ALIGNING LEARNER PREFERENCES FOR INFORMATION SEEKING, INFORMATION SHARING AND MOBILE TECHNOLOGIES

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ABSTRACT

This paper reports on the development of a new information communications technology (ICT) learning preference survey, its cross-validation with attitudes towards mobile learning, and new perspectives on information seeking, information sharing, and mobile access derived from the relationships uncovered. The Information and Communications Technology Learning (ICTL) survey instrument is designed to measure learners' preferences and information behavior for learning, knowledge acquisition, and sharing in the Web 2.0 technology pervasive environments of the twenty-first century. The instrument development process includes analysis for reliability and validity of instrument scales. The multi-step refinement process revealed two constructs with, respectively, very good and respectable measurement properties: Information Sharing (alpha = .83) and Information Seeking (alpha = .71). Cross-validation with a newly established mobile learning instrument confirms that both the Information Sharing and Information Seeking scales of ICTL have significant ($p < .001$) alignment with mobile learning attitudes. Implications of findings are discussed.

KEYWORDS

ICT learning, information seeking behavior, mobile learning.

1. INTRODUCTION

Collaboration fostered by a doctoral level psychometrics course and scholarly interest in the role of mobile technologies in learning prompted the authors to develop and validate an instrument to measure learners' dispositions toward new learning and knowledge acquisition activities that are made available by information and communications technology (ICT). The authors also sought to examine relationships between the ICT survey and an established mobile learning survey.

The two surveys employed in this research study were:

1) The Information and Communications Technology Learning (ICTL) survey, and
2) The Mobile Learning Scale (MLS).

The development of the Information and Communications Technology Learning survey is described in detail in subsequent sections of this paper. The Mobile Learning Scale v1.0 also plays a key role in this study and therefore its development history and psychometric properties are briefly discussed. MLS v1.0 was originally created from the key points developed for a paper on mobile learning prospects for informal learning in higher education (Khaddage & Knezek, 2011). Many of these key points initially emerged during working group discussions of the 2011 International Summit on ICT in Education (UNESCO, Paris, 2011) (Knezek, Lai, Khaddage, & Baker, 2011). Explorations of the relationships among the emerging factors uncovered the relationships that are reflected in the title of this paper and are also addressed in details in the discussion. These findings illustrate that cross-validation techniques can contribute to the richness of understanding as gauged by the underlying constructs found in the cross-validation of instruments with established reliability.

2. CONCEPTUAL RATIONALE

Measuring student technology attitudes related to learning and information seeking in technology pervasive learning environments of the twenty-first century is of particular interest to educators and learning technologists who seek to integrate ICT for effective teaching and learning. Also of great interest are learners' attitudes towards learning with mobile technologies. The role of mobile technology in education is yet to be clearly defined, and therefore it is reasonable that many current papers present convincing arguments about ways that that mobile technologies and applications can bring many benefits to the learning environment. For example, Khaddage and Latterman (2012) point out that mobile technologies and application offer benefits such as portability, simplicity, and availability. A multi-year study conducted by Kolko and colleagues at the University of Washington reports on the adoption of ICT in Central Asia stating that "mobile phone usage is outpacing the rate of Internet adoption, that access to the Internet is primarily through public access sites". Also reported is a trend towards the combination and conflation of technology related information seeking and communication usage patterns (Kolko, Rose & Johnson, 2007).

The seemingly unlimited new media contexts and information access options in formal and informal settings are often regarded as venues of invaluable opportunity for teaching and learning in the twenty-first century (Arnone, Small, Chauncey & McKenna, 2011). There are those who warn that education that does not utilize these new media-based technologies will not adequately develop student potential, leaving students with a deficit in digital literacies that may contribute to student disengagement from classroom activities (Judson, 2010). Felt (2010) identifies new media literacy (NML) skills as a set of cultural competencies, social skills, and ICT tool skills that are essential for learning and mastery in the twenty-first century. New media literacy skills are being associated with content-based learning in the framework of Jenkins and colleagues (Jenkins, Clinton, Purushotma, Robison, Weigel, 2006), and are thought to support student thinking and learning.

With information communications technology (ICT) now commonplace in all facets of our daily lives, including teaching and learning (Christensen & Knezek, 2006), it is important to understand student information seeking behavior in the Web 2.0 framework for formal and informal learning. Kuhlthau's Information Search Process (ISP) model, devised in the 1980's and revised in the 1990's, depicts six stages of student information activity: initiation, selection, exploration, formulation, collection, and presentation (Kuhlthau, 1991). These six stages reflect the primary tasks to be accomplished when students go beyond social communications technology exchanges and engage in complex information behaviors that can be useful for directing learning activities. Emphasis should be placed on supporting information seeking tasks which are associated with independent learning and knowledge construction (George, Bright, Hurlbert, Linke, St. Clair & Stein, 2006). Established for an understanding of student information behavior in support of guided instructional, diagnostic, and intervention programs, Kuhlthau's ISP model has been applied extensively for decades. An extensive review of literature and inquiry project conducted in 2007 among (n=574) school students indicated that Kuhlthau's information seeking model for affective, cognitive, and physical dimensions of information behavior continues to be usefulness for explaining student information seeking behavior and knowledge acquisition in the digital, technology pervasive information environment of Web 2.0 (Kuhlthau, Heinstrom, & Todd, 2008). Findings confirm that while some stages in the search process may be intensified in new instantaneous information environments "the Information Search Process seems to be an over-arching process regardless of search venue, or print or digital format" (Kuhlthau, et al, 2008).

Mobile learning is a relatively new phenomenon with its theoretical basis still under development (Kearney, Schuck, Burden, Aubusson, 2012). With the rapid growth of mobile devices throughout the world (World Bank, 2012), the need has emerged for studies of affordances and barriers that might enhance or constrain the adoption of mobile learning in higher education. This approach is consistent with the principles of diffusion of innovations (Rogers, 2003) that have served as a useful model for studying the introduction of new information technologies in the past, and which have been suggested by Chueng and Hew (2009) as an appropriate framework for examining the adoption of mobile devices in teaching and learning.

While mobile learning is recognized as the desired outcome for application of mobile technology to distance learning, the widespread availability of mobile technology and the association of mobile learning with new forms of communications related activities for engaged learning spotlights mobile learning for a broad range of formal and informal learning activities in the twenty-first century (Andrews and Tynan,

2012). Cox (2012) contends that research approaches investigating innovative ways of teaching and learning with ICT in the future should address technology-enhanced learning "outside formal educational settings" (p. 2) as well as the opportunities presented by "the uptake of thin client technologies" (p. 5) that are mobile and personalized. Lai (2011) devoted a section of his work on digital technology and the culture of teaching and learning in higher education to "… how digital technologies may provide a more active and flexible learning experience by adopting a participatory pedagogical approach and by blending formal learning with informal learning" (p. 1263).

3. DEVELOPMENT OF THE INFORMATION AND COMMUNICATIONS TECHNOLOGY LEARNING (ICTL) SURVEY

The Information and Communications Technology Learning (ICTL) survey was designed and validated to help address questions related to how students prefer to utilize ICT for information seeking, information sharing, and knowledge acquisition. Instrument development included analysis for internal consistency reliability, principal components exploratory factor analysis, multidimensional scaling, and higher order factor analysis. Items were initially gathered by the first author in an effort to better understand learner preferences and the role that ICT plays in learning today. A review of literature did not reveal validated instruments for measurement of student learning preference for use of ICT for learning activities and knowledge acquisition within the ubiquitous communications landscape of the twenty-first century (Mills and Knezek, 2012). Items for a 15-item prototype instrument, the Information Communications and Technology Learning (ICTL) survey version 1.0, are displayed in Figure 1. Survey questions are Likert-type, rated on a 5 point scale with response choices from 1= strongly disagree to 5 = strongly agree. Note that item 9 is negatively worded requiring that response ratings be reversed before summing (or averaging) with ratings from other items to form a Likert-type scale. The reverse coding for item 9 results in answer choices having increasing value along the response scale 1-5.

Information and Communications Technology Learning (ICTL) survey

1. I would like to be a participating member of an online community.
2. I use Internet technology to explore topics of interest.
3. I like to share interests and reflections online.
4. I like to enroll in classes to continue my education.
5. I use Internet communications and other technology tools for self-expression.
6. I learn many things by interacting with other Internet users.
7. I like to take classes from good professors.
8. I use Internet communications technology tools when I want to learn about something new.
9. I learn best in a traditional classroom setting. (R)
10. Internet technology helps me be successful in my college classes.
11. More classroom learning should include interactive communication technology experiences.
12. The things I need to know are taught by instructors in the classroom.
13. I learn more when I regulate my own learning experience and seek information on things that I want to learn about.
14. I use Internet communications technology to keep current on topics related to my field of expertise.
15. I post information that might be of interest to other people.

Figure 1. Information and Communications Technology Learning (ICTL) survey items. Note: ICTL v1.0 2011 by L. Mills & G. Knezek.

4. DATA COLLECTION

Survey subjects were volunteer participant college students enrolled in one of two institutions of higher education in Texas (USA), a junior college with a two-year curriculum, and a four-year state university. Sixty-two (62) respondents completed the ICTL survey online during the fall semester of 2011. The survey participants were 89% women (n=55) and 11% men (n=7) spanning 18 to 59 years of age.

5. INSTRUMENT REFINEMENT

5.1 Internal Consistency Reliability and Construct Validity

Reliability analysis was used to assess the internal consistency of the instrument scales according to Cronbach's Alpha index. As shown in Table 1, Cronbach's Alpha for all 15 items of the ICTL instrument is considered "respectable", (alpha = .77) according to reliability guidelines by DeVellis (1991).

Exploratory factor analysis, principal components analysis (PCA) with varimax rotation, was conducted in order to identify scales/factors that are orthogonally aligned (Mertler & Vannatta, 2005). PCA produced four factors with eigenvalues greater than one. Scree plot analysis (see Figure 2) indicated a two or possibly four factor solution in light of Stevens' (1992) suggestion that constructs in the sharp decent of the graph, before the first point of leveling, be retained. The four-factor solution was selected because the items within each factor were judged to have greater content validity. These four factors (see Table 1) were tentatively named Online Reflection, Internet Exploration, ICT Research, and Classroom Learning, with alphas of 0.88, 0.70, 0.43, and 0.54, respectively, when subjected to post hoc internal consistency reliability analysis. Measurement scales produced for these factors were found to have internal consistency reliabilities ranging from very good for Online Reflection to unacceptable for Classroom Learning, according to guidelines by DeVellis (1991).

Table 1. Cronbach's Alpha for ICTL. Internal consistency reliabilities for ICTL scales

Scale	No. of Items	Item numbers	Cronbach's Alpha	DeVellis Guidelines
ICTL- Total scale	15	1-15	0.77	Respectable
Online Reflection	6	3, 5, 11, 6, 15, 1	0.88	Very Good
Internet Exploration	4	7, 2, 13, 4	0.70	Respectable
ICT Research	3	8, 10, 14	0.43	Unacceptable
Classroom Learning	2	12, 9	0.54	Unacceptable

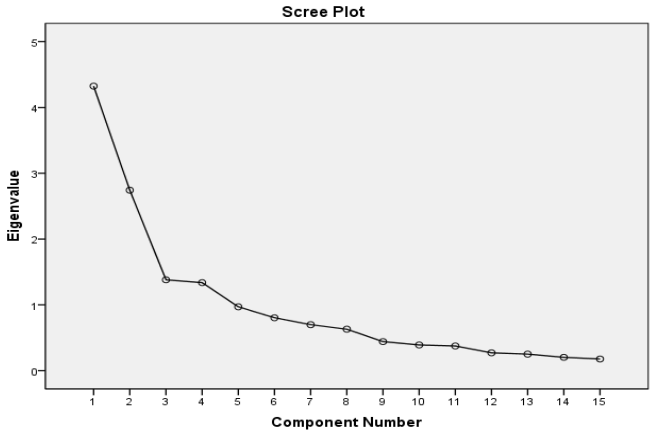

Figure 2. Scree plot for exploratory factor analysis of ICTL items

Higher order factor analysis was conducted to explore explanatory constructs at a higher level common among the four factor scales identified by PCA: Online Reflection, Internet Exploration, ICT Research, Classroom Learning (see Table 2). Scale scores produced for each of the factors were used as input variable values for the higher order procedure. A Scree plot for higher order factor analysis (Figure 3) reveals two factors in the sharp decent of the line. Table two shows that these two components explain 70% of the total variance.

Table 2. Higher order factor analysis loadings for four ICTL scales. Two components account for 70% of variance

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Vari	Cumulative %	Total	% of Variance	Cum %	Total	% of Variance	Cum %
1	1.567	39.182	39.182	1.567	39.182	39.182	1.547	38.664	38.664
2	1.227	30.686	69.868	1.227	30.686	69.868	1.248	31.204	69.868
3	.694	17.338	87.206						
4	.512	12.794	100.000						

Figure 3. Scree plot for higher order factor analysis

Internal consistency reliability was computed for these two higher-order construct scales. The first scale, Information Seeking was found to have alpha = .71 (respectable according to DeVellis (1991)). Cronbach's Alpha index for the second scale, Information Sharing was .83 (very good per DeVellis' guidelines (1991)). The items forming each higher-order scale are listed in Table 3.

5.2 Higher Order Factor Analysis and Multidimensional Scaling

Higher order factor analysis and multidimensional scaling indicated two possible factors which, upon examination by researchers, proved to have content (face) validity. One factor consisted of items that were related to ICT use for reflection, communication, and sharing. The second factor grouped items related to ICT for seeking information related to areas of interest, expertise, or study. Multidimensional scaling was conducted to further examine the underlying factors for the ICTL survey. The ALSCAL Euclidian distance model with maximum of two dimensions was generated to examine distances and proximities for items in relation to one another. Two main output clusters are visible on the Euclidean distance model (Figure 4). This two-scale alignment confirms results of higher order factor analysis. Instrument items in quadrant II & III, with item #8, which is located near the Y axis were examined as the first of two scales, and all other items in quadrants I & IV as the second of two scales which were identified by use of higher order factor analysis and multidimensional scaling. This two-factor solution was accepted and resulted in the Information Seeking, and Information Sharing scales of the ICTL.

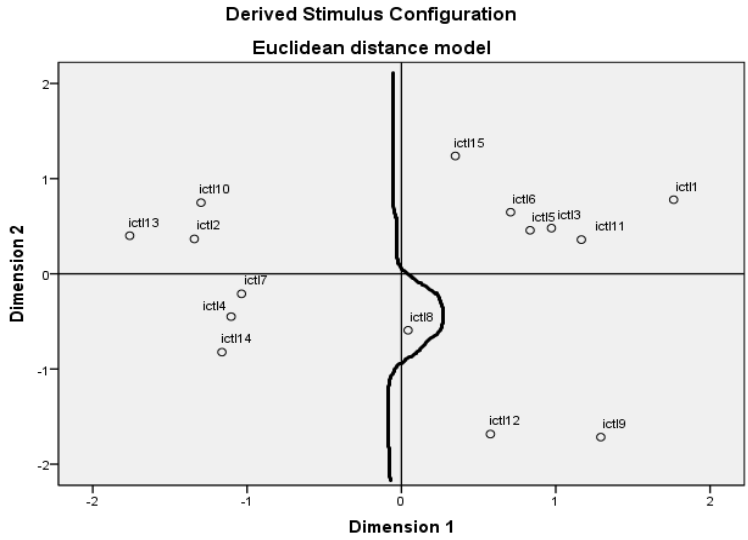

Figure 4. Euclidean distance model. Multidimensional scaling plot of ICTL items

Table 3. Items for higher order scales. Two scales emerged from higher order factor analysis

ICTL Scale	# Items	Item Numbers	Alpha Cronbach's	Rating (DeVellis)
ICTL- Total scale	15	1-15	0.77	Respectable
subscales:				
Information Seeking	7	2,4,7,8,10,13, 14	0.71	Respectable
Information Sharing	8	1,3,5,6,9r,11, 12,15	0.83	Very Good

Note: Item #9 was reverse coded.

5.3 Criterion-related Validity

Criterion related validity was examined for the three scales of ICTL by correlation analysis with the Mobile Learning Scale, a 7-item, unidimensional, Likert-type survey instrument developed by Khaddage and Knezek (2011) for used with higher education students. The Mobile Learning Scale version 1.0 was designed to assess acceptance of mobile learning, including perceptions of mobile learning devices and tools (Apps) for informal learning, and feelings about using theories and models to incorporate mobile learning into higher education (Knezek & Khaddage, 2011). Knezek and Khaddage (2011) found the internal consistency reliability for the seven-item instrument to be very good (alpha = 0.85) (DeVellis, 1991) among 81 undergraduate and graduate university students completing the survey in a large Midwestern university in the USA during August and September of 2011. A list of the items on the Mobile Learning Scale version 1.0 is provided in Figure 5. Correlation analysis revealed concurrent validity between ICTL, Information Seeking, Information Sharing and the Mobile Learning Scale. Significant correlations ($p < .01$) were found between Mobile Learning (ML) total scale score and all three ICTL measures: a) ML with ICTL_Total $r = .37$ ($p < .0005$), b) ML with ICTL_Information Seeking $r = .35$ ($p < .0005$), and c) ML with ICTL_Information Sharing $r = .37$ ($p < .0005$). This magnitude of Pearson Product Moment Correlation would be considered a moderate effect size according to guidelines by Cohen (1988). This confirms that the ICTL survey scales have demonstrable criterion related validity in the form of alignment with an established Mobile Learning Scale. This research finding contributes new knowledge to the emerging set of models and theories developing in the field of mobile learning. In particular, the implication is that both information seeking and information sharing are important aspects to be considered in mobile learning environments

Instructions: Select one level of agreement for each statement to indicate how you feel.
SD = Strongly Disagree**, D** = Disagree, **U** = Undecided**, A** = Agree**, SA** = Strongly Agree

	MOBILE LEARNING SCALE	**SD**	**D**	**U**	**A**	**SA**
1.	The rapid development of Mobile Learning devices and tools (Apps) has empowered informal learning.	①	②	③	④	⑤
2.	Mobile Apps could be integrated seamlessly to support informal learning.	①	②	③	④	⑤
3.	Mobile Apps could bring enormous opportunities into universities to further empower informal learning	①	②	③	④	⑤
4.	Student acceptance of Mobile Learning in higher education would be high.	①	②	③	④	⑤
5.	Recent developments in Mobile Learning are leading to the exploration of new methods/models at universities	①	②	③	④	⑤
6.	Theoretical models and methods can assist in informing the design for mobile learning Apps	①	②	③	④	⑤
7.	The integration of mobile applications, mobile social networking platforms and other mobile technologies has become pervasive in teaching and learning.	①	②	③	④	⑤

Figure 5. Mobile Learning Scale (MLS) Version 1.0 items. Note: MLS v1.0 8/2011 by F. Khaddage & G. Knezek

Additional associations were found between other attributes of interest and one or more of the scales used in this study. Females tended to rate higher than males on mobile learning attitudes ($p = .012$) but there were no significant differences by gender on information seeking or information sharing preferences. Age was negatively correlated with information seeking ratings ($p = .008$) and information sharing ($p = .001$), but no significant correlation was found between age and mobile learning attitude (NS). Mobile learning attitudes were positively correlated ($p = .002$) with self-reported creative tendencies as measured by a 13 item Likert Scale. These findings add context to the associations reported in the previous paragraph, and raise additional questions to be addressed in future research.

6. DISCUSSION

In recent decades the role of formal education as the disseminator of significant learning experiences has diminished (Aittola, 1999). Information communications technologies of the twenty-first century support a variety of learning, sharing and knowledge acquisition options which can take place in many places facilitated by internet-based communications tools (Knezek, Lai, Khaddage & Baker, 2011), thereby altering the role of formal education in learning. The information seeking, sharing and mobile access dimensions of learning which are measured by validated instruments identified in this paper are well fitted to assist teachers and learning technologists to design instruction that will support learning interaction with new options in mobile learning technologies and ICT.

As stated by Naismith, Lonsdale, Vavoula, and Sharples, (2004, p. 36) the current challenge is for educators and technology developers to find a way to ensure that new learning methods are effective – highly situated, personal and collaborative for the long term, and accepted by students. Research for formal and informal learning in new technology pervasive environments should include data on student preferences that can help identify students' attitudes, level of acceptance, opinions and expectations regarding the integration of new technologies such as mobile learning into teaching and learning. This approach is what Andrews and Tynan (2012) have referred to as "investigating the human voice" (p. 565) to meet the unique needs of today's learner. Hence, by creating and validating instruments to measure attitudes toward adoption and use of new technology options, such as the ones presented in this paper, which can more precisely and efficiently assess reliability and validity and make continuous refinements, we can allow for informed understanding of ICT learning and information seeking preferences of students. Additionally, the findings of this study imply that the ICTL and Mobile Learning Scale are useful for measurement in three areas of focus for the study of students' needs: information seeking preferences and behaviors, information sharing preferences and

behaviors, and perceptions of teaching and learning with mobile devices.

A review of the literature revealed that existing instruments for measurement of technology in teaching and learning have frequently focused on self-reported measures that assess student and teacher attitudes and proficiency with information and communication technology for technology integration (Knezek & Christensen, 2000). Instruments have also been validated to measure success with teaching and learning in Internet enriched learning environments (Hong, Ridzuan, & Kuek, 2003). A number of instruments measure different facets of learning. For example, Litzinger, Wise, Lee, & Bjorklund (2003), developed an instrument to measure aspects of self-directed learning. The authors contend that there is a need for the ICT and mobile learning scales to measure learner preference for ICT and mobile technologies for information behavior such as seeking and sharing.

7. SUMMARY AND CONCLUSIONS

Data collected online from college student volunteers for a learning preference study was used to refine the Information Communication Technology Learning (ICTL) survey. Construct validity was examined in a multi-step process. Reliability was analyzed for all 15 items of this survey and found to be respectable (alpha = .77) according to established guidelines (DeVellis, 1991). Four possible measurement factors were identified by PCA exploratory factor analysis: two of these were considered unacceptable with low internal consistency reliabilities according to established guidelines. However, higher order factor analysis and multidimensional scaling identified a two higher order constructs with very good and respectable measurement properties: Information Sharing (alpha = .83) and Information Seeking (alpha = .71). Scales produced from these two factors were found to be significantly correlated ($p < .0005$) with student mobile learning (MLS) attitudes, providing cross-validation evidence for ICTL scales. The correlations between ICTL scales and MLS were at the $r = .35$ level or higher, indicating that sharing and seeking information both are perceived as functions to be performed with mobile technologies. These findings support the authors' conclusion that the Information and Communications Technology Learning (ICTL) instrument is worthy of further use, either alone or as part of a battery of instruments including others such as the Mobile Learning Scale.

This study also contributes new knowledge to the emerging set of models and theories developing in the field of mobile learning. In particular, the implication is that both information seeking and sharing behaviors are important points of consideration in mobile learning environments. Further research is needed to determine if the instruments used for this research can assist educators and researchers in better understanding student preferences for ICT integration in order to improve support for information behavior targeting formal and informal learning. Findings from this study, such as the positive correlations identified between mobile learning attitudes and creative tendencies, and the confirmed female preference for mobile learning while no gender differences regarding information seeking or sharing were found, suggest that the ICTL and MLS instruments possess criterion related characteristics that may be useful in addressing additional research questions on students' attitudes towards mobile devices, ICT integration, and information seeking behaviors. These areas will be pursued in future studies.

REFERENCES

Aittola, T., (1999). Possibilities of Informal Learning Inside and Outside the School. Retrieved: http://eric.ed.gov/PDFS/ED469193.pdf.

Andrews, T. & Tynan, B., (2012). Distance learners: connected, mobile and resourceful individuals. Australasian Journal of Educational Technology, Vol. 28, No. 4,pp 565-579.

Arnone, M.P., et al., (2011). Curiosity, Interest and Engagement in Technology-Pervasive Learning Environments: a New Research Agenda. Educational Technology Research and Development. Vol. 59 No. 2, pp181-198.

Cox, M. J., (2012). Formal to informal learning with IT: research challenges and issues for e-learning. Journal of Computer Assisted Learning DOI: 10.1111/j.1365-2729.2012.00483.x.

Cheung, W. S., & Hew, K. F., (2009). A review of research methodologies used in studies on mobile handheld devices in K-12 and higher education settings. Australasian Journal of Educational Technology, Vol. 25, No. 2,pp 153-183.

Cohen, J.,(1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Earlbaum Associates, Hillsdale, NJ.

Christensen, R., & Knezek, G., (2006). Construct Validity for the Teachers' Attitudes Toward Computers Questionnaire, Journal of Computing in Teacher Education, 2006, Vol. 23, No. 2, pp 55-61.

DeVellis, R.F.,(1991). Scale development. Sage Publications, Newbury Park, NJ.

Felt, L., (2010). Making Education (Double) Count. Boosting Student Learning via Social and Emotional Learning and New Media Literacy Skills. Elearn Magazine. Retrieved: http://elearnmag.acm.org/archive.cfm?aid=1839556

George, et al., (2006). Scholarly use of information: graduate students' information seeking behaviour. Information Research, Vol. 11, No. 4, paper 272. Retrieved: http://informationr.net/ir/11-4/paper272.html.

Hong, K., et al, (2003). Students' attitudes toward the use of the Internet for learning: A study at a university in Malaysia. Educational Technology & Society, Vol. 6, No. 2,pp 45-49. Retrieved: http://www.ifets.info/journals/6_2/5.html

Jenkins, H., et al, 2006. Confronting the challenges of participatory culture: Media education for the 21st Century. The MacArthur Foundation, Chicago, IL.

Judson, E. (2010). Improving technology literacy: does it open doors to traditional content? Educational Technology Research and Development, Vol. 58, No. 3,pp 271-284.

Kearney, M., et al, (2012). Viewing mobile learning from a pedagogical perspective. Research in Learning Technology, Vol. 20, No. 1063519, pp 1-17.

Khaddage, F., & Knezek, G., (2011), Device Independent Mobile Applications for Teaching and Learning: Challenges, Barriers and Limitations. Proceedings of Association for the Advancement of Computing in Education: Global Learn. Asia Pacific, pp 1-7.

Khaddage, F.,Lattenman C., (2012) The Future of Mobile Apps for Teaching and Learning Book Chapter in the "Handbook of Mobile Learning – definitions Publisher: Routledge (Imprint of Taylor and Francis Group), USA (in press).

Knezek, G. & Christensen, R., (2000). Impact of new information technology on teachers and students. Education and Information Technologies, Vol. 7, No. 4,pp 369-376.

Knezek, G., & Khaddage, F. (2011). A preliminary analysis of the Mobile Learning Scale. Paper presented to the World Educational Research Association (WERA) Annual Conference. Kaohsiung, Taiwan, December 17, 2011.

Knezek, G., et al. (2011). Student technology experiences in formal and informal learning. Preceedings of EduSummIT. Paris, France. Retrieved: http://edusummit.nl/res2011/calltoaction2011/briefpapers2011.

Kolko, B., et al., (2007). Communication as information-seeking: the case for mobile social software for developing regions. Paper presented at the 16th international conference on the World Wide Web (WWW), Banff, Alberta, Canada, pp 863 – 872.

Kuhlthau, C, (1991). Inside the search process: information seeking from the user's perspective. Journal of the American Society for Information Science, Vol 42, No. 5,pp 361-371.

Kuhlthau, C., et al, (2008). The 'information search process' revisited: Is the model still useful? Information Research, Vol. 13, No. 4.paper 355. Retrieved from http://informationr.net/ir/13-4/paper355.html.

Lai, K. W. (2011). Digital technology and the culture of teaching and learning in higher education. Australasian Journal of Educational Technology, Vol. 27, Special Issue No. 8,pp 1263-1275.

Litzinger, T., et al. (2003). Assessing Readiness for Self-Directed Learning. Proceedings, 2003 ASEE Conference and Exposition American Society for Engineering Education. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.133.2900&rep=rep1&type=pdf

Mertler, C., & Vannatta, R. (2005). Advanced and Multivariate Statistical Methods (Third. Edition). Pyrczak Publishing, Los Angeles, CA.

Mills, L. & Knezek, G. (2012). Measuring Learning Preferences within the Integrated Communications Learning Landscape. In P. Resta (Ed.), Proceedings of Society for Information Technology & Teacher Education International Conference 2012 . Chesapeake, VA,pp 1994-1999.

Naismith, L., et al. (2004). NESTA Futurelab Report 11: Literature Review in Mobile Technologies and Learning. NESTA Futurelab. Bristol, UK.

Stevens, J., 1996. Applied multivariate statistics for the social sciences. Lawrence Erlbaum Associates, Hillsdale, NJ. pp 366.

Rogers, E. M. (2003). Diffusion of innovations, 5th ed. The Free Press, New York.

World Bank (2012). Maximizing Mobile. Retrieved http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/IC4D-2012-Report.pdf