pre-service teachers in both undergraduate and graduate programs. Participants responded to surveys regarding their technology skills and ideas about technology integration both at the beginning of their program coursework and after completing the technology requirement of their degree program. Responses were analyzed by program and graduate/undergraduate status in order to assess the impact of stand-alone courses verses an integrated model, and also to investigate changes in all students' dispositions regarding technology.

Keywords: Learning difficulties, Multiple representations-based instruction, Physics concepts, Action research, Problem-solving strategy, Intrinsic purpose of learning.

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1. INTRODUCTION

Pre-service teacher preparation programs have long struggled with the best way to prepare future teachers with the skills, information, and professionalism that they need to become effective teachers. Over the years, a variety of approaches and program designs have been created and implemented, touted as "the one." However, no specific curricular design has emerged as the single best way to prepare future teachers. Darling-Hammond *et al.* (2005) suggest that there may not be one best way to design teacher preparation programs, but rather some critical elements common to successful program designs that contribute to the effective professional preparation of teachers. These critical elements include student teaching and field experiences, portfolios and performance assessments, case studies, action research, analyses of teaching and learning, and autobiographies. Although these recurrent pedagogies represent progress in the overall design of teacher preparation programs, the ways in which specific focus areas within professional preparation curricula are incorporated are less widely studied and addressed. One of these specialized areas critical to pre-service teacher preparation is educational technology.

The Teacher Education Accreditation Council (TEAC) and the National Council for Accreditation of Teacher Education (NCATE) both recognize the need for teachers to be able to use technology effectively for student learning. TEAC includes technology as one of its three crosscutting themes, along with multicultural perspectives, and learning to learn (Teacher Education Accreditation Council, 2010). NCATE expects teacher education programs to address technology integration in a number of their standards when seeking accreditation (National Council for the Accreditation of Teacher Education, 2010-2012). Supporting both organizations' efforts to prioritize educational technology, The International Society for Technology in Education (ISTE) developed a set of National Educational Technology Standards for Teachers (NETS*T), outlining the skills and dispositions needed for teaching in the digital age (International Society for Technology in Education, 2008). While each of these organizations has stressed the importance of pre-service teacher's ability to use technology as a teaching tool, institutions of higher education have struggled with how best to respond to this issue as it relates to professional preparation program design. Today, discrete classes where students learn about equipment and best practices for integrating technology into teaching pedagogy are common in college curricula (Hargrave and Hsu, 2000; Hofer, 2005). However, newer models of teacher preparation programs incorporate a more integrated approach to curriculum, where coursework is interwoven and topics that previously were housed in dedicated courses (such as math pedagogy, learning theories, technology, etc.) are now incorporated developmentally throughout a curriculum (Hofer, 2005). Interestingly, the two models for teacher preparation programs, one with distinct courses in particular topics and the other with spiraled curricula, co-exist concurrently at institutions of higher education. While it would seem that curriculum design would have an impact on in-service and pre-service teacher's use of and attitude toward using technology in teaching practice, this has not been widely studied.

The bulk of the current research in educational technology and teacher education examines concepts, strategies, and knowledge that best enables current and future teachers to use technology in learning and instruction. The Technological Pedagogical and Content Knowledge (TPCK) model, which proposes a conceptual framework for effective technology integration in teaching and learning, was outlined in depth by the Association of American Colleges of Teacher Education AACTE Committee on Innovation and Technology (2009). Using this framework, (Polly, 2011) found that elementary school teachers experienced growth in technological, pedagogical, and content knowledge when creating technology-rich learning materials. Hsu (2012) researched specific learning experiences that could be incorporated into technology courses to better enable future teachers to use technology effectively. While research regarding technology content and pedagogical practice is crucial to pre-service and in-service teacher's ability to use educational technologies in professional practice, Berlin and White (2012) posit that an equally large barrier to technology integration is a teacher's philosophical and epistemological beliefs.

Since the appearance of computers in schools, teacher, and pre-service teacher's attitudes toward using technology have been investigated. Ertmer (2005) research argues that current teacher pedagogical beliefs are barriers to effective technology integration. Hew and Brush (2007) revealed several obstacles in K-12 schools when attempting to integrate technology into the curriculum, one of which is teacher attitudes and beliefs. And Nair and Das (2012) found that teacher's perceived usability had a significant impact on their perceptions about, utility of, and dispositions toward integrating technology into their teaching practices. Given that teacher's adoption of any educational innovation, particularly technology, is predicated on their belief that the innovation is valuable (Saldivar *et al.*, 2012) teacher and pre-service teacher's attitudes play a vital role in the way in which technology is integrated into teaching practice.

The current study contributes to the existing literature by investigating the impact of curriculum design on pre-service teacher's perceptions of using technology in education. It attempts to investigate the benefits and drawbacks of two pre-service preparation programs, one with distinct courses in particular topics and the other with spiraled curricula, for their impact on future teacher's attitudes toward and ability to integrate technology into teaching and learning practices.

2. METHOD

2.1. Participants

The teacher education program studied is a Division within a small, liberal arts institution with 6,000 students. It currently offers undergraduate and graduate degrees in Childhood Education (1-6), Special Education (B-12), Literacy (B-12), Adolescence, and Education (7-12). Of these students, 77% were women, 23% men. In addition, 88% of students were white and 12% from minority populations. The survey was conducted during the 2011-2012 academic year. All incoming students into initial certification programs were surveyed about their perceptions of technology in the classroom environment (approximately 160 students). In addition, all students completing their technology coursework were surveyed using the same question structure about their perceptions of technology in the classroom environment (approximately 120 students). The approximations for both numbers are due to the fact that exact enrollment numbers change throughout the semester and the survey was requested by individual course instructors. The total number of participants in the study consisted of 179 college students enrolled in initial certification programs at a small state university in northern New York. 89 of the participants were in their first semester of study, another 89 were completing their coursework in educational technology. One individual did not report where s/he was in his/her program of study. All participants ranged in age from 18-50 years old, with the majority between 18-21 years old, and none held initial teacher certification. Among students surveyed in their first semester of study, 24 were enrolled in a Bachelor of Science (B.S.) program in Childhood Education, 45 were in a combined Bachelor of Science/Masters in Education (B.S./M.S. Ed.) degree program in Childhood and Special Education, 3 were in a combined Bachelor of Arts/Masters of Science in Teaching (B.A./M.S.T.) program in Adolescence Education, 12 were in a Master of Science in

Teaching (M.S.T.) program in Adolescence Education, and 5 were in a Master of Science in Teaching (M.S.T.) program in Childhood Education. Of the students surveyed after taking their technology requirements, 26 were enrolled in a Bachelor of Science (B.S.) program in Childhood Education, 28 were in a combined Bachelor of Science/Masters in Education (B.S./M.S. Ed.) degree program in Childhood and Special Education, 19 were in a combined Bachelor of Arts/Masters of Science in Teaching (B.A./M.S.T.) program in Adolescence Education, 12 were in a Master of Science in Teaching (M.S.T.) program in Adolescence Education, and 4 were in a Master of Science in Teaching (M.S.T.) program in Childhood Education.

Students in the various stand-alone and combined M.S.T. programs were in the graduate portion of their coursework, while students in the B.S. and B.S./M.S. Ed. programs were engaging in their undergraduate courses. At the time of the survey, the graduate and undergraduate students were participating in two different models of teacher preparation programs. The graduate students were engaged in a more traditional form of teacher preparation, where distinct courses targeted specific topics (i.e. technology), while the undergraduate students were participating in a preparation program with a spiraled curriculum where technology is woven throughout their curriculum.

2.2. Procedures

Surveys were administered using the value-added approach which measures entering perceptions of students against a post-coursework assessment (Pedersen and White, 2011). This pre- and post-assessment was administered as an electronic survey given in targeted courses. The pre-survey was distributed in introductory courses both at the undergraduate and graduate level. The post-survey was administered after students completed their curriculum studies coursework in their junior year and the graduate, post-survey was administered after students completed the stand-alone technology course. The researchers outlined the purpose of the current study through a consent disclosure at the beginning of the survey. The surveys were distributed via email by course instructors for the pre-assessment and post assessment surveys were completed in class.

2.3. Criterion Measures

The pre-assessment survey was part of a broader initial perceptions electronic survey, which consisted of a total of 22 open-ended, and scaled responses, three of which specifically addressed technology. The follow-up (post-survey) only addressed technology questions and contained five technology specific questions (two additional questions were added regarding specific forms of technology). The technology questions assessed participant's knowledge and perception(s) of integrating technology into pedagogy, as well as basic skills with technology. Three questions were open-ended, and two questions utilized Likert-scales. Sample items from the survey are below (Question 1, 2, and 4 were included in both the pre and post course work survey):

1. How would you integrate technology into the classroom? Describe how you have or would integrate technology into a lesson.

2. How would you rate your skills in using technology in instruction (Excellent, Good, Fair, Poor)
3. How would you rate your ability to use the following forms of technology in a P-12 classroom: (Excellent, Good, Fair, Poor, Don't Know)
   a. Word Processing
   b. Databases (i.e. Excel)
   c. Presentation Software (i.e. PowerPoint, Presi)
   d. Internet Researching
   e. Web development
   f. Animation
   g. Video
   h. Smart Board
   i. Blogging
   j. Social networking
   k. Cell Phones
   l. Interactive web applications
   m. Virtual Worlds
4. Is there benefit to student learning if technology is integrated throughout a curriculum?
5. Do you feel that your skills in technology have been improved through your education coursework at SUNY Plattsburgh? Yes No Please describe.

2.4. Data Analysis

Most of the data analysis consisted of general demographic data, overall survey scores, and self-reported ability with various technologies, which were all tabulated using frequency counts. In addition, correlations between demographic data and self-reported ability with technologies were also calculated for the post-assessment survey. This consisted of Bivariate correlations of scores on qualitative items, age, degree program, year in coursework, and completion of technology courses.

Figure-1. Technology Rating Scale

Rating	Category
0	Technology is absent from planning and instruction
1	Technology is used only by teacher for communication and productivity (newsletters, research, etc.)
2	Technology is used by teachers as a reward to students for good classroom behaviour and only after "real work is done."
3	Technology is used by teachers to augment instruction (demonstrations, presentations, and movies)
4	Technology is used by students and teachers for research, writing papers and presentations.
5	Technology is woven throughout the curriculum and students are actively using technology to understand concepts and demonstrate learning.

Finally, scale definitions were created so that responses to the open-ended survey items could be rated (see Figure 1). The definitions were derived from the work of Han (2010) on theorizing new media and, more distantly, on the conceptualizations of Habermas (1989) on public life and social nature. The open-ended survey questions were coded using a thematic analysis based on the scale, and inter-rater agreement on scale definitions was established between the two researchers using consensus scoring.

3. RESULTS

3.1. Skills Using Technology in Instruction

Both groups, the "new" students, who were in their first semester of education coursework with minimal, if any, instruction about educational technology, and students completing their technology coursework were all asked to rate their skills using technology in instruction (see Table 1). 11 students who studied earlier in their curriculum rated themselves Excellent, while 34 of these same students responded Good. 19 of the "new" students self-evaluated their skills as Fair and 2 rated themselves Poor. Interestingly, of the students completing their technology coursework three rated themselves Excellent, 64 responded Good, 20 said Fair, and one rated him/herself Poor.

Table-1. Self-Evaluation of Skills for Using Technology in Instruction

		How would you rate your skills in using technology in instruction?				
		Excellent	**Good**	**Fair**	**Poor**	**Total**
Pre-Technology Coursework	Count	11	34	19	2	66
	Percentage	16.7%	51.5%	28.8%	3.0%	100.0%
Current-Technology Coursework	Count	3	64	20	1	88
	Percentage	3.4%	72.7%	22.7%	1.1%	100.0%
Total	Count	14	98	39	3	154
	Percentage	9.1%	63.6%	25.3%	1.9%	100.0%

Table 2 reveals how students in the various teacher preparation degree programs rated their ability to use technology in instruction. Of the 154 total responses to this question, 98 respondents across degree programs rated their skills for using technology in instruction as Good. Of those 98 responses, 42 were students in the combined B.S./M.S.Ed. program in Childhood and Special Education. Only three students across degree programs rated their skills as poor, but 39 respondents reported that their skills were Fair. Interestingly, only 14 students rated their skills as Excellent.

Table-2. Self-Evaluation of Skills for Using Technology in Instruction by Degree Program

		How would you rate your skills in using technology in instruction?				Total
		Excellent	Good	Fair	Poor	
In which program are you enrolled?	B.S. Childhood Education	4	29	10	0	43
	Combined B.S./M.S. Ed. Childhood Education (B-6)	8	42	12	0	62
	Combined B.A/M.S.T. Adolescence Education	0	11	8	1	20
	M.S.T. Adolescence Education	1	14	6	1	22
	M.S.T. Childhood Education	1	2	3	1	7
Total		14	98	39	3	154

Skills with Specific Technologies

Students completing their technology coursework were asked to rate their ability (Excellent, Good, Fair, or Poor) to use a variety of technologies in a P-12 classroom. These technologies included word processing, databases (i.e. Excel), presentation software (i.e. PowerPoint, Presi), internet researching, web development, animation, video, SmartBoard, blogging, social networking, cell phones, interactive web applications, and virtual worlds. The self-evaluations were then correlated with demographic data, such as age and gender, as well as self-evaluations of overall skill with technology in instruction, and ability to integrate technology into the classroom. Table 3 reveals a significant positive correlation between students perceived ability to use technology in instruction, and their self-evaluated skill with animation and with virtual worlds ($p<.05$). Significant positive correlations also exist at $p<.01$ between students self-rated skills with interactive web applications, blogging, SmartBoards, video, and web development, and their professed ability using technology in instruction.

Table-3. Correlations of Demographics, Technology Skill Self-Evaluations, and Ability to Integrate Technology into the Classroom

Correlations

		In which program are you enrolled?	How would you rate your skills in using technology in instruction?	Techology Scale Score	Please select your age within the following scale:	What is your sex?	Work Processing	Databases (i. e. Excel)	Presentation Software (i.e. PowerPoint, Presi)	Internet Researching	Web development	Animation	Video	Smart Board	Blogging	Social networking	Cell Phones	Interactive web applications	Virtual Worlds
In which program are you enrolled?	Pearson Correlation	1	.126	.300**	.582**	-.254*	-.175	-.162	-.027	-.134	-.023	.124	.102	-.090	.115	.183	.244*	-.090	.275**
	Sig. (2-tailed)		.244	.005	.000	.017	.106	.132	.801	.214	.833	.249	.348	.404	.287	.088	.022	.407	.010
	N	89	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
How would you rate your skills in using technology in instruction?	Pearson Correlation	.126	1	.101	.182	.071	.143	.196	.214*	.175	.387**	.224*	.293**	.484**	.316**	.170	.347**	.296**	.218*
	Sig. (2-tailed)	.244		.355	.089	.511	.186	.068	.047	.103	.000	.036	.006	.000	.003	.113	.001	.005	.042
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Techology Scale Score	Pearson Correlation	.300**	.101	1	.371**	-.052	-.122	.001	-.067	-.107	.016	-.005	-.021	.105	.063	.006	.060	-.113	-.028
	Sig. (2-tailed)	.005	.355		.000	.634	.265	.996	.542	.329	.883	.961	.852	.337	.565	.955	.580	.298	.797
	N	86	86	86	86	86	85	86	85	86	86	86	85	86	85	86	86	86	85
Please select your age within the following scale:	Pearson Correlation	.582**	.182	.371**	1	-.227*	-.132	-.144	-.038	-.173	.031	.029	.033	-.052	.098	.335**	.321**	-.085	.139
	Sig. (2-tailed)	.000	.089	.000		.034	.224	.182	.728	.106	.774	.790	.758	.631	.366	.001	.002	.432	.199
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
What is your sex?	Pearson Correlation	-.254*	.071	-.052	-.227*	1	-.001	.253*	-.063	.010	.084	.139	.160	.145	.064	-.171	-.059	.144	-.011
	Sig. (2-tailed)	.017	.511	.634	.034		.990	.018	.562	.929	.438	.198	.140	.180	.558	.113	.590	.182	.921
	N	87	87	86	87	87	86	87	86	87	87	87	86	87	86	87	87	87	86
Work Processing	Pearson Correlation	-.175	.143	-.122	-.132	-.001	1	.290**	.381**	.224*	.204	.092	.204	.230*	.148	.125	.047	.250*	.072
	Sig. (2-tailed)	.106	.186	.265	.224	.990		.006	.000	.037	.058	.398	.060	.032	.174	.250	.662	.019	.509
	N	87	87	85	87	86	87	87	86	87	87	87	86	87	86	87	87	87	86
Databases (i.e. Excel)	Pearson Correlation	-.162	.196	.001	-.144	.253*	.290**	1	.007	.153	.315**	.435**	.297**	.330**	.115	-.032	-.086	.217*	.177
	Sig. (2-tailed)	.132	.068	.996	.182	.018	.006		.952	.156	.003	.000	.005	.002	.289	.766	.424	.042	.102
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Presentation Software (i. e. PowerPoint, Presi)	Pearson Correlation	-.027	.214*	-.067	-.038	-.063	.381**	.007	1	.318**	.207	.131	.332**	.340**	.343**	.332**	.232*	.166	.236*
	Sig. (2-tailed)	.801	.047	.542	.728	.562	.000	.952		.003	.054	.227	.002	.001	.001	.002	.031	.124	.029
	N	87	87	85	87	86	86	87	87	87	87	87	86	87	86	87	87	87	86
Internet Researching	Pearson Correlation	-.134	.175	-.107	-.173	.010	.224*	.153	.318**	1	.243*	.198	.401**	.340**	.234*	.111	.149	.453**	.222*
	Sig. (2-tailed)	.214	.103	.329	.106	.929	.037	.156	.003		.023	.064	.000	.001	.029	.303	.165	.000	.039
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Web development	Pearson Correlation	-.023	.387**	.016	.031	.084	.204	.315**	.207	.243*	1	.562**	.438**	.400**	.360**	.052	.074	.512**	.298**
	Sig. (2-tailed)	.833	.000	.883	.774	.438	.058	.003	.054	.023		.000	.000	.000	.001	.633	.494	.000	.005
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Animation	Pearson Correlation	.124	.224*	-.005	.029	.139	.092	.435**	.131	.198	.562**	1	.505**	.388**	.290**	-.026	-.077	.388**	.518**
	Sig. (2-tailed)	.249	.036	.961	.790	.198	.398	.000	.227	.064	.000		.000	.000	.006	.813	.477	.000	.000
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Video	Pearson Correlation	.102	.293**	-.021	.033	.160	.204	.297**	.332**	.401**	.438**	.505**	1	.444**	.422**	.192	.131	.483**	.353**
	Sig. (2-tailed)	.348	.006	.852	.758	.140	.060	.005	.002	.000	.000	.000		.000	.000	.074	.227	.000	.001
	N	87	87	85	87	86	86	87	86	87	87	87	87	87	87	87	87	87	86
Smart Board	Pearson Correlation	-.090	.484**	.105	-.052	.145	.230*	.330**	.340**	.340**	.400**	.388**	.444**	1	.167	-.025	.040	.350**	.246*
	Sig. (2-tailed)	.404	.000	.337	.631	.180	.032	.002	.001	.001	.000	.000	.000		.122	.819	.710	.001	.022
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Blogging	Pearson Correlation	.115	.316**	.063	.098	.064	.148	.115	.343**	.234*	.360**	.290**	.422**	.167	1	.413**	.422**	.340**	.578**
	Sig. (2-tailed)	.287	.003	.565	.366	.558	.174	.289	.001	.029	.001	.006	.000	.122		.000	.000	.001	.000
	N	87	87	85	87	86	86	87	86	87	87	87	87	87	87	87	87	87	86
Social networking	Pearson Correlation	.183	.170	.006	.335**	-.171	.125	-.032	.332**	.111	.052	-.026	.192	-.025	.413**	1	.758**	.278**	.318**
	Sig. (2-tailed)	.088	.113	.955	.001	.113	.250	.766	.002	.303	.633	.813	.074	.819	.000		.000	.009	.003
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Cell Phones	Pearson Correlation	.244*	.347**	.060	.321**	-.059	.047	-.086	.232*	.149	.074	-.077	.131	.040	.422**	.758**	1	.303**	.295**
	Sig. (2-tailed)	.022	.001	.580	.002	.590	.662	.424	.031	.165	.494	.477	.227	.710	.000	.000		.004	.006
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Interactive web applications	Pearson Correlation	-.090	.296**	-.113	-.085	.144	.250*	.217*	.166	.453**	.512**	.388**	.483**	.350**	.340**	.278**	.303**	1	.514**
	Sig. (2-tailed)	.407	.005	.298	.432	.182	.019	.042	.124	.000	.000	.000	.000	.001	.001	.009	.004		.000
	N	88	88	86	88	87	87	88	87	88	88	88	87	88	87	88	88	88	87
Virtual Worlds	Pearson Correlation	.275**	.218*	-.028	.139	-.011	.072	.177	.236*	.222*	.298**	.518**	.353**	.246*	.578**	.318**	.295**	.514**	1
	Sig. (2-tailed)	.010	.042	.797	.199	.921	.509	.102	.029	.039	.005	.000	.001	.022	.000	.003	.006	.000	
	N	87	87	85	87	86	86	87	86	87	87	87	86	87	86	87	87	87	87

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Integration of Technology into the Classroom

Coded ratings of open-ended questions about student's perceptions of and ability to integrate technology into the classroom ranged from 5 (high) to 0 (low). Scores were averaged across all open-ended questions to achieve a mean rating for each student. Table 4 illustrates the frequency of scores for these questions across undergraduate and graduate students who were completing coursework in educational technology. The majority of students, 41 undergraduate and 16 graduate, had a rating of 3 - Technology is used by teachers to augment instruction (demonstrations, presentations, and movies) on their ability to integrate technology into the classroom.

Table-4. Coded Scores on Open-Ended Questions by Undergraduate/Graduate Level

	Score on Open-Ended Questions				
	2	**3**	**4**	**5**	**Total**
Undergraduate	3	41	8	1	53
Graduate	1	16	13	3	33
Total	4	57	21	4	86

Table 5 reveals the frequency of mean scores for questions about student's perceptions of and ability to integrate technology into the classroom across students new to their program of study and students completing coursework in educational technology. The majority of both groups, 47 students in the technology courses and 23 students who had not yet engaged in their coursework, scored a 3 - Technology is used by teachers to augment instruction (demonstrations, presentations, and movies) on their ability to integrate technology into the classroom. Unsurprisingly, 19 students who were enrolled in their technology coursework had mean scores of 5 - Technology is woven throughout the curriculum and students are actively using technology to understand concepts and demonstrate learning - on the open-ended questions, while only 6 "new" students had the same scores.

Table-5. Coded Scores on Open-Ended Questions by Completion of Technology Coursework

	Score on Open-Ended Questions						
	0	**1**	**2**	**3**	**4**	**5**	**Total**
Pre-Technology Coursework	1	1	21	23	6	6	58
Current-Technology Coursework	0	0	5	47	15	19	86
Total	1	1	26	70	21	25	144

A significant difference at the $p<.01$ level was found between the type of curriculum in which students engaged in technology coursework (spiral curriculum where technology preparation is woven through coursework vs. a traditional curriculum with stand-alone technology classes) and scores on open-ended questions about using technology in the classroom. Table 6 reports the Pearson correlation coefficient as .321, showing that in the stand-alone courses students discussed and experienced a more complete integration of technology into curriculum.

Table-6. Correlation of Coded Scores on Open-Ended Questions by Completion of Technology Coursework

		Curriculum Design	Score on Open-Ended Technology Questions
Curriculum Design	Pearson Correlation	1	.321**
	Sig. (2-tailed)		.003
	N	89	86

**. Correlation is significant at the 0.01 level (2-tailed).

4. DISCUSSION

Both prior to coursework in educational technology, and while taking technology classes, students rated their ability with various technologies as "Good." Interestingly, more students who had not yet taken their educational technology classes rated their skills as "Excellent" than did those who were engaged in this type of coursework. This finding could be due to the fact that students currently in classes were exposed to technologies with which they previously had no experience, or which they hadn't thought of as useful in teaching and learning. Additionally, discussions concerning 21st century skills and the ISTE NETs standards for teachers likely took place during technology coursework, thus creating a potential new awareness for the types of technologies teachers were expected to use in the classroom and a realization by students that they still had a lot to learn.

A significant, positive, correlation was found between students perceived ability to integrate technology into instruction and their self-evaluated technology skills with certain applications and multimedia, such as blogging, Smart Boards, video, web development, and interactive web applications. These results support the idea that technologically-savvy pre-service teachers are more likely to use technology in deep and meaningful ways in the classroom, beyond just the standard presentations and Internet research that often occur in schools today. The finding also upholds the philosophy that pre-service teachers need to develop their technology skills while in their professional preparation programs, rather than just learn how to use the skill sets that they currently possess for educational purposes.

The majority of both graduate and undergraduate students rated giving demonstrations/presentations, and showing movies as the way that they perceived that technology could be integrated into the classroom. Intriguingly, the majority of students both in their technology coursework and those who have not yet taken educational technology classes had the same perception of how technology is integrated into instruction. While this shows that student perceptions of infusing technology into education does not change by the level of study or where in technology coursework students engage, educational technology classes may have some impact in the way students view using technology in classrooms. Of the 86 students completing their educational technology coursework, approximately 22%, or 19 students, considered effective integration of technology into education as "woven throughout the curriculum and having students actively using technology to understand concepts and demonstrate learning." While not a generalizable finding, technology coursework does help some students think about using technology in classrooms in rich and engaging ways.

Overall, the majority of students in all degree programs rated their ability to integrate technology into instruction as "Good." This reveals that, regardless of type of education program and its associated curriculum design, students perceived their preparation in educational technology as adequate. However, students completing their technology coursework scored more highly on questions about integrating technology into the classroom than did students new to their program of study. Therefore, the way in which educational technology study is positioned in a curriculum may impact a future teacher's skill with and ability to use technology in the educational process. Additionally, there was a significant difference in scores on open-ended questions about using technology in the classroom between students in degree programs with a spiral curriculum (where technology preparation is woven through the coursework) and students in specialized technology courses. Students in stand-alone technology courses scored significantly higher on questions about using technology for teaching and learning than did their counterparts enrolled in courses with content that was integrated. These findings support the idea that deep study in educational technology, in classes dedicated to the topic, does impact pre-service teacher's conceptions of using technology in the teaching and learning process. Students engaged in such professional preparation come to view technology as more than a vehicle for communication and research, but rather as a powerful way for students to convey meaning and represent knowing. With the current emphasis in today's schools on 21st century skill acquisition, it's imperative that teachers entering and currently in the field are professionally prepared with contemporary best practices in educational technology.

Finally, although prior to taking educational technology classes students feel that they have proficient skill with technologies, they are unclear, and in a very few cases seemingly unwilling, to discuss how to effectively utilize technology to enhance teaching and learning. Although an unsurprising result, it does inform teacher preparation in two ways. The first is that today's pre-service teachers feel confident in their ability to use various technologies, but self-reported skills are often erroneous because ability can be inflated or under-estimated. It would likely be best for instructors in preparation programs to directly assess pre-service teachers' baseline ability with technology to determine where their skills need to be developed or areas in which they need to grow. In addition, students need instruction on what it means to effectively integrate technology into teaching since it is clear that they do not know how to do it in a way that maximally enhances the teaching and learning process. These results are intriguing because they cross initial preparation for students in both the graduate/traditional teacher preparation program and the undergraduate/spiraled teacher preparation program.

Further research implications for professional teacher preparation and the study of educational technology are warranted. The current study could be extended to account for the professional preparation of faculty teaching in the various programs and curriculum designs. Often, in programs with spiral curricula, faculty are expected to teach all facets of teacher education, including educational technology. Unfortunately, not all college faculty are academically prepared to do so. Conversely, college faculty trained as educational technologists generally always teach stand-alone technology courses, thereby giving those instructors and the students in their courses a distinct advantage in their technology preparation. A future research study could take into consideration the professional preparation of college faculty and the effect that has on pre-service teacher's attitudes toward and ability to effectively integrate technology into teaching and learning in various types of degree program curricular designs.

In future, it would also be useful to compare pre-service teacher's technology skill development and their subsequent ability to effectively integrate technology into actual classroom practices. For instance, it would be worth investigating the opportunities that student teachers are trying to use technology to enhance teaching and learning during their practicum experiences. Additionally, investigating student skills and perceptions of technology in education in both traditional degree programs and those with spiral curricula, where both have engaged in deep study of technological applications for teaching and learning is important. Such research may support the findings of Darling-Hammond *et al.* (2005) that there may not be one best way to design teacher preparation programs. However, as long as the common, critical, element of relevant and challenging study of technology in education exists, many types of successful program designs can contribute to the effective professional preparation of teachers.

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