Education Tech Research Dev (2014) 62:13–33
DOI 10.1007/s11423-013-9325-2

RESEARCH ARTICLE

Development and validation of the educational technologist multimedia competency survey

Albert D. Ritzhaupt · Florence Martin

Published online: 28 November 2013

Abstract The purpose of this research study was to identify the multimedia competencies of an educational technologist by creating a valid and reliable survey instrument to administer to educational technology professionals. The educational technology multimedia competency survey developed through this research is based on a conceptual framework that emphasizes the current definition of the field. Following the conceptual framework, a review of literature and an emergent theme analysis on 205 job announcements in educational technology were conducted. Eighty-five multimedia competencies were derived from this analysis and organized into knowledge, skill, and ability statements. These data were examined using descriptive statistics, internal consistency reliability, exploratory factor analysis, and multivariate analysis of variance. Though the purpose of the instrument was to measure multimedia competencies relevant to the field of educational technology, other constructs on the instrument emerged as more important in the analysis. The results include key competencies, such as knowledge of methods and theories of instruction; soft skills; and the ability to work in a team-oriented environment. A discussion about the results is provided. The instrument was found to have a valid and internally consistent structure.

Keywords Multimedia competencies · Educational technologist · Instructional designer · Competencies

A. D. Ritzhaupt (✉)
School of Teaching and Learning, College of Education, University of Florida, 2423 Norman Hall, PO Box 117048, Gainesville, FL 32611, USA
e-mail: aritzhaupt@gmail.com

F. Martin
University of North Carolina Wilmington, Wilmington, NC, USA

Introduction

What multimedia knowledge, skills, and abilities must one possess to be an effective educational technologist? This question has been addressed by several researchers and practitioners (Ritzhaupt et al. 2010; Sugar et al. 2012; Daniels 2008; Daniels et al. 2012; Wakefield et al. 2012). The answers remain inconclusive, but prior research on the topic suggests that educational technologists must be abreast in software packages and tools, including screen recording software, office productivity software, learning management systems, digital video and audio software (Ritzhaupt et al. 2010; Sugar et al. 2012).

The research has used a wide variety of techniques, including job announcement analysis (Ritzhaupt et al. 2010; Sugar et al. 2012), Delphi technique (Daniels et al. 2012), and survey research (Ritzhaupt et al. 2010; Sugar et al. 2009). While methodological variety is desirable, there is no single valid and reliable mechanism to measure the beliefs of educational technology professionals based on sound principles. A framework to explain the multimedia competencies of an educational technologist is presented. The article provides a systematic procedure to develop a valid and reliable survey instrument for measuring the perceptions of educational technology practitioners. The conceptual framework is described, relevant literature is reviewed, and the creation of a prototype instrument is documented. Test of the instrument's construct validity and reliability are presented. Additional discussion is provided, and the instrument is available in the Appendices.

Relevant literature

Conceptual framework

The conceptual framework incorporates a definition of educational technology (Januszewski and Molenda 2007) and connects the definition to knowledge, skill, and ability statements (Wang et al. 2005). Knowledge, skill and ability statements were adopted because they are used to generate competencies for licensure and certification exams (Wang et al. 2005). In this study, knowledge, skill, and ability statement represent the various competencies of educational technologists. The definition of the field of educational technology adopted highlights three actionable terms for summarizing the work of professionals in the field: create, use, and manage.

> "Educational technology is the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources" (Januszewski and Molenda 2007, p. 1).

Figure 1 illustrates the conceptual framework. Figure 1 illustrates a triangle to envision the knowledge, skill, and ability statements. Knowledge statements refer to an organized body of information, usually factual or procedural. Skill statements refer to the manual, verbal or mental manipulation of things. Finally, ability statements refer to the capacity to perform an activity. These statements can be thought of as overlapping in which skills rest upon knowledge, and abilities rest upon skills as illustrated in Fig. 1. For example, the "Ability to create a web-site" might require knowledge of several areas, such as the hypertext markup language, web authoring tools, and cascading style sheets, and also require skills in web design. These competency layers are not mutually exclusive categories and may overlap.

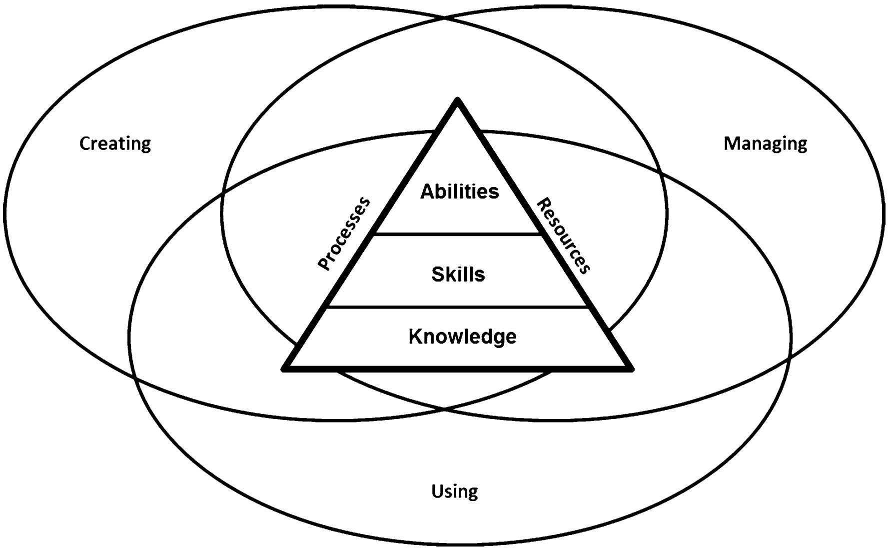

Fig. 1 Knowledge, skill, and ability statements as core multimedia competencies in educational technology (adapted from Ritzhaupt et al. 2010)

Competencies are generally measurable or observable knowledge, skills, abilities, attitudes, and behaviors critical to successful job performance. Many terms can describe a competency. For instance, Richey et al. (2001) define competency as "a knowledge, skill or attitude that enables one to effectively perform the activities of a given occupation or function to the standards expected in employment" (p. 31). The focus here is on knowledge, skill, and ability statements as the competencies. Though, attitudes or behavior are important, they are effectively captured using the statement derived in this current study. Finally, the term educational technologist has been defined in this study to include job titles like instructional designer, performance technologist, curriculum designer, instructional developer, e-learning specialist, and other relevant titles used to describe professionals in the field.

Developing competencies

A key aspect of developing degree program core curricula is ensuring alignment with expectations for those graduating in a field. It is essential educators teach material that learners will need in their professional career. Since technology applications are constantly changing, the competencies should be gauged periodically. Several organizations have attempted to document the competencies of professionals in our field, including Association for Educational Communications and Technology (AECT), International Board of Standards for Training, Performance and Instruction (IBSTPI), American Society for Training and Development (ASTD), and International Society for Performance Improvement (ISPI).

Earle and Persichitte (2005) identified multimedia competencies as part of the AECT curriculum standards. AECT standards for preparing school media specialists and educational technology specialists. The standards were categorized in the different domains of design, development, utilization, management, and evaluation. A new set of standards has been adopted by the AECT board of directors in 2012. The main categories in these standards are content knowledge, content pedagogy, learning environments, professional knowledge and skills, and research (AECT 2012).

The IBSTPI competency model consists of three main components, domains, competencies, and more specific performance statements associated with each competency. In the 2012 revision there were 22 newly updated IBSTPI instructional design competencies. These competencies were grouped into five domains and were supported by 105 performance statements. The competencies were identified as essential, advanced, or managerial. In developing the competency revisions, the board found that technology had distinctly transformed instructional design and predicted that it is likely to continue to strongly influence on what instructional designers do. IBSTPI followed a rigorous process to develop and validate competencies (Klein and Richey 2005). Richey et al. (2001) identified knowledge, skills, attitudes, and tasks associated with a particular job role of instructional designer as analyst/evaluator, online learner, instructor, and training manager. Once a job role was defined then current practices and existing standards were identified to facilitate competency development. Additionally, ethics and values were used to evaluate job-related behaviors. Finally, evolving nature and the future of the job roles were articulated. IBSTPI competency development process included five major phases: (1) identification and review of foundational research (2) competency drafting (3) competency validation (4) revision and rewriting and, (5) publication and dissemination (Spector et al. 2006). The formal competency validation process included a survey research to establish the extent to which each competency and performance statement is clearly stated and representative of a critical job-related function, task or activity. These instruments were administered to a several hundred practitioners and scholars in diverse geographical locations and work environments.

ASTD has developed competency-based standards for the Certified Professional in Learning and Performance (CPLP) (ASTD 2009). ASTD also has developed a competency model for learning and performance, which identifies the roles, areas of expertise, and foundational competencies for professionals in the learning and performance field. This model was developed using a data-driven approach with content validated by thousands of learning and development professionals. The model redefines the skills and knowledge required for trainers to be successful. This model was originally developed in 2004 but was updated in 2008–2009 and again in 2010–2011.

ISPI also developed an industry certification: the Certified Performance Technologist (CPT) (ISPI 2013). It has designed and developed a set of 10 standards and six principles based on the ISPI code of ethics. The standards include focusing on outcomes, determining the cause and the performance requirements, and measuring intervention results and impact (ISPI 2013). The standards were developed by a special 30-member taskforce of performance improvement professionals from across the globe. The CPT has been earned by more than 1,100 learning and performance professionals in 26 different countries (ISPI 2013).

Additionally, a number of studies have been conducted to identify multimedia competencies for educational technologists (Sugar et al. 2012; Wakefield et al. 2012; Lowenthal et al. 2010; Earle and Persichitte 2005). Job announcement analysis is one of the common identification methods, the other two being survey research and Delphi techniques.

Brown et al. (2007) identified entry-level multimedia production competencies and skills of educational technology professionals. They implemented a biennial survey on multimedia production competencies, asking current instructional design and technology employers what skills and competencies that a current graduate needs to have in order to succeed in their particular workplace. The survey instrument is based on Earle and Persichitte (2005), Richey et al. (2001) competencies. They received 36 responses to their 14-item survey. All of the respondents were engaged in the media production process with over eighty percent of the respondents (80.6 %) administering or specifying content for media production personnel and almost seventy percent having (69.4 %) media production as one of their professional responsibilities. When asked to identify computer-based authoring skills that an instructional design and technology graduate needs to possess, they found that the respondents top two choices were Flash and Dreamweaver (Brown et al. 2007). Using images as buttons, creating of non-linear navigation, sound files and animation files were key authoring skills. Survey results were helpful in aligning program curriculums with the needs of the professional educational technology community. The survey results were also helpful to determine trends in the use of various software applications.

Martin and Winzeler (2008) identified competencies for multimedia knowledge, skills and tools. In a 26-item survey combined in three categories of knowledge, skill, and tools, 28 responses were received from educational technology professionals. Web design skills and tools were rated the highest in two categories. Graphic design skill was considered as an important skill for educational technologists. The survey also emphasized the importance of theory-based multimedia design principles.

Wakefield et al. (2012) analyzed 59 instructional design job postings and identified key competencies such as skills, knowledge, and behaviors. Five broad competencies were in high demand (communication and interpersonal skills, managing multiple instructional design projects, specific traits, and skills that may make a candidate more successful within the field such as working collaboratively in teams).

Lowenthal et al. (2010) analyzed what instructional designers need to know and sought to understand the tools and technologies required of instructional designers and e-learning professionals. From their job announcement analysis, the top three results were general instructional design experience, communication skills and collaboration skills. In the technical skills category they found that learning management systems, web development and Microsoft office at the top of their list.

Richey et al. (2001) in their list of IBSTPI competencies listed several multimedia skills as primary requirement for the e-learning specialist. These competencies include applying principles of message design, creating or selecting visuals that instruct, orient or motivate, delivering presentations that effectively engage and communicate, select appropriate media and delivery systems, select or modify existing instructional material, develop instructional materials among several others.

Job announcement analysis for competencies

Job announcement analysis has been one of the common methods of identifying competencies (Moallem 1995; Sugar et al. 2012; Ritzhaupt et al. 2010). Job announcement analysis is defined as “any process of collecting, ordering, evaluating work or worker-related information” (p. 8). Dessler (2004) defines it as the procedure for determining the duties and skill requirements of a job and the kind of person who should be hired. Job analysis data can be used in a number of different ways—recruitment and selection, compensation, performance appraisal, discovering unassigned duties, compliance, job restructuring, training program development, qualifications standard development, test development, performance evaluation, preparation of accurate job descriptions, and employee counseling (Dessler 2004; Wilson 1974).

Sugar et al. (2012) analyzed 615 job postings to identify multimedia competencies for instructional technologists. In this study, two researchers examined each job posting. Each statement from the job posting was analyzed and was the unit of analysis. Specific themes emerged from the specific job postings. Then, 66 specific categories were developed from their analysis using a constant-comparative technique (Creswell 2009; Glaser and Strauss 1967; Lincoln and Guba 1985). They also analyzed and tabulated these categories using Hartley et al. (2010) competence domains: Knowledge (e.g., adult learning theories); Process (e.g., learning how to use a particular software program); Application (e.g., how to conduct a needs assessment); Personal and Social (e.g., effective communication skills); and Innovative and Creative (e.g., visual design). Particular media formats (e.g., Flash) also were recorded.

Moallem (1995) analyzed 150 jobs (57 business/industry, 54 university/school district, and 39 government/military) during a 3 year time period. Each job announcement was examined, and each unit of information related to required skill or knowledge was recorded. The units were categorized based on skill, knowledge and experience, and the unit frequencies in each category were tabulated. Cross tabulations were done to compare the occurrence of skills and knowledge areas within one category to their occurrence of skills and knowledge areas in other categories. Most frequently required and least frequently required skills and areas of knowledge were also identified.

Purpose statement

Though, there are many different approaches to validate competencies, a reasonable assumption is that professionals in the field should be included in the process as was done in competency validation process of IBSTPI. We released our competencies to professionals within the field of educational technology to target the relative importance of each competency. This not only served as a mechanism to assess the relative importance of each competency, it also served a mechanism to validate the instrument based on an acceptable sample.

The purpose of this research study was to identify the multimedia competencies for educational technologist by creating a valid and reliable survey instrument to administer to educational technology professionals. The research question answered in this study is: What multimedia knowledge, skills, and abilities must one possess to be an effective educational technologist? The following section outlines our methodology for this endeavor.

Method

Instrument development procedures

The instrument used to assess competencies in this study was developed in three steps. First, an extant literature review was conducted to examine the types of knowledge, skills, and abilities recommended by the experts in the field (Alessi and Trollip 2001; Mayer 2001; Moallem 1995; Tennyson 2001; Kenny et al. 2005; Sumuer et al. 2006; Ritzhaupt et al. 2010; Sugar et al. 2009, 2012; Daniels et al. 2012; Wakefield et al. 2012). Second, 205 educational technology job announcements were analyzed using an emergent themes analysis (Tashakkori and Teddlie 1998). These job announcements were collected from the AECT database, ASTD Database, CareerBuilder, Chronicles of Higher Education,

Table 1 Job announcements by online job database

Job database	*n*	%
AECT database	1	0.49
ASTD database	3	1.46
Career builder	50	24.39
Chronicles of higher education	11	5.37
eLearning guild	6	2.93
Higher education jobs	39	19.02
ISPI database	4	1.95
Monster	91	44.39

eLearning Guild, Higher Education Jobs, ISPI Database, and Monster over a 3 month period. All job announcements were verified as within the field of educational technology by reading the announcements themselves. They included job titles like instructional designer, educational technologist, curriculum designer, etc. and had to include the keyword "multimedia." Table 1 shows the distribution of job announcements compiled from each online database. As can be gleaned, the majority of the jobs were compiled from Monster, career builder, and higher education jobs.

The analysis revealed over 85 key multimedia competencies organized into knowledge, skill and ability statements. These competencies represent the processes and resources educational technologists employ for practice illustrated in Fig. 1. Third, the instrument was reviewed by three professionals within the field educational technology for clarity and intent. Statements were revised and assigned the following response scale: Not important at all (1); Important to a small extent (2); to some extent (3); to a moderate extent (4); and to a great extent (5). This response scale was adopted to gauge the relative importance of a competency from an educational technology professional's perspective. The instructions for participants read "Please indicate the importance of the following (knowledge/skill/ability) statements in creating, using, and managing multimedia learning resources and processes." The final instrument included a background section that collected relevant demographic information and 85 competency items in one of the three domains (i.e., knowledge, skills, and abilities). The given name of the survey was the educational technologist multimedia competency survey (ETMCS).

Participants

The ETMCS was sent to several educational technology listservs as outlined in the 'Procedures' section. Two-hundred thirty-one respondents completed at least a portion of the instrument. Only 192 participants responded to at least half the instrument and were retained in the sample. Participants represented wide range of backgrounds (see Table 2). Sixty percent of the sample were females. Participants had a wide range of income with ~39 % in the $50,001–$75,000 range. Participants also had a wide range of experience. Most (80 %) participants were classified as White/Caucasian. The majority of the participants were employed in higher education and held a master's degree or higher.

The respondents were members of a wide range of professional associations, including 32 % having membership in AECT, 20 % having membership in ISTE, 12 % in ASTD, 10 % in ISPI, and 8.7 % in AACE. Eighty-five percent of the respondents reside within the United States, and the remaining represent diverse international countries including South Africa, the Netherlands, the United Kingdom, and the United Arab Emirates.

Table 2 Demographic characteristics of participant population

	n	%
Gender		
Female	115	59.9
Male	77	40.1
Income level		
\$0–\$30,000	27	14.1
\$30,001–\$50,000	41	21.4
\$50,001–\$75,000	74	38.5
\$75,001–\$100,000	35	18.2
\$100,001–\$150,000	11	5.7
>\$150,000	4	2.1
Ethnicity		
American Indian/Alaska native	1	.5
Asian	15	7.8
Black/African American	6	3.1
White/Caucasian	155	80.7
Hispanic/Latino	7	3.6
Other	8	4.1
Years experience (years)		
0–4	58	30.2
5–8	43	22.4
9–12	46	24.0
13–16	20	10.4
17–20	4	2.1
>20	21	10.9
Context		
Business/industry	28	14.6
Currently unemployed	9	4.7
Government	4	2.1
Higher education	134	69.8
K-12	16	8.3
Military	1	.5
Highest degree earned		
High school	2	1.0
Associates	2	1.0
Bachelors	24	12.5
Masters	108	56.3
Specialist	5	2.6
Doctorate	51	26.6

Procedures

The ETMCS was released to a wide audience via the ITFORUM listserv, INSTTECH-listserv (Educause), AECTlistserv, the Florida State University Alumni listserv, Arizona University Alumni listserv, and the of University of South Florida Alumni listserv. All of these listservs have practicing educational technology professionals in their membership.

The survey was accessible for a 3-week period, and during this time, two reminder emails were sent out. Since so many different listservs were used to recruit respondents, response rates cannot be determined because each listserv does not have unique membership (and an individual could belong to two or more of the listservs).

Data analysis

Data were subjected to descriptive analysis, internal consistency reliability analysis, and exploratory factor analysis (EFA). EFA was conducted to explore the underlying structure of the data. Additionally, multivariate analysis of variance (MANOVA) was conducted on these data to determine whether individual differences occur across the various demographics. All quantitative analyses were conducted using SPSS version 20. An alpha level of .05 was used for all statistical tests.

Results

The Appendices include the complete survey instrument with associated item-level statistics, including the mean, standard deviation, and the coefficients from the pattern matrix from the EFA. Items are assigned to constructs following the Kaiser criterion with eigenvalues greater than or equal to one. Internal consistency reliability, as measured by Cronbach's alpha, for the scale was very high in each domain at $\alpha = .96$ for knowledge, $\alpha = .93$ for skill, and $\alpha = .95$ for ability. The Cronbach's alpha for the total scale is $\alpha = .98$.

Exploratory factor analysis

Bartlett's test of sphericity for these data had a Chi square of 14314.72 ($p < .001$), which suggested the intercorrelation matrix contained adequate common variance. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.90, which was above the 0.5 recommended limit (Kaiser 1974). Separate EFAs were conducted for each domain (knowledge, skills, ability). The participant-to-item ratio for the knowledge domain is approximately 5:1, for the skill domains ~9:1, and for the ability domain 8:1. All of the participant-to-item ratios are below the 10:1 ratio for factor analysis suggested by Kerlinger (1974) and above the thresholds described as more than adequate by some researchers in maintaining factor stability (Arrindell and Van der Ende 1985; Guadagnoli and Velicer 1988). Thus, these data appeared to be well suited for factor analysis. All EFA models were executed using principal axis factoring and an oblique (promax) rotation, as the factors were anticipated to be related.

Knowledge domain

Knowledge statements refer to an organized body of information usually of a factual or procedural nature. There were 41 knowledge statements derived from the conceptual framework and three step process (review of literature, job announcement analysis, and review by professionals). The EFA on these data showed that eight factors were extracted in nine rotations. The data exhibited a relatively simple structure in the pattern matrix, which is shown in see Appendix 1 in Table 7 along with the descriptive statistics for each item. These data meaningfully loaded on relevant factors to the field of educational technology. The eight factor model explained ~65 % of the variance in these data. As can

Table 3 Knowledge domain factors and statistics

Factor label	M	SD	% of variance	Cumulative variance	Number of items	Cronbach alpha
1. Educational authoring and utility software	2.90	0.89	39.265	39.265	7	.90
2. Graphics, web, audio and video software	3.71	0.88	7.224	46.489	7	.92
3. Theories and methods of instruction	3.89	0.78	5.777	52.266	7	.87
4. Programming and scripting languages	3.02	0.95	4.033	56.299	7	.91
5. Office production software	3.52	0.88	2.526	58.825	4	.82
6. Course management software	3.85	0.90	2.455	61.280	4	.82
7. Accessibility and copyrights	3.55	0.99	1.942	63.222	3	.80
8. Computer hardware and networks	3.23	1.00	1.862	65.084	2	.81

be gleaned in Table 3, all of the factors have suitable internal consistency reliability ranging from .80 to .92, which is well above the .7 social science standard (Nunnally 1978). Also notable is that *theories and methods of instruction*; *course management software*; *office production software* and *graphic, web, audio, and video software* were the highest rated factors. *Educational authoring and utility software*, and *programming and scripting languages* were the least rated factors.

Skill domain

Skill statements refer to the adept manual, verbal or mental manipulation of things (Ritzhaupt et al. 2010). There were a total of 21 skill statements derived from the conceptual model and three phase implementation of the survey. The EFA on these data showed that four factors were extracted in six rotations. Again, the data exhibited a relatively simple structure in the pattern matrix, which is shown in see Appendix 2 in Table 8 along with the descriptive statistics for each item. The four factor model explained ~67 % of the variance in these data. As can be seen in Table 4, *soft skills*, which include things like interpersonal skills, written and oral communications skills, had the highest score of all the factors in the skills domain. *Multimedia production skills*, which encompasses things like web, print, and graphics design, actually had the lowest of all the factors. Again, all of the factors have acceptable internal consistency reliability ranging from .76 to .91.

Ability domain

Ability statements refer to the capacity to perform an observable activity (Ritzhaupt et al. 2010). There were 23 ability statements derived from the conceptual framework and three phases in the survey's development. The EFA on these data showed four factors extracted from eight rotations. Again, the data exhibited a relatively simple structure in the pattern matrix, which is shown in see Appendix 3 in Table 9 along with the descriptive statistics for each item. The four factor model explained ~69 % of the variance in these data. As illustrated in Table 5, the highest rated factor was the ability of a professional to *Work in a team-oriented environment*. This factor included items like the ability to manage teams, work well with others, and to work with diverse constituencies (e.g., subject-matter experts). The least important factor and most diverse was *Teaching, multitasking, and*

Table 4 Skills domain factors and statistics

Factor label	M	SD	% of variance	Cumulative variance	Number of items	Cronbach alpha
1. Multimedia production skills	3.29	0.90	41.16	41.16	6	.91
2. Soft skills	4.48	0.67	15.20	56.36	7	.90
3. Managerial and technical skills	3.63	0.83	5.89	62.25	4	.78
4. Supporting skills	3.81	0.85	5.09	67.34	4	.76

Table 5 Ability domain factors and statistics

Factor label	M	SD	% of variance	Cumulative variance	Number of items	Cronbach alpha
1. Work in a team-oriented environment	4.54	0.70	46.94	46.94	6	0.93
2. Conduct an instructional design process	4.32	0.74	9.76	56.70	7	0.89
3. Teaching, multitasking, and prioritization	3.83	0.84	6.54	63.23	6	0.85
4. Work with technology and assessment	4.21	0.76	5.33	68.57	5	0.82

prioritization. Also important was the ability to *Conduct an instructional design process* and *Work with technology and assessment*. All of the factors the ability domain demonstrated a high level of internal consistency reliability ranging from .82 to .93 (Nunnally 1978).

Multivariate analysis of variance

Before running the MANOVA, data were examined for the normality (skewness and kurtosis), linearity, and homogeneity of variance of these data. There were no severe departures from these statistical test assumptions, thus the data appeared to be well-suited for a MANOVA. These data and factor structures were entered into a MANOVA model examining the individual differences of gender, income, ethnicity, years' experience, and highest degree earned. We purposefully did not include the interaction effects due to parsimony as the interaction effects can be difficult to explain.

The results of the MANOVA are illustrated in Table 6. The only differences to emerge were in income and highest degree earned. Income had two significant main effects, and highest degree earned had seven main effects detected. Income had a main effect on *Soft skills* and the ability to *Work in a team-oriented environment*. Highest degree earned had a main effect on *Graphics, web, audio and video software*, *Accessibility and copyrights*, *Multimedia production skills*, *Supporting skills*, *Work in a team-oriented environment*, and *Conduct an instructional design process.* Both income level and highest degree earned beckon further research to examine why these variables lead to statistically significant differences among the population.

Table 6 Multivariate analysis of variance on demographics across domains

	Gender		Income		Ethnicity		Years' experience		Highest degree	
	F	*p*	F	*p*	F	*p*	F	*p*	F	*p*
Knowledge domain										
1. Educational authoring and utility software	0.18	.67	1.44	.22	1.40	.22	1.39	.24	2.31	.05
2. Graphics, web, audio and video software	0.35	.55	1.02	.41	1.22	.31	1.49	.20	2.86	.02*
3. Theories and methods of instruction	1.25	.27	1.11	.36	1.18	.33	0.16	.98	1.25	.30
4. Programming and scripting languages	0.44	.51	1.51	.20	1.10	.37	1.52	.19	1.74	.14
5. Office production software	1.52	.22	1.35	.25	1.43	.21	0.86	.51	1.38	.24
6. Course management software	0.09	.76	1.86	.11	1.60	.16	1.62	.16	1.81	.12
7. Accessibility and copyrights	0.14	.71	0.98	.44	0.65	.69	1.51	.20	2.43	.04*
8. Computer hardware and networks	0.13	.72	0.94	.46	0.99	.44	2.27	.06	.34	.89
Skills domain										
1. Multimedia production skills	0.51	.48	0.38	.86	0.67	.67	1.54	.19	2.49	.04*
2. Soft skills	0.08	.78	4.51	.00*	0.84	.54	0.31	.91	2.79	.02*
3. Managerial and technical skills	0.06	.81	1.21	.31	1.17	.33	0.30	.91	1.38	.24
4. Supporting skills	1.65	.20	1.65	.16	0.75	.61	0.78	.57	2.84	.02*
Ability domain										
1. Work in a team-oriented environment	0.04	.85	3.83	.00*	0.33	.92	0.18	.97	3.39	.01*
2. Conduct an instructional design process	0.18	.67	1.06	.39	0.23	.97	0.76	.58	2.84	.02*
3. Teaching, multitasking, and prioritization	0.18	.67	0.76	.58	0.83	.55	0.71	.62	1.64	.16
4. Work with technology and assessment	0.05	.82	1.82	.12	0.35	.91	1.04	.40	1.43	.22

* Significant at the .05 level

Discussion

Interpretation of the results must be viewed within the limitations and delimitations of the present study. The job announcement analysis was based on job announcements posted for only one period of time (3 months in 2009) and primarily in the United States. Since technology and practice changes at such a rapid pace, future job announcements may vary. Further, there was great variability in the length of the job announcements, as some were very specific in terms of the desired knowledge, skills, and abilities while others were not. There is also a concern that we could have used other job announcement databases to cast a wider net for relevant competencies. We limited our inclusion to eight databases that we felt were representative of our field, but the resulting competencies may have been biased by this inclusion decision.

The survey of professionals is limited to the honesty and expertise of those that responded. Additionally, the survey of professionals was biased to professionals in a higher education context in that professionals in higher education responded to the survey with greater frequency. Another limitation is what actually appeared as competencies on the final instrument. Most of the items were related to multimedia; however, other items were more general in nature to the field, for example, knowledge of instructional design models/principles (e.g., Dick and Carey) or assessment methods. Some areas (e.g., evaluation) may not have been as well-represented on the survey if the information was not readily accessible in the job announcements themselves. In light of these limitations and delimitations, we believe the rigorous procedures we followed led to good content validity of the ETMCS.

To develop the items and stems used on this survey, the instrument development process traversed a three phase process starting with the establishment of a conceptual framework based on a current operational definition of the field of educational technology. An extant review of literature to identify and examine relevant knowledge, skills, and abilities recommended by experts in the field was conducted. Two hundred-five job announcements were systematically evaluated from well-recognized employment databases. This was a rigorous development process for the survey to ensure the content was representative of the many facets to a complex domain. This resulted in 85 competencies for professionals in our field.

The instrument has good construct validity for these data. It was administered electronically to a wide range of educational technology professional belonging to six different professional listservs in the field and subjected to an EFA to examine the underlying structure of these data. EFAs were conducted for each domain (knowledge, skill, and ability) and meaningful factor loadings were identified based Eigenvalues greater than or equal to one. An analysis of the internal consistency reliability of these factors demonstrated that the factor structure had acceptable Cronbach alpha scores across the three domains provides strong evidence of reliability of the ETMCS for these data.

The highest rated factor was the *Theories and methods of instruction*, which included items like cognitive theories of learning, motivation theories, instructional design models/principles, and adult learning theory. This finding reinforces the importance of academic programs in the field emphasizing how people learn and perform, and this finding also suggests that while several technologies are coming and going in our field, the core principle remains the same: educational technologists must understand the underlying theories and methods that constitute the field. Merrill (2007) indicated that integrating theory and research is one attribute that distinguishes educational technologists from the others who are not trained in instructional design. Reigeluth (1983) states that instructional design theories offer the knowledge base that guides educational practice and provides guidelines for the design of learning environments.

The second most important factor from the knowledge domain was *Course management software*, which included items like assessment software (e.g., Respondus), virtual classrooms (e.g., Elluminate Live), and course management systems (e.g., Blackboard). It is irrefutable that course and learning management systems (LMS/CMS) have been widely adopted in several contexts, including higher education (Coates et al. 2005). Campus computing survey reported that 93 % of higher education institutions used an LMS/CMS in 2010 to facilitate blended and online learning (Green 2010). The adoption of LMS/CMS has made it possible for 6.2 million students to be enrolled in online courses in Fall 2012 in higher education (Allen and Seaman 2013). This type of software appears to be prevalent and important at this point in time. Other areas in the knowledge domain also scored relatively high, including factors like *Graphics, web, audio and video software*; *Office production software*; and *Accessibility and copyrights*. These are other knowledge areas that we should emphasize in our academic programs to emerging professionals and our professional development opportunities for our practicing professionals.

At an item level, we also have some important findings to illuminate. Those knowledge items with scores greater than 4.0, include knowledge of cognitive theories of learning, instructional design models/principles, copyright laws, assessment methods, presentation software, screen recording software, course/learning management systems, and Web 2.0 technology. Though these individual items all belong to different factors in the knowledge domain model, they all contribute to a larger picture of the knowledge needed to be successful in our field. These are things both professionals in the field and our academic programs should emphasize in both professional development opportunities and academic courses.

While having knowledge is important, the skills to execute this knowledge are equally important. The highest rated factor was *Soft skills*, which includes several areas like oral and written communications, interpersonal skills, or customer service skills. We believe this is a critical finding as it indicates that our academic programs are in a position to teach things often the most difficult to teach. It also reflects the trends in STEM education research and practice, such as the increasing emphasis on twenty first century skills like collaboration (Partnership for twenty first century Skills 2009). There are several approaches to teaching *soft skills* (Russell et al. 2005), but many educators will agree that *soft skills* are among the most difficult to teach. *Soft skills* are being taught in an e-learning format using social simulators (Gaffney et al. 2008). Richey et al. (2001) in their list of competencies for IBSTPI included "communicating effectively in written, visual and oral form" as a primary skill for analyst, evaluator, eLearning specialist and project manager. Other soft skills such as "active listening skills in all situations" and "facilitating meetings effectively" were also listed as supporting competencies for the eLearning specialist. Van Rooij (2010) states that instructional designers need both instructional design skills and project management skills and interpersonal skills such as communication, leadership and team building are essential for effective project management. Further, this implies that to be successful in our field, one must possess *soft skills*.

The lowest rated skills factor was *Multimedia production skills*. This included items like graphics design, web design, animation, design, and more. This was a surprising finding in that several job announcements contained these skills and our motivation for creating this survey instrument was to gauge a professional's belief about the importance of *Multimedia production skills*. We believe this has implications to both educators and practicing professionals. To educators, we believe that the emphasis purely on the development of *Multimedia production skills* may be a poor selection of instructional strategies. Rather, we think a theory through practice approach is most appropriate. That is, students should be provided theories and methods to operationalize using their *Multimedia production skills*. To professionals, we believe this is a sign that educational technologists (or instructional designers) are not using these skills as much in practice. This finding is certainly something that needs to be more carefully examined in future research. Within the skills domain, there were a few items with scores >4.0. These skills include interpersonal, written communication, oral communication, customer service, time-management, organizational, troubleshooting, and editing and proofing skills.

In the ability domain, the ability of a professional to *Work in a team-oriented environment* was the most important factor to emerge. This was not a surprising finding to us. Much of the literature and job announcement analysis reinforced this point, suggesting that educational technologist must be able to work with diverse team members under pressure and deadlines. Instructional designers usually do not work in silo but tend to work in a team with project managers, subject matter experts, graphic designers, programmers, authoring specialists, media specialists, testers and many others (eLearning coach 2012).

Analogous to the *Soft skills* emerging as the most important factor in the skill domain, this reiterates to the professionals in our field that working with other people is a major expectation whether they be clients, subject-matter experts, programmers, graphics designers and more. To academic programs, this suggests that we should be requiring our students to design, develop, and deliver solutions in a team-oriented environment to optimize the transfer to the workforce expectation. Another important factor to emerge was the ability to *Conduct instructional design process*. This ability was consistent with our findings from the knowledge domains in that *Theories and methods of instruction* was the leading factor. These two go together as instructional design models describes instructional design processes for different settings (Gustafson and Branch 1997). Educational technologists must be well-versed in the theories, methods and overall instructional design process employed in our field.

When testing whether there were differences based on the demographic characteristics of the sample, only two demographic characteristics had differences based on income and highest degree earned. Income had a main effect on *Soft skills* and the ability to *Work in a team-oriented environment*. Highest degree earned had a main effect on *Graphics, web, audio and video software*, *Accessibility and copyrights*, *Multimedia production skills*, *Supporting skills*, *Work in a team-oriented environment*, and *Conduct an instructional design process*. This suggests there are divergences in perspective based on an individual's education and income level. However, there were no differences identified based on gender, ethnicity, or experience.

ETMCS shows much promise as a viable measurement system that could be updated and used periodically to assess the status quo of multimedia competencies within our field. Future research should target updating the ETMCS based emerging technologies and trends (e.g., mobile learning has taken off in our field). Further, future research might seek to conduct a confirmatory factor analysis of the instrument to test whether our understanding of the constructs is consistent with how these constructs are measured using this tool. We believe the ETMCS is a valuable measurement system for our field.

Conclusions

What can be concluded from the survey development and validation process with professionals in the field of educational technology? We think these results provide compelling evidence that professional in the field of educational technology must have a diversified portfolio of knowledge, skills, and abilities to be successful in their job function. The vast majority of the constructs and individual items have averages above the central point, suggesting that the competencies are generally perceived as more important than less by professional in the field. Practitioners can use this information to improve their competencies. Educators can use these results to improve their academic programs. Researchers can use this instrument as a basis for future research on the competencies or professionals in our field.

Appendices

Appendix 1

See Table 7.

Table 7 Knowledge domain

Knowledge of …	Pattern matrix									
	M	SD	1	2	3	4	5	6	7	8
Cognitive theories of learning	4.07	1.03	−0.11	−0.14	0.85	0.19	−0.05	0.04	−0.04	−0.01
Motivation theories (e.g., ARCS)	3.75	1.07	0.10	0.00	0.73	0.04	−0.04	−0.03	0.00	0.01
Adult learning theory	3.90	1.08	0.05	0.02	0.72	−0.10	−0.05	−0.01	0.11	−0.02
Instructional design models/principles (e.g., Dick and Carey)	4.23	0.94	−0.07	0.13	0.69	−0.10	0.05	0.05	0.03	0.00
Mayer’s multimedia principles (e.g., Modality principle)	3.69	1.15	0.05	0.29	0.54	0.04	−0.12	−0.10	0.17	−0.17
Project management body of knowledge (PMBOK)	3.36	1.07	0.18	0.11	0.33	−0.08	0.18	−0.11	0.20	−0.15
Accessibility (e.g., Section 508)	3.66	1.18	−0.10	0.01	0.12	0.04	0.04	−0.10	0.86	−0.04
Copyright laws	4.07	1.03	−0.16	0.09	0.19	−0.18	0.11	0.01	0.64	0.28
Computer networks	3.18	1.13	0.08	0.05	0.01	0.09	0.07	0.06	0.03	0.64
Assessment methods	4.23	0.96	0.02	−0.14	0.54	−0.10	0.06	0.28	0.05	0.19
Computer hardware	3.28	1.06	0.07	0.16	−0.09	0.05	0.11	0.06	0.03	0.54
Word processing software (e.g., Word)	3.92	1.04	−0.08	0.00	−0.01	−0.04	0.91	0.09	−0.01	−0.06
Spreadsheet software (e.g., Excel)	3.46	1.08	0.01	−0.08	−0.04	0.00	0.72	−0.02	0.15	0.20
Presentation software (e.g., PowerPoint)	4.02	1.11	−0.07	0.04	−0.02	−0.04	0.81	0.17	−0.02	0.05
Database software (e.g., Access)	2.99	1.09	0.29	−0.05	0.03	0.21	0.42	−0.20	0.08	0.26
Web authoring tools (e.g., Dreamweaver)	3.96	0.99	0.03	0.52	0.15	0.18	0.27	0.09	−0.20	−0.07
Desktop publishing software (e.g., PageMaker)	3.08	1.18	0.58	0.36	−0.05	−0.12	0.30	−0.17	−0.14	0.02
Bitmap image software (e.g., Photoshop)	3.80	1.03	−0.03	0.79	0.06	0.11	0.15	−0.03	−0.12	−0.02
Vector image software (e.g., Illustrator)	3.26	1.13	0.39	0.58	0.02	−0.02	−0.13	−0.12	0.09	0.06
Audio software (e.g., Audacity)	3.76	1.08	−0.04	0.72	−0.03	0.10	−0.09	0.02	0.21	0.14
Video software (e.g., Premiere)	3.64	1.15	0.13	0.62	−0.11	−0.01	−0.14	0.09	0.27	0.17
Screen recording software (e.g., Captivate or Camtasia)	4.03	0.94	0.00	0.67	0.08	−0.03	−0.04	0.38	−0.18	−0.07
Educational authoring software (e.g., Toolbook or Authorware)	3.15	1.21	0.80	0.15	−0.04	−0.15	−0.15	0.16	−0.08	−0.01
Course/learning management systems (e.g., Blackboard or Moodle)	4.20	1.00	−0.05	0.14	0.07	−0.12	0.04	0.74	−0.18	0.16

Table 7 continued

Knowledge of …	Pattern matrix									
	M	SD	1	2	3	4	5	6	7	8
Content management systems (e.g., Joomla)	3.28	1.11	0.45	−0.04	0.04	0.18	0.01	0.27	−0.13	0.19
3D modeling tools (e.g., Maya)	2.61	1.13	0.86	−0.01	0.05	0.03	−0.02	−0.05	−0.07	0.09
Game engines (e.g., Torque)	2.51	1.09	0.86	0.03	0.07	0.11	−0.16	−0.05	−0.08	0.09
Client-side scripting languages (e.g., JavaScript)	2.92	1.18	0.11	0.17	−0.06	0.77	0.03	−0.12	−0.04	0.05
Flash (and ActionScript)	3.27	1.11	0.10	0.47	0.03	0.49	−0.03	−0.11	−0.05	−0.02
Cascading Style Sheets (CSS)	3.41	1.16	−0.21	0.30	−0.09	0.74	0.00	−0.01	0.20	−0.07
Markup languages (e.g., HTML/XHTML/XML)	3.66	1.05	−0.34	0.30	−0.03	0.66	0.10	0.21	−0.02	0.04
Project management software (e.g., Microsoft Project)	2.86	1.09	0.63	−0.14	−0.03	0.03	0.31	−0.02	0.17	−0.16
Virtual environments (e.g., SecondLife)	2.83	1.11	0.56	0.04	−0.06	0.09	0.01	0.21	0.00	−0.01
Server-side scripting languages (e.g., PHP)	2.55	1.22	0.22	−0.08	0.07	0.80	−0.14	0.05	−0.13	0.15
Programming languages (e.g., C++)	2.19	1.20	0.35	−0.14	0.04	0.66	0.02	−0.14	−0.02	0.00
Learning object standards (e.g., SCORM)	3.05	1.26	0.27	−0.09	0.00	0.35	−0.05	0.16	0.20	−0.07
Accessibility software (e.g., JAWS)	2.89	1.27	0.15	−0.15	0.02	0.35	−0.09	0.14	0.50	−0.01
Web 2.0 technology (e.g., Wikis, Blogs, Podcasts, etc.)	4.12	1.07	0.00	0.00	0.02	0.06	0.10	0.66	0.01	0.06
Assessment software (e.g., Respondus)	3.39	1.21	0.41	0.04	0.00	0.04	0.06	0.46	0.03	−0.21
Virtual classrooms (e.g., Wimba or Elluminate! Live)	3.68	1.15	0.12	0.03	−0.03	0.04	0.09	0.53	0.24	−0.17
Streaming video technology (e.g., Windows Media Server)	3.53	1.16	0.13	0.39	−0.10	−0.06	−0.05	0.35	0.15	0.10

Appendix 2

See Table 8.

Table 8 Skills domain

Skill type	Pattern matrix					
	M	SD	1	2	3	4
Interpersonal communication skills	4.64	.747	−.057	.902	−.030	−.024
Written communication skills	4.66	.719	−.013	.930	−.076	−.056
Oral communication skills	4.51	.822	.007	.850	−.049	.042
Customer service skills	4.29	.951	−.181	.439	.414	.079
Negotiation skills	3.96	1.013	−.078	.299	.549	−.011
Statistical analysis skills	3.10	1.074	.292	.163	.596	−.318
Project management skills	3.98	1.063	−.010	.126	.659	.059
Time-management skills	4.44	.890	.087	.493	.174	.157
Organizational skills	4.44	.806	−.018	.494	.226	.281
Web design skills	3.76	.977	.718	.160	−.109	.091
Trouble-shooting skills	4.36	.928	.299	.489	.060	−.045
Graphics design skills	3.56	1.078	.825	.151	−.230	.114
Animation design skills	3.07	1.133	.917	−.095	.090	−.081
Video production skills	3.28	1.131	.708	−.096	.081	.095
Print design skills	3.24	1.058	.629	.032	.034	.109
Game and simulation design skills	2.81	1.157	.803	−.105	.189	−.131
Storyboard design skills	3.72	1.182	.406	−.168	.131	.466
Typing skills	3.75	1.200	.119	.141	−.173	.612
Interviewing skills	3.62	1.088	−.096	−.054	.416	.501
Budgeting and cost estimation skills	3.47	1.108	.096	−.156	.680	.093
Editing and proofing skills	4.15	.961	.041	.134	.109	.505

Appendix 3

See Table 9.

Table 9 Ability domain

Ability to …	Pattern matrix					
	M	SD	1	2	3	4
Apply multimedia design principles to design and development	4.76	.644	.201	.753	−.108	−.002
Create effective instructional products	4.64	.803	.147	.858	−.202	.032
Apply sound instructional design principles	4.23	.942	−.263	.583	.054	.451
Develop accessible instructional products	4.19	1.011	.007	.663	.320	−.078
Conduct a needs assessment	4.06	1.021	.014	.608	.300	−.046

Table 9 continued

Ability to …	Pattern matrix					
	M	SD	1	2	3	4
Conduct a task analysis	4.00	1.095	−.056	.179	.353	.424
Work with synchronous technology	4.34	.886	−.030	.344	.113	.479
Work with asynchronous technology	4.01	1.141	.309	−.060	.039	.405
Sit at a computer for extended periods	3.89	1.002	.427	.055	.441	−.147
Manage teams	4.54	.799	.895	.103	.064	−.214
Work well with others (in teams)	4.56	.769	.705	.036	.116	.005
Work independently	4.48	.868	.697	.014	.007	.183
Work on multiple projects (multi-task)	3.44	1.259	−.014	−.169	.473	.431
Work in multiple operating systems (e.g., Mac/PC/Linux)	4.06	1.015	−.023	.464	.478	−.058
Conduct evaluation (formative/summative)	4.02	1.034	−.048	.502	.423	−.116
Develop and administer sound assessments	4.09	1.038	.111	−.013	−.007	.643
Operate computer hardware	4.59	.809	.391	.021	−.068	.543
Adapt and learn new technology and processes	4.49	.894	.634	.285	−.063	−.041
Work with diverse constituencies (e.g., SMEs and clients)	4.58	.803	.764	−.092	−.006	.267
Work under deadlines	4.60	.801	.778	−.011	−.023	.219
Prioritize work	3.74	1.150	.008	−.116	.801	.101
Teach online	3.66	1.203	.049	−.162	.879	.045
Teach face-to-face	4.16	1.046	.074	.273	.368	.188

References

Alessi, S., & Trollip, S. (2001). *Multimedia for learning; methods and development* (3rd ed.). Boston, MA: Pearson Education.

Allen, I. E., & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States*. Wellesley, MA: Babson College.

American Society for Training and Development (ASTD). (2009). CPLP certification. Retrieved November 23, 2013 from http://www.astd.org/Certification.

Arrindell, W. A., & Van der Ende, J. (1985). Cross-sample invariance of the structure of self-reported distress and difficulty in assertiveness. *Advances in Behavior Research and Therapy, 7*, 205–243.

Association for Educational Communications and Technology (AECT). (2012). AECT standards. Retrieved November 23, 2013 from http://c.ymcdn.com/sites/aect.site-ym.com/resource/resmgr/AECT_Documents/AECT_Standards_adopted7_16_2.pdf.

Brown, A., Sugar, B., & Daniels, L. (2007). *Media production curriculum and competencies: Identifying entry-level multimedia production competencies and skills of instructional design and technology professionals: Results from a Biennial Survey*. Paper presented at Association of Educational Communications and Technology, Anaheim, CA.

Coates, H., James, R., & Baldwin, G. (2005). A critical examination of the effects of learning management systems on university teaching and learning. *Tertiary Education and Management, 11*(1), 19–36.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative and mixed methods Approaches* (3rd ed.). Los Angeles, CA: Sage.

Daniels, L. (2008). Identifying entry-level competencies of instructional design and technology educators and professionals: Results from a biennial survey. In K. McFerrin et al. (Eds.), *Proceedings of society for information technology & teacher education international conference 2008* (pp. 1381–1385). Chesapeake, VA: AACE.

Daniels, L., Sugar, W., Brown, A., & Hoard, B. (2012). Educational technology professionals in higher education: Multimedia production competencies identified from a Delphi study. In P. Resta (Ed.), *Proceedings of society for information technology and teacher education international conference 2012,* pp. 1711–1714.

Dessler, G. (2004). *Human resource management* (10th ed.). Upper Saddle River, NJ: Prentice Hall.

Earle, R. S., & Persichitte, K. A. (Eds.). (2005). *Standards for the accreditation of school media specialist and educational technology specialist programs* (4th ed.). Bloomington, IN: Association for Educational Communications and Technology.

eLearning coach (2012). Starting an eLearning team. Retrieved November 23, 2013 from http://theelearningcoach.com/elearning_design/starting-an-elearning-department/.

Gaffney, C., Dagger, D., & Wade, V. (2008). Soft skill simulation authoring tools: A state of the art survey. Presented at WWW, Beijing.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory*. Chicago, IL: Aldine.

Green, K. (2010). 2010 campus computing survey. IT budget cuts slowing; campus LMS strategies in transition. Retrieved November 23, 2013 from http://www.campuscomputing.net/sites/www.campuscomputing.net/files/Green-CampusComputing2010.pdf.

Guadagnoli, E., & Velicer, W. F. (1988). Relation of sample size to the stability of component patterns. *Psychological Bulletin, 103*, 265–275.

Gustafson, K., & Branch, R. (1997). *Survey of instructional design models*. Syracuse, NY: Information Resource Publications.

Hartley, R., Kinshuk, K. R., Okamoto, T., & Spector, J. M. (2010). The education and training of learning technologists: A competences approach. *Educational Technology and Society, 13*(2), 206–216.

International Society for Performance Improvement (ISPI). (2013). International society for performance improvement—certified performance technologist. Retrieved November 23, 2013 from http://www.ispi.org/content.aspx?id=186&linkidentifier=id&itemid=186.

Januszewski, A., & Molenda, M. (2007). *Educational technology: A definition with commentary*. London: Routledge/Taylor and Francis Group.

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika, 39*, 31–36.

Kenny, R. F., Zhang, Z., Schwier, R. A., & Campbell, K. (2005). A review of what instructional designers do: Questions answered and questions not asked. *Canadian Journal of Learning and Technology, 31*(1), 9–26.

Kerlinger, F. (1974). *Foundations of behavioural research*. New York: Holt, Rienhart and Winston.

Klein, J. D., & Richey, R. C. (2005). The case for international standards. *Performance Improvement, 44*(10), 9–14.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage.

Lowenthal, P., Wilson, B. G., & Dunlap, J. C. (2010). An analysis of what instructional designers need to know and be able to do to get a job. In *Presented at the annual meeting of the Association for Educational Communications and Technology*. Anaheim, CA.

Martin, F. & Winzeler, B. (2008). Multimedia Competencies for Instructional Technologists. In *Proceeding of the UNC teaching and learning with technology conference*. Raleigh, NC.

Mayer, R. E. (2001). *Multimedia learning*. New York: Cambridge University Press.

Merrill, D. (2007). The proper study of instructional design. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (2nd ed., pp. 336–341). Saddle River, NJ: Pearson Prentice Hall.

Moallem, M. (1995). Analysis of job announcements and the required competencies for instructional technology professionals. ERIC document: ED405355.

Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.

Reigeluth, C. M. (1983). *Instructional-design theories and models: An overview of their current status*. Hillsdale, NJ: Erlbaum.

Richey, R. C., Fields, D. C., Foxon, M. (with Roberts, R. C., Spannaus, T., & Spector, J. M.) (2001). *Instructional design competencies: The standards* (3rd ed.). Syracuse, NY: ERIC Clearinghouse on Information and Technology.

Ritzhaupt, A. D., Martin, F., & Daniels, K. (2010). Multimedia competencies for an educational technologist: A survey of professionals and job announcement analysis. *Journal Educational Multimedia and Hypermedia, 19*(4), 421–449.

Russell, J., Russell, B., & Tastle, W. J. (2005). Teaching soft skills in a systems development capstone class. *Information Systems Education Journal, 3*(19), 3–19.

Spector, J. M., Klein, J. D., Reiser, R. A., Sims, R. C., Grabowski, B. L., & Teja, I. D. L. (2006). *Competencies and standards for instructional design and educational technology*. Discussion paper for ITFORUM.

Sugar, W., Brown, A., & Daniels, L. (2009). Identifying entry-level multimedia production competencies and skills of instructional design and technology professionals: Results from the 2009–2010 biennial survey. In *Presented at the annual conference of the Association for Educational Communications and Technology (AECT)*. Louisville, KY.

Sugar, W., Hoard, B., Brown, A., & Daniels, L. (2012). Identifying multimedia production competencies and skills of instructional design and technology professionals: An analysis of recent job postings. *Journal of Educational Technology Systems, 40*(3), 227–249.

Sumuer, E., Kursun, E., & Cagiltay, K. (2006). Current major competencies for instructional design and technology professionals. In E. Pearson & P. Bohman (Eds.), *Proceedings of world conference on educational multimedia, hypermedia and telecommunications 2006* (pp. 1617–1622).

Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology: Combining qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.

Tennyson, R. D. (2001). Defining core competencies of an instructional technologist. *Computers in Human Behavior, 17*, 355–361.

Van Rooij, S. W. (2010). Project management in instructional design: ADDIE is not enough. *British Journal of Educational Technology, 41*(5), 852–864.

Wakefield, J., Warren, S., & Mills, L. (2012). Traits, skills,andcompetencies aligned with workplace demands: What today's instructional designers need to master. In P. Resta (Ed.), *Proceedings of society for information technology and teacher education international conference 2012* (pp. 3126–3132).

Wang, N., Schnipke, D., & Witt, E. A. (2005). Use of knowledge, skill, and ability statements in developing licensure and certification examinations. *Educational Measurement: Issues and Practice, 24*(1), 15–22.

Wilson, M. (1974). *Job analysis for human resource management: A review of selected research and development*. ERIC Document: ED107860.

Albert D. Ritzhaupt is an associate professor of educational technology in the School of Teaching and Learning at the University of Florida. His primary research areas focus on the design and development of technology-enhanced learning environments, and technology integration in education. His publications have appeared in multiple venues, including the *Educational Technology Research and Development*, *Educational Technology*, *Journal of Research on Technology in Education*, *Computers in the Schools*, *Journal of Computing in Higher Education*, *Computers & Education*, *Behavior Research Methods*, *Journal of Interactive Learning Research*, *Journal of Computers in Mathematics and Science Teaching*, *Journal of Educational Computing Research*, and *Computers in Human Behavior*.

Florence Martin is an associate professor in the instructional technology program at the University of North Carolina, Wilmington. She received her Doctorate and Master's in Educational Technology from Arizona State University. Previous to her current position she worked on instructional design projects for Maricopa Community College, University of Phoenix, Intel, Cisco Learning Institute, and Arizona State University. She is currently researching on mobile learning, learning analytics, and multimedia competencies.