INTERNATIONAL JOURNAL OF INSTRUCTIONAL TECHNOLOGY AND DISTANCE LEARNING

September 2016
Volume 13 Number 9

ISSN 1550-6908

PUBLISHER'S DECLARATION

Research and innovation in teaching and learning are prime topics for the *Journal of Instructional Technology and Distance Learning* (ISSN 1550-6908). The Journal was initiated in January 2004 to facilitate communication and collaboration among researchers, innovators, practitioners, and administrators of education and training involving innovative technologies and/or distance learning.

The Journal is monthly, refereed, and global. Intellectual property rights are retained by the author(s) and a Creative Commons Copyright permits replication of articles and eBooks for education related purposes. Publication is managed by DonEl Learning Inc. supported by a host of volunteer editors, referees and production staff that cross national boundaries.

IJITDL is committed to publish significant writings of high academic stature for worldwide distribution to stakeholders in distance learning and technology.

In its first twelve years, the Journal logged over twelve million page views and more than two million downloads of Acrobat files of monthly journals and eBooks.

International Journal of
Instructional Technology & Distance Learning

Vol. 13. No. 9.

ISSN 1550-6908

Table of Contents – September 2016

Return to Table of Contents

Editorial

HyperCard

Donald G. Perrin

In 1988, I was appointed to a faculty development position at San Jose State University. My mission was to prepare faculty to use computers for instruction. My predecessor, a national leader in instructional design, confided that knocking on doors did not win a good faculty response. For the first month, I listened to what faculty and administrators had to say as I was introduced to them, and their ideas became the basis of a short questionnaire about services they might use and topics for faculty workshops. There was an excellent response. As a result I developed a faculty workroom - 16 state of the art computers with software, printers and switched networks that became the Alquist Center for Innovative Learning. We were lavishly supported by Silicon Valley companies including Apple Computer and Intel. In the first decade, we received almost a million dollars in equipment, software, and services.

The first workshop was HyperCard, using hyper-links to make interactive lessons. Fifty-six faculty members signed up. The School of Engineering had a new computer lab with more than 50 Macintosh computers, so I rescheduled the workshop in the Engineering lab. When I inspected the room, it was large, very bright, with low ceilings and sun streaming through windows on one side. I had planned to do step-by-step follow-me instruction, but projected images would be too small because of the low ceiling, and the screen would be washed out by light from the windows. I needed another solution. The solution was HyperCard.

I put together a HyperCard program that was loaded on every computer. I began the workshop with a short introduction on how to use the computer. Then everybody looked at the initial training examples at their own pace on their own Macintosh computer. This activity took less than ten minutes. Then I asked how many would like to see more examples and how many were ready for how-to instruction. The class was evenly split. That was not a problem. By choosing "A" on the screen they could see more examples; by choosing "B" they began the learning sequence. I had one assistant, but very few hands were raised with questions till the end. Then we had a short discussion and invited attendees to visit, seek help and work in our new faculty lab in the Instructional Media Center.

This was the first of many great experiences with faculty. The Alquist Center for Innovative Learning was humming with activity. It had both Macintosh and PC computers, switched networks to provide adequate bandwidth for audio, video and television. It had software and courseware to support a wide variety of disciplines. And it had a host of faculty developing materials for their own courses, classrooms and students. These faculty were among the first educators to have access to a CD maker and other innovations as they became available.

From an instructional point of view, The Alquist Center was able to propagate the most current ideas in learning theory, instructional design, communication, and technology. It designed customized training programs for different teaching disciplines and helped individual faculty to achieve their teaching – and learning – objectives. The Center collaborated closely with the Television Education Network, San Jose State's ITFS television outreach to satellite campuses and industry training rooms throughout the Silicon Valley.

In 1997, I left to become Dean of Learning Technologies for the Riverside Community College District. Key design and development documents from that project can be found in the December 2014 issue of this Journal.

Return to Table of Contents

Return to Table of Contents

Editor's Note: There are many reasons for the high attrition rate among doctoral students. This study recognizes these barriers and builds courses to set academic standards, clarify program expectations, and provide foundations for higher levels of learning. Critical and creative thinking are essential for assessment, problem solving, decision making, and effective practice. Rubrics clarify expectations on how assignments and projects should be prepared and presented and how they will be scored.

Critical and creative thinking and rubric calibration in a first-year doctoral course sequence

Shawn C. Boone, Linda C. de Charon and Stephanie K. Ferguson
USA

Abstract

The first year of the doctoral program is critical to the preparedness and retention of students. Although the number of students who have completed their earned doctoral degrees has recently increased, the attrition rate for doctoral students demonstrates that between 50 and 80 percent of students still do not complete their doctoral degree programs. Researchers have discovered myriad of reasons as to why doctoral student abandon their studies. Included in these reasons is the result of insufficient preparation within students' first few courses, a lack of clarity and expectation of course knowledge and skills related to the fundamental aspects of doctoral study, and poor connections between career preparation and doctoral course work. Preparing students' doctoral demeanor and critical writing, creativity, thinking, and researching skills has been found to be crucial for success in doctoral programs. To support development of these core skills, a cohesive doctoral faculty feedback calibration cycle can be implemented to support faculty feedback within the core programmatic student learning areas. This framework of faculty professional development is based on Dewey's Constructivist Learning Theory and Tinto's Persistence Theory in Higher Education. Use of this cycle in an online doctoral program has resulted in a 20% increase in student retention during the first year of the program.

Keywords: Online doctoral program; skill development; critical thinking; critical writing; creativity; faculty feedback; calibration cycle; faculty development; student retention; constructivist learning; educational persistence

Introduction

Flynn, Chasek, Harper, Murphy, and Jorgensen (2012) contended "research report a national doctoral attrition rate between 50% and 85% with no evidence that this trend is declining" (p. 242). While the 2012 U.S. census identified only 1.1% of Americans as holders of doctoral degrees, the 2014 census indicated that 1.7% of Americans held doctoral degrees, perhaps indicating a significant increase in graduation during that 2 year period. Although an increase in graduation rates of doctoral students may be a new trend, doctoral granting institutions still face a high attrition rates. Attrition is often related to lack of preparation and engagement as well as lack of relevance of course material to industry practices (Anderson, Cutright & Anderson, 2013; Mendenhall, 1983). Problems with retention and matriculation are often the result of insufficient preparation within students' first few courses (Anderson et al., 2013), a lack of clarity and expectation of course knowledge and skills related to the fundamental aspects of doctoral study (Mendenhall, 1983), and poor connections between career preparation and doctoral course work (Porter & Phelps, 2014).

Development of student knowledge and skills in a manner that leads to successful degree completion is also crucial for a university's reputation (Anderson et al., 2013). Further complications and gaps exist in the role, support, and calibration of doctoral level faculty members who attempt to impart knowledge and skills for critical and creative thinking

development to their doctoral students. This development is critical to ensure programmatic alignment with objectives and goals of doctoral programs.

Barriers to first year doctoral program success

The first year of any doctoral university program is essential for creating a foundation of skills necessary for success and for retaining students (Anderson et al., 2003; Mendenhall, 1983). Grover (2007) contended that doctoral programs often lack the clear and consistent structure desired by doctoral students, and students are typically unprepared for the level of ambiguity that is not associated with lower level education. Airey (2012) posited that discovering strategies to prevail over challenges is fundamental to student success.

Anderson et al. (2013) posited that a significant barrier exists between doctoral students' perceived and actual engagement in the community and among faculty. Although a more focused intent to create meaningful doctoral education experiences has been long realized, a scarcity of literature exists on how to achieve effective, sustained practitioner-doctoral program education and student matriculation. The initial courses of the doctoral journey should establish the academic standards and program expectations while also supporting the current and future needs of the students.

Students cited issues including lack of peer and faculty support (Anderson et al., 2013; Noonan, Ballinger, & Black, 2007), feelings of isolation (Lahenius, 2012), unreasonable expectations (Grover, 2007), and poor career preparation (Porter & Phelps, 2014) as reasons for attrition. Grover (2007) asserted that students entering into doctoral programs are unaware of the high demands placed on knowledge creation and academics, and subsequently, students find themselves frustrated by program demands, unmotivated to complete rigorous tasks, and unsuccessful in their attempts to complete the doctoral program.

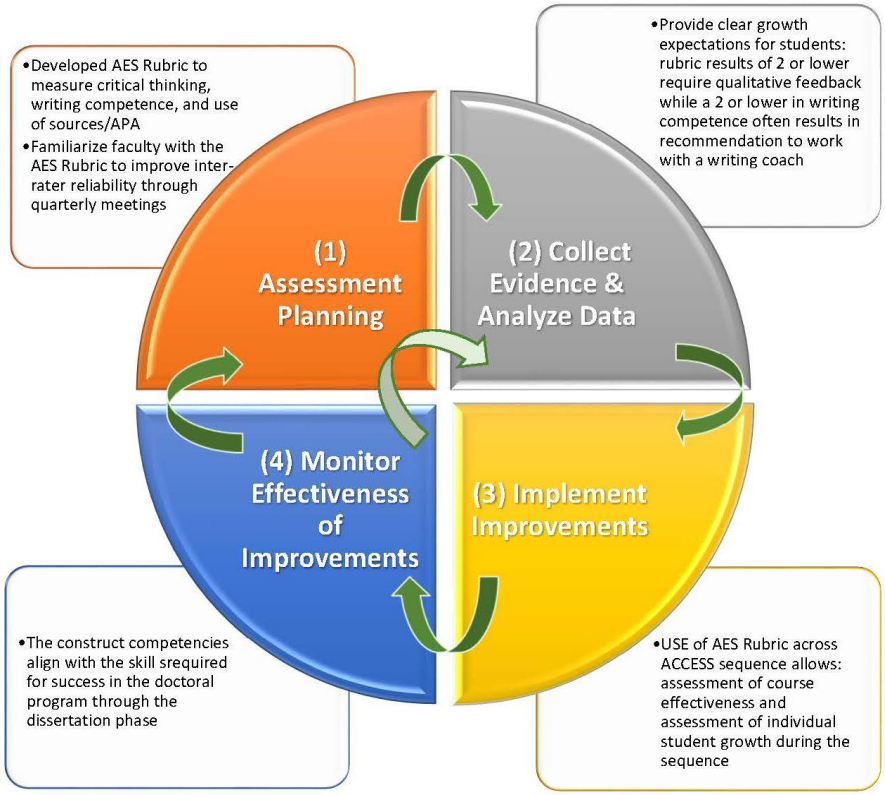
Establishing a theoretical framework to overcome barriers

Hammer (2000) argued that doctoral students need professional socialization to build explicit professional attitudes and behaviors. Researchers have overwhelmingly pointed to the need for doctoral students to create professional communities of scholarship, practice, and collaboration early during the doctoral program (Anderson et al., 2013; Grover, 2007; Lanenius, 2012); to conduct research central to students' industry related fields (Murphy & Vriesenga, 2005), and to be taught explicitly on how to think critically and creatively by faculty members who share common goals of student development and skill development.

To achieve goals of socialization and community building through explicit expectations and to address gaps in supporting doctoral students from start to finish one online doctoral program developed a first year sequence that includes a qualifying preparation course, a leadership course, a 5 day face-to-face residency, and an initial research course. In addition to the core curriculum aspects, the sequence provides co-curricular supports such as writing coaches, writing materials and resources, tutorials, workshops, and seminars. The sequence focuses on four major areas of student preparation and engagement; critical thinking, critical writing, critical research, and alignment between the degree program and dissertation topic.

To assist in overcoming issues associated with student skill development, the faculty uses a calibration cycle focused on training a specialized cohort of faculty who participate in quarterly meetings to familiarize themselves with and discuss use of a rubric used to evaluate student's demonstration of their ability to analyze, evaluate, and synthesize the course materials and their dissertation topic literature. The faculty calibration cycle (shown in the figure) focuses on elevating faculty engagement, enhancing faculty consistency in feedback, mitigating grade inflation, and establishing clear expectations between teaching and learning processes (Love &

Kotchen, 2010). The creation of a cohesive faculty calibration cycle was also critical in establishing and sustaining clear organizational learning protocols (Boone, 2014).



The calibration cycle uses the educational theory of constructivism, specifically Vygotsky's (1978) zone of proximal development, which contends that learners should continually be challenged by information within proximity to slightly above their current level of knowledge. Learning that is viewed as building a foundation of required competencies is a source of motivation and impetus to further educational challenges. As such, providing an early foundation by way of critical thinking, writing, and researching for the dissertation creates enthusiasm for conducting the research. Equally critical is the necessity for instructors to engage students early and often through the known and unknown by virtue of consistent and in-depth faculty feedback. This enthusiasm for learning and research also dovetails with Tinto's theory of persistence (1975). Tinto contended that persistence, and therefore retention, occurs when students perceive that they are making progress toward their personal academic goals.

Calibration of faculty feedback also diminishes grade inflation, which can be harmful to student development. Love and Kotchen (2010) posited that grade inflation harms rather than supports students' self-esteem. The faculty calibration cycle is grounded in two opposing theories; grade attribution theory and grade leniency theory. Based on grade attribution theory students tend to attribute their good grades to their own superlative performance, while they attribute their poor grades to inferior teaching. Grade leniency theory proposes that students reward instructors who give them good grades by rating their faculty evaluations with high scores (Love & Kotchen, 2010).

Constructivism theory. Dewey's (1938) theory of education supports the construct that the curriculum should be functional and pragmatic, contending that students who receive the opportunity to gain practical knowledge become more enthusiastic about their learning. Vygotsky (1978) developed the zone of proximal development theory to describe effective methods for

advancing student knowledge through development of lesson plans that are challenging yet achievable. Students who interact effectively with their cohort and faculty often set personal goals for their learning and desire a more demanding curriculum (Vytgotsky, 1978). Tinsley and Lebak (2009) expanded on Vygotsky's zone of proximal development theory by identifying a similar theory rooted in andragogy--the zone of reflective capacity. The zone of reflective capacity is constructed when adult students engage in positive interactions with others who share their learning goals. Tinsley and Lebak (2009) asserted that collaboration with other students and guidance from the faculty can expand student's critical reflection, increasing the capacity for an environment conducive for learning.

Persistence theory in higher education. The theory of persistence (Tinto, 1975) contends that persistence, and therefore retention, occurs in higher education when students perceive that they have successfully integrated academically and socially with peers and faculty and are making progress toward their personal academic goals. Edwards (2000) and later Love and Kotchen (2010) postulated that faculty members who inflate grades and who provide students with erroneous appearances of achievement, impede students' growth and lessen self-esteem. Attention by faculty members should be placed on students' actual progress and in-depth feedback that moves students' understanding of deficiencies.

Development of critical and creative thinking

Strategies that create proper connections between career preparation and doctoral course work (Porter & Phelps, 2014) are often ill-conceived in higher education institutions. At the doctoral level, students complain about the manner in which assignments and activities are structured, connected to career relevance, and integrated into dissertation level thinking and writing. Critical thinking and creative thinking (also known as creativity) are interrelated skills required for problem solving and generating new ideas. Lau (2011) asserted that creative thinking is required to develop innovative ideas for problem resolution, and critical thinking is required to assess and implement those ideas. Evidence of critical and creative thinking produces innovation within students' fields and doctoral dissertation work. Creative thinking can foster critical thinking, and conversely critical thinking can foster creative thinking.

Creative thinking is defined as creating unique and original approaches to problem solving; creativity emphasizes original ideas and use of innovation. Critical thinking involves evaluation of ideas and identification of optimal solutions. This higher level of thinking includes development of the aptitude to distinguish fact from opinion and to recognize errors in reasoning (Nicholls, de Charon, & Hutkin, 2010). Dr. Martin Luther King Jr. (1947) asserted:

> A great majority of the so-called educated people do not think logically and scientifically. . . . Education must enable one to sift and weigh evidence, to discern the true from the false, the real from the unreal, and the facts from the fiction. The function of education, therefore, is to teach one to think intensively and to think critically. (para. 3-4)

Ruggiero (2003) defined thinking as being comprised of three dimensions; reflective, creative, and critical. Creative thinking involves creating ideas to address problems using techniques such as brainstorming and visualization, and critical thinking is the process to make decisions based on separation of fact from opinion, recognition of errors in reasoning, and analysis of arguments to identify the optimal alternatives (Ruggiero, 2003).

Critical thinking and creativity within higher education

Faculty within higher education must actively consider that students have innate strengths based in thinking critically or creatively, but typically students will not have strengths in both of these skill sets. Many authors have asserted the benefits of critical thinking and creativity in education. According to Clifford, Boufal, and Kurtz (2004), critical thinking is a positive predictor of grade

point average in higher education. These authors viewed critical thinking as a result of personality and cognitive abilities. Clifford et al. (2004) additionally pointed out that development of critical thinking is increasingly becoming a primary objective of higher education.

Instructors should be aware that creative and critical thinking are critical to effective decision making and problem solving (Nicholls et al, 2010). Gibbons and Gray (2004) asserted that when students learn to think creatively and critically the outcome of higher education is advanced from merely gaining knowledge to gaining the capabilities for innovative and analytical exploration of the knowledge received. Learning the ability to problem solve effectively requires educators to foster an educational environment to enhance these skills by encouraging students to ask questions and consider problems that allow imagination and require in-depth thinking.

Chan (2013) emphasized that higher education should allow students to develop and balance these two important capabilities. Scholars contend that the ability to reason and think critically is central to higher education (Alazzi, 2008). Students should learn to develop critical thinking skills through conceptualization, analysis, and evaluation using observation, experience, and reflection. Through systematic use critical and creative thinking students can acquire the ability to view problems and their solutions in a context of wider ranging possibilities.

As part of the faculty calibration and assessment cycle, faculty members look for approaches to improve student critical and creative thinking as a means for students to develop skills required for success in their doctoral programs. Additionally, faculty members discuss and share approaches for consistency in assessing critical and creative thinking and writing competences. Creating clear expectations and communicating these expectations to students are critical to the process.

Rubrics and their importance

In the field of education, rubrics are scoring guides intended to provide constructive feedback to students while clarifying the characteristics of quality work and promoting self-reflection (Burke, 2011; Taggart, Phifer, Nixon, & Wood, 1998). Rubrics assist students in understanding what is expected of them as well as detailing a continuum from novice to expert. As students become acclimated to using rubrics, they learn to set goals, think critically and creatively, and establish plans to achieve their goals (Arter & Chappuis, 2006; Taggart et al., 1998; Tomlinson, 2003). Utilizing rubrics allows instructors to define complex learning objectives while “ensuring that judgements about student work are consistent over time, between assignments, and with colleagues” (Arter & Chappuis, 2006, p. 3). Instructors are able to analyze data gleaned from rubrics to identify the link between instruction and assessment of students as well as the connection between expected and achieved success (Taggart et al., 1998).

Rubrics in assessment of learning

In the calibration model assessment for learning uses the assessment process and products as tools to improve student learning. Such assessment involves instructors using data to inform their instructional practices and typically includes the following characteristics:

- Assists students in learning effectively rather than simply achieving a higher grade;
- Delineates clear goals for the task being assessed;
- Encourages personal responsibility in the learning process;
- Provides effective feedback, which serves as a motivator for the learner to improve;
- Encourages self-assessment (Arter & Chappuis, 2006).

Assessment for learning is an interactive exchange between the student and the instructor. In contrast, assessment of learning enables instructors to report the status of a student at a given time providing a snapshot of performance (Arter & Chappuis, 2006). Thus, the goal of assessment of learning is to determine rank whereas the goal of assessment for learning is to improve student achievement. A rubric can serve both purposes; however, the effectiveness of a rubric depends upon its reliability.

The need for calibration

The subjective nature of assessment and evaluation is a recurring issue in education. Rubrics provide "a shared standard of quality" which is imperative in order to ensure consistency and fairness in evaluation (Kilgore, 2002). Without a rubric, a grade of an 'A' may not mean the same thing in two sections of a course taught by two different instructors. Thus, it is essential that rubrics are calibrated so that all raters using the rubric view the same work sample with the same or similar ranking.

The calibration cycle model for faculty feedback developed out of a student-driven need to mitigate student complaints of "no one ever told me," which is a direct implication of the grade leniency theory. Further impetus for the calibration cycle model focused on a faculty centered need to create clear expectations for faculty on scoring assignments and consistent feedback on expectations for assignment content, APA format, and organization. To achieve this level of faculty expectation, the program uses a small cohort of faculty who teach across and within the first year sequence. Faculty feedback consistency is created through use of a common rubric to assess analysis, evaluation, and synthesis of students' assignments. This level of professional development contrasts what is commonly experienced by doctoral faculty and student development. Learning to think both critically and creatively alters educational outcomes from merely gaining knowledge to gaining the ability to explore knowledge analytically and innovatively (Nicholls, de Charon, & Hutkin, 2010).

The calibration process

The goal of the calibration process is to foster inter-rater reliability ensuring that various instructors rate the same performance with the same score. Utilizing quarterly virtual faculty meetings, the same authentic work sample is used and instructors focus on one aspect or metric of the rubric per meeting. This encourages faculty members to focus on the nuances of the selected metric in order to address instructional expectations.

A standardized scoring technique was implemented where instructors read through the assignment prompt, the authentic work sample, and the rubric metric prior to beginning the scoring process. Then, instructors read the performance criterion for the lowest point value and ask themselves whether the student met that specific performance criterion. If the answer is 'no', then the instructor assigned the lowest score for the current metric. If the answer is 'yes', then the instructors move to the next performance criterion and repeat the process. The end result is for the instructors to assign the student the score for the highest performance criterion that is fully met. Faculty members then share their ratings and provide a rationale for their scores. Collegial discussion provides faculty and administration the opportunity to standardize their assessment practices and address any modifications needed (Borkowski, 2006; Gorggins-Selke, 2013).

Outcomes of the calibration process

Along with helping to standardize the scoring process and providing practice rating authentic work samples, through the discussion of individual rationales and interpretations faculty members increase their awareness of potential rater biases. In addition to higher inter-rater reliability

(Burke, 2011; Kilgore, 2002; Taggart et al., 1998), faculty members who participate in the process become better-acquainted with course assignments and teaching expectations (Groggins-Selke, 2013).

Through the collegial discussion of scores and their rationales, universities and programs help establish the validity of the rubric and the performance criteria by acknowledging and addressing alignment issues (Borkowski, 2006). Similarly, the calibration process mitigates grade inflation by standardizing the assessment of student work (Groggins-Selke, 2013; Love & Kotchen, 2010).

Actions for faculty to improve student critical thinking and creativity

As experienced in the first year implementation of the calibration and assessment cycle, higher-education faculty should work with students to identify their personal preferences toward either critical thinking or creativity, leverage their existing strength, and improve these skills. Improving critical thinking and creativity skills should start by identifying students' intrinsic ability, either creativity or critical thinking, to recognize their developmental need (de Charon, 2003). Instructors should engage students in the course content and ask probing questions to determine students' styles of developing solutions as either creative or based in critical thinking (Lederer, 2007). After identifying students' area of strength the instructor should place students into two groups based on their intrinsic strength and engage them in activities to develop the opposite skill (de Charon, 2003). Activities should be designed to assist critical thinkers develop creative solutions, and activities should be designed assist intrinsically creative learners to improve their critical thinking skills when considering how to solve a problem.

Assisting critical thinkers improve their creativity skills should enable students to look beyond factual responses and to deliberate on the possibilities. Instructors should encourage the students to deal in curiosity and imagination. Brainstorming should be used to help students consider fanciful ideas without being judged. Use of visualization and theoretical thinking can assist students in developing their ability to be innovative and creative (de Charon, 2003).

Assisting creative students to advance their critical thinking skills requires that students focus on structured and carefully planned solutions. A productive exercise for helping creative students develop critical thinking skills is to have the students visualize an innovative potential solution and consider the steps required to implement that goal. This activity allows students to identify the reality of the requirements needed to accomplish the visualized objective beyond the creative but perhaps unrealistic vision. Recognizing the structure and details required to accomplish potential solutions will help creative student evaluate options based on facts and help them to remain grounded and critical in their thinking (de Charon, 2003).

Higher education should provide an opportunity for students to develop thinking practices and patterns that integrate both critical thinking and creativity. An effective critical thinking and creativity curriculum should identify students' individual preferences and should challenge those preferences while fostering their abilities to think both critically and creatively. Providing calibrated rubrics to assess authentic learning incorporating both critical and creative thinking is one way to help students hone their critical and creative thinking skills (Halpern, 1998).

Another critical aspect of the development of higher education faculty is the need for the faculty to become extensions of collaborative teams and networks of support (Boone, 2014). Increasing higher education faculty networks produces ownership (Boone, 2014), which is critical to doctoral student development.

Closing thoughts

Costa and Kallick (2004) remind that, "the ultimate purpose of assessment is to have students learn to become self-evaluative" (p. 3). With such skills in place when students graduate, they will have the tools to know how to adapt external critique into self-improvement; they will possess the ability to give and receive constructive feedback and revise their work based upon the feedback provided (Costa & Kallick, 2004).

Critical and creative thinking are essential to problem solving, decision making, and effective practice in all education programs. Development of these skills can be enhanced in the online classroom with the use of calibrated rubrics (Halpern, 1998; Mumford, Medeiros, & Partlow, 2012; Pacansky-Brock, 2013).

Assessment using rubrics also yields data, which, when analyzed, interpreted, and internalized, provides instructors, administrators, and organizations the information required to modify their actions to more effectively attain their goals. "Assessment guides instruction when it is used as a tool to inform instruction, improve student achievement, and provide a positive learning experience for all students," their instructors, and their schools (Burke, 2011, p. 138). Use of this rubric and cycle to calibrate faculty assessment of online doctoral student work has resulted in improved impartiality and has contributed to a 20% increase in student retention during the first year of the program. Adoption of similar strategies may reduce student attrition for online universities globally.

References

Airey, J. (2012). How to manage a school-work-life balance. British Journal of Nursing, 21(2), 115.

Alazzi, K. (2008). Teachers' perceptions of critical thinking: A study of Jordanian secondary school social studies teachers. The Social Studies, 99(6), 243-248.

Anderson, B., Cutright, M., & Anderson. S. (2013). Academic involvement in doctoral education: Predictive value of faculty mentorship and intellectual community on doctoral education outcomes. International Journal of Doctoral Studies, 8, 195-201. Retrieved from http://ijds.org/Volume8/IJDSv8p195-201Anderson0405.pdf

Arter, J., & Chappius, J. (2006). Creating and recognizing quality rubrics. Upper Saddle River, NJ: Pearson.

Boone, S.C. (2014). Using organizational learning to increase operational and conceptual mental models within professional learning communities. Journal of Psychological Issues in Organizational Culture, 5(3), 85-99. doi: 10.1002/jpoc.21152

Borkowski, N. (2006). Changing our thinking about assessment at the doctoral level. In Maki, P. & Borkowski, N (Eds.). The assessment of doctoral education: Emerging criteria and new models for improving outcomes (pp. 11-51). Sterling, VA: Stylus Publishing.

Burke, K. (2011). From standards to rubrics in six steps: Tools for assessing student learning (3rd ed.). Thousand Oaks, CA: Sage Publications.

Chan Z.C.Y. (2013). A systematic review of creative thinking/creativity in nursing education. Nurse Education Today, 33 (1382–1387). doi: 10.1016/j.nedt.2012.09.005

Clifford, J.S., Boufal, M.M., & Kurtz, J.E. (2004). Personality traits and critical thinking skills in college students: Empirical tests of a two-factor theory. Assessment, 11 (2). doi: 10.1177/1073191104263250

Costa, A., & Kallick, B. (2001). Building a system for assessing thinking. In A. Costa, Developing minds: A resource book for teaching thinking (3rd ed, pp. 517-524). Alexandria, VA: Association for Supervision and Curriculum Development.

de Charon, L. (2003). A transformational leadership development program: Jungian psychological types in dynamic flux. Organization Development Journal. 21(3). 9-18.

Dewey, J. (1938). Experience and education. New York, NY: Touchstone Books.

Edwards, C.H. (2000). Grade inflation: The effects on educational quality and personal wellbeing. Education, 120, (3).

Flynn, S.V, Chasek, C.L., Harper, I.F., Murphy, K.M., & Jorgensen, M.F. (2012). A qualitative inquiry of the counseling dissertation process. Counselor Education and Supervision. 12 (51), 242-255.

Gibbons, J., & Gray, M. (2004). Critical thinking as integral to social work practice. Journal of Teaching in Social Work, 24, 19–37.

Groggins-Selke, M. (2013). Rubric assessment goes to college: Objective, comprehensive evaluation of student work. Lanham, MD: Rowman & Littlefield Education.

Grover, V. (2007). Successfully navigating the stages of doctoral study. International Journal of Doctoral Studies, 2, (9-21).

Halpern, D. (1998). Teaching critical thinking for transfer across domains: Disposition, skills, structure training, and metacognitive monitoring. American Psychologist, 53(4), 449-455. doi: 10.1037/0003-066.53.4.449

Hammer, D.P. (2000). Professional attitudes and behaviors: The "A's and B's" of professionalism. American Journal of Pharmaceutical Education, 64, 455-464.

Kilgore, B. (2002). Rubrics and more: The assessment companion (2nd ed.). Austin, TX: Professional Associates Publishing.

King, M. L. (1947). The purpose of education. The Maroon Tiger. Morehouse College, GA.

Lahenius, K. (2012). Communities of practice supporting doctoral studies. The International Journal of Management Education, 10, (29-38). doi: 10.1016/j.ijme.2012.02.003

Lau, J.Y.F. (2011). An introduction to critical thinking and creativity: Think more, think better. Hoboken, NJ: Wiley.

Lederer, J. (2007). Disposition toward critical thinking among occupational therapy students. The American Journal of Occupational Therapy, 61(5), 519-26.

Love, D., & Kotchen, M. (2010). Grades, course evaluations, and academic incentives. Eastern Economic Journal, 36: 151-163. doi: 10.1057/eej.2009.6

Mendenhall, M. (1983). Overcoming obstacles in the dissertation requirement: Advice to the doctoral candidate. Teaching of Psychology. 10(4), 210-212

Mumford, M., Medeiros, K., & Partlow, P. (2012). Creative thinking: Processes, strategies, and knowledge. The Journal of Creative Behavior, 46(1), 30-47. doi: 10.1002/jocb.003

Nicholls, D., de Charon, L., & Hutkin, R. (2010). Development of critical thinking and creativity: Practical guidelines for the postsecondary classroom. ATEA Journal, (3)3, 12-15.

Noonan, M.J., Ballinger, R., & Black, R. (2007). Peer and faculty mentoring in doctoral education: Definitions, experiences, and expectations. Journal of Teaching and Learning in Higher Education, 19(3) 251-262. ISSN 1812-9129

Pacansky-Brock, M. (2013). Best practices for teaching with emerging technologies. New York, NY: Routledge.

Porter, S.D., & Phelps, J.M. (2014). Beyond skills: An integrated approach to doctoral student preparation for diverse careers. Canadian Journal of Higher Education, 44(3), 54-67.

Ruggiero, V. R. (2003). Making your mind matter: Strategies for increasing practical intelligence. Oxford, UK: Rowman & Littlefield Publishers.

Taggart, G., Phifer, S., Nixon, J., Wood, M. (Eds.). (1998). Rubrics: A handbook for construction and use. Lancaster, PA: Technomic Publishing.

Tinsley, R. & Lebak, K. (2009). Expanding the zone of reflective capacity: Taking separate journeys together. Journal of Teacher Research. 11(2), 1-11. Retrieved from: http://journals.library.wisc.edu/index.php/networks/article/viewFile/190/404

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. Review of Educational Research, 45(1), 89-125.

Tomlinson, C. (2003). Fulfilling the promise of the differentiated classroom: Strategies and tools for responsive teaching. Alexandria, VA: Association for Supervision and Curriculum Development.

Vygotsky, L.S. (1978). Mind and society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

About the authors

Shawn Boone, EdD is Associate Dean of Instruction in the School of Advanced Studies (Doctoral Studies) at University of Phoenix. He has earned degrees in administrative leadership in teaching and learning, and in curriculum, instruction, and assessment. He supported K-12 public, private, and charter schools in Los Angeles. Shawn has been an online faculty member since 2009 and a doctoral research faculty member since 2011.

Email: Shawn.Boone@phoenix.edu

Linda de Charon, PhD has earned degrees in engineering, systems technology, and leadership decision sciences. She supported federal government programs as an aerospace engineer and intelligence programs as a strategic planner for nearly 30 years. Linda has been an online doctoral studies instructor since 2004 and is a full-time faculty member of University of Phoenix Online School of Advanced Studies.

Email: LdeCharon@email.phoenix.com

Stephanie Ferguson, PhD is Dean of Distance Learning and Professional Studies at New Mexico Junior College. She has earned degrees in special education-gifted studies, curriculum and instruction, and English education. Stephanie's professional experience includes teaching in K-12 and post-secondary institutions both face-to-face and online. She has been a faculty member with University of Phoenix since 2002.

Email: sakfergusonphd@gmail.com

Return to Table of Contents

Editor's note: Attrition of human capital at the highest academic level incurs a high economic cost. This article is designed to inform faculty, administrators and doctoral students how mentoring relationships can increase the success rate in doctoral programs. It explores reasons why so many doctoral students fail to complete their degree, and measures that will improve results for the candidate, the university, and the society as a whole.

Fostering productive online doctoral mentoring relationships

Brent Muirhead and Anastasia Metros
USA

Abstract

This discussion provides a review of the doctoral mentoring literature. The narrative highlights the importance of the dissertation chair and doctoral student relationship and the additional myriad of factors that contribute to the success of doctoral students. Online doctoral dissertation chairs aiming to improve dissertation completion rates would do well to support, encourage, give detailed feedback to, and provide guidance and resources to students on such topics as time management which is a consistent challenge for students.

Keywords: doctoral education, dissertation, online education, doctoral mentoring, dissertation chair, doctoral student success.

Introduction

The researchers have studied doctoral mentoring issues for the past decade and have worked as a dissertation chair and committee member with numerous students and coached new chairs. While working with doctoral colleagues, it was apparent that chairs varied in their mentoring skills, dedication to their work and the quality of advice provided to their students (e.g. written feedback). These experiences created questions about what were the best mentoring practices and led to exploring more about this vital subject. Unfortunately, approximately 50% of doctoral students never complete their degree and are classified as being All But Dissertation (ABD) (Holmes, Robinson & Seay, 2010; Pyhalto, Toom, Stubb & Lonka, 2012). The absence of a terminal degree does have a significant negative impact on people who experience diminished job opportunities. There are emotional and financial costs that are difficult to quantify. People must endure the disappointment of having to revise their career plans while having to pay college loans for incomplete degrees. Sadly, these individuals are in the twilight zone of higher education where they have been forgotten.

The ultimate academic challenge

The doctoral journey is the ultimate academic challenge for students. Individuals are expected to make significant personal investments of their time and financial resources. Barnes and Randall (2012) and Gravis (2007) relate that depending upon the academic discipline it will take students between five and ten years to complete their doctoral degrees. Higher education administrators and teachers are exploring ways to improve doctoral education. Earning advanced degrees enables individuals to cultivate new skills and develop knowledge expertise to be researchers, scholars, scientists, innovators and practitioners who can have a positive impact on others. Martin (2012) relates six practical reasons why individuals pursue a graduate education: enjoy learning and are life-long learners, increase career opportunities, job promotion, earn more money, personal sense of achievement and acquire credibility in the marketplace.

Unfortunately, some educational leaders express little concern about the doctoral high attrition rate. Damrosch (2006) considers the long apprenticeships as a useful educational feature because

this will "…serve to weed people who are not happy with the present system and to select for individuals who work well in an atmosphere of heightened individualism and lowered intellectual sociability" (p. 37). In sharp contrast to this view, educators are worried about the attrition issue. Menand (2010) states "…there is a huge social inefficiency in taking people of high intelligence and devoting resources to training them in programs that half will never complete…" (p. 152). During the past decade, there has been a growing concern about the number of students who drop out of doctoral programs. Barnes and Randall (2012) note that "In fact, the rate of attrition from doctoral programs has been described as 'scandalously' high when compared to professional programs such as law and medicine" (p.48).

The doctoral dissertation is a unique document that transcends the academic requirements for master degree programs in the United States. Graduate work usually requires completing an applied project while working with one teacher or advisor. Also, the short document (e.g. 25-50 pages) usually takes less than six months to complete for the degree. In sharp contrast, the doctoral process can take years to create a document that can range between 125- 200 pages in length (Beck, 2013). Students work directly with a dissertation chair and three or more committee members. Also, there are administrators such as department heads and deans who can influence the dissertation work through their academic expectations, rules and guidelines (Golde, 2005). Additionally, the research proposal must go through a series of approvals involving the chair, committee members and Institutional Review Board (IRB) before conducting original research. Therefore, the dissertation contains a degree of complexity involving working with a number of variables that demands being dedicated to process filled with uncertainty about the amount of time required to complete the research.

Student issues

A Survey on Doctoral Education and Career Preparation on doctoral student experiences reveal serious issues in graduate education. The survey acquired data from 4,000 students who represented 11 academic disciplines and 27 schools. Doctoral students shared three significant findings (Golde & Dore, 2001):

1. Students prepared to conduct research, but the majority of the jobs in higher education were teaching positions.
2. Students wanted greater flexibility and freedom to select courses outside their discipline to increase the breadth of their knowledge.
3. Students felt they lacked adequate knowledge about the doctoral process, expectations of mentors, the length of a degree program and research funding.

These research findings affirmed Nyquist et al. (1999) who conducted a four-year longitudinal study with students. The individuals related frustrations about the lack of coordinated plans to foster teaching skills, the absence of adequate mentor feedback, confused about career options and unrealistic expectations for their departmental work. Graduate students expressed a great deal of negativity about their experiences and becoming disillusioned because they had to replace their personal values with the academy's value system. Nyguist et al. (1999) shared that struggles with conflicting values created a survival mentality and "… a sense of grim determination to finish what they have started, along with some bitterness about the process. Inherent passion and joy in discovering more about one's field and sharing it with others are replaced with resignation and disappointment" (p. 20).

Identifying the reasons for the high rate of doctoral attrition reflects the complexity of this issue. Golde (2005) investigated the doctoral experiences of 58 students from four departments: history, English, biology and geology. The study produced several valuable insights into the causes for attrition: student abilities and talents were poorly matched to their academic discipline,

differences in expectations between students and departmental faculty, students had serious concerns about obtaining a job and struggling with social isolation. The socialization process in doctoral programs has been a focus for researchers. Gardner (2010) interviewed 60 doctoral students from different academic disciplines. The investigation found that the departmental culture and the degree of supportive relationships with mentors and peers can be important factors in helping reduce the amount of time to complete their degrees. Linden, Ohlin and Brodin (2013) found that the absence of faculty being coached and trained on their mentor roles made them more prone to focus on task orientation while neglecting sharing strategies that encourage research skill development.

The doctoral mentoring relationship

Research on doctoral studies does contain valuable insights into faculty and student experiences. Four major themes emerge from the literature. Students must learn how to adjust to the academy's value system. A second challenge involves being able to interpret and manage the mixed messages about their departmental work and study priorities. Thirdly, having low expectations about their future job prospects in higher education. A fourth theme is students want greater support from their mentors (Nyguist et al. 1999; Golde & Dore, 2001 & Golde, 2005). The themes reflect vital issues facing today's graduate education leaders who design and manage degree programs that should meet a diversity of student needs. Therefore, it is important to identify effective doctoral mentoring relationships that will help students have positive and productive educational experiences.

The literature on dissertation mentoring identifies three key attributes to this unique professional relationship: reciprocal, developmental and interactive. The term reciprocal highlights a mutuality between the dissertation chair and mentee that can involve a variety of communication formats such as face-to-face, phone, texting and online. Therefore, it is entirely different from the relationship that rarely have a reciprocal element such as supervisors. The developmental trait is learning oriented, and the mentor is helping individuals enhance their research skills, critical and creative thinking and scholarly writing. Consistent interaction over several years is an essential part of the dissertation mentoring relationship to provide the guidance the mentee needs to complete research projects (Haggard, Dougherty, Turban & Wibanks, 2011).

In the literature, a distinction is made between the terms mentor and faculty advisor. Mentoring transcends advising because it involves both personal and professional relationships. Also, academic advisors might not become mentors for a variety of reasons such as the need for a greater time commitment. Mentor relationships evolve over time as student grow and their needs change while progressing through the research process. The National Academy Science (1997) observes that "A mentor will try to be aware of these changes and vary the degree and type of attention, help, advice, information, and encouragement that he or she provides" (p. 1).

Sands, Parson and Duane (1991) describe the mentoring relationship as representing four primary roles: friend (foster work and life balance, encourages and socializes with student) career guide (promote networking and increase presence in academic community), information source (resource for university/department policies/selecting committee members/research ethics) and intellectual guide (refine problem statement, select appropriate research method, feedback on written work, enhance research and writing skills). This doctoral model offers a practical way to frame mentoring relationships (The National Academy of Sciences, 1997).

Students will sometimes struggle in securing a mentor, and this could be partially due to university policies and practices. Universities reward those who conduct research with financial compensation and reduced teaching assignments. Mentors usually receive fewer rewards and financial incentives (Johnson, 2002; Dickson & Johnson, 2000). Doctoral supervision is

demanding professional endeavor and higher education schools have been slow to provide greater recognition and financial rewards (Mullen, 2007).

Starting a mentor relationship can be enhanced by creating a dissertation agreement. Black (2012) calls this a "…pre-nuptial agreement" (p. 99) and recommends addressing the following areas:

- Working Relationship
- Dissertation Planning
- Communication
- Formatting, Editing and Statistical Services
- Committee
- Quality of work (p. 100).

The agreement offers a guide for mentors and students by establishing a clear understanding of expectations about their dissertation work.

Researchers have devoted attention to identifying student needs during their research. Noonan, Ballinger and Black (2007) utilized three focus groups with four mentees, four peer mentors who work with new students and eight faculty mentors. The study findings revealed how student needs vary during different phases of their dissertation work. During the first stage, students receive guidance involving tuition, scholarships, courses and program completion requirements and begin the socialization process into the academy. During the second stage, mentors promote greater self-direction, career development (e.g., presentations) and role redefinition. Mentors provide advice in the form of scaffolding that mirrors principles found in cognitive apprenticeship.

Guidance begins by modeling expected scholarly practices, shares skills, and knowledge expertise and steadily helps the student to become more self-directed over time. It reflects an emphasis on the collaborative nature of mentoring and is designed to cultivate independent skill development and increase student confidence (Shore, 2014). The study indicated that mentors and students must devote attention to developing a good working relationship that defines their roles and expectations. For instance, students expressed the importance of starting their program with adequate advice. Noonan, Ballinger, and Black (2007) relate a student sharing that "The goal is to make sure the doctoral student is on track. You know academically, and everything else that impact the academic…situation: the person's life, the department politics. Whatever…could happen that throws you off track" (p. 255).

Johnson (2002) discusses how students classify successful mentors as being able to demonstrate positive personality traits such as being intelligent, flexible, caring, empathetic, encouraging, ethical and competent. The emphasis on having a caring mentor is frequently mentioned in the literature. Ku, Laham, Yeh, and Cheng (2008) observe that "Caring may be interpreted as being available, working with students, and showing extra patience" (p. 375).

Clark, Harden, and Johnson's (2000) national study of those who had completed their doctoral degree in clinical psychology identified three psychological mentor traits "acceptance, support and encouragement (p. 267)" as essential for creating and sustaining a positive relationship. Mullen (2007) highlights positive mentor qualities such as being visionary and having high energy and dedicated to helping students experience success.

University educators that are considering to be mentors must evaluate their workloads and schedule a realistic number of students. Therefore, besides the commitment of time, mentors should be selective and consider variables such as having shared interests (e.g. research topic). Mentors should devote time getting to know their students and affirm their talents while relating their dedication to helping them fulfill their dreams and goals. Students sometimes guidance that a realistic goals involve pursuing excellence. Individuals can display perfectionism in their study

habits, and they must learn strategies to manage their feelings of insecurity, or it will hinder their doctoral work. Chairs can encourage their students by reminding them that even excellent dissertations often contain some minor errors (Johnson, 2002; Shore, 2014).

During the doctoral program, students will sometimes question whether they belong in this academic intense culture. Building mentee confidence in their abilities will occur over time through relevant and caring feedback on written work that clearly acknowledges improving their skills. As individuals learn how to balance their writing and research activities, they will become more productive. Making steady progress on the dissertation can be a major source of encouragement because it reflects being disciplined and focused. Mentors can encourage their students by reminding them of their dedication to helping them, working with them to create short and long-term goals and publicly praising them for specific achievements (Kamler & Thomson, 2006).

Doctoral students can experience conflicts with their dissertation chair and committee members. Mentors should always strive to resolve relational conflicts to keep their relationship productive and beneficial. Blum (2010) explains how students can have major dependency issues while learning to be independent researchers. Also, individuals can have conflicts with their committee members such as concerns about the quality of feedback on written work. Mentors can offer practical advice to help students manage complex situations with their committee members. Students can have unrealistic expectations and forget that educators have a life outside the university (Shore, 2014). Even the best mentors must sometimes terminate work with a student when their relationship becomes too dysfunctional. Dissertation chairs should make these decisions in the best interests of students and be role models of ethical behavior and attitudes (Johnson, 2002).

Student writing challenges

Writing the doctoral dissertation creates new social and academic challenges. Working on the dissertation represents a change in the course schedule and students will usually no longer meet their colleagues in classes (face-to-face or online). The long periods of solitary research while working on the open-ended projects can create stress and contribute to feelings of social isolation. Students who work online or doing their doctoral work on a part-time basis can feel alone (Taylor & Beasley, 2005). Experiencing extended periods of social isolation can be a contributing factor to people dropping out of doctoral programs. Mentors can help students by promoting collaboration activities with classmates and social networking (Ali & Kohun, 2007). International students enjoy meeting mentors and students at informal events such as a food potluck. Academic workshops can provide opportunities for social interaction. The meetings can be a source of encouragement as people realize that others are experiencing similar academic challenges and problems (Ku, Laham, Yeh, & Cheng, 2008).

Mentors can have conversations with their students to establish writing goals. The key is to develop a practical timeline that includes adequate time for revisions and creating the proposal and completing the dissertation. The timeline enables the mentor and student to monitor progress (Muirhead & Blum, 2006). Mentors can encourage students to create blocks of time for writing. Students must learn strategies that enable them to balance writing, reading and research to be productive (Single, 2010). For instance, learning to take notes while reading the literature will provide a systematic way to organize and capture ideas and insights. This practice fosters critical reading and prepares material for future use (Muirhead & de Charon, 2012).

Sharing relevant and timely feedback on written work is a valuable best practice for mentors. It helps individuals understand the quality of their narratives and offers guidance on make revisions (Bitchener, Basturkmen, & East, 2010). Mentors should be alert to opportunities to provide

specific advice during important stages in the research process. For instance, the literature review can create a great deal of anxiety in mentees who wonder about their ability to filter accurately, interpret and organize information. Mentors can encourage the use of mind maps as an effective way to organize relevant information sources.

Students often start their projects with excitement about doing original research and producing new knowledge. Mid-way through their dissertation work, the glamour fades as they realize how much work is required. Taylor and Beasley (2005) observe that "…candidates lose their sense of direction, feel overwhelmed by what little they have done and what is left to be done, suffer the loss of confidence, or are bored out of their minds by the endless grind" (p.113). When students reach this critical stage, they risk either falling behind or decide to quit their degree program. Mentors must carefully monitor student work to identify when they need to provide more direct guidance and spark the student's desire to complete their research. Taylor and Beasley (2005) offer five practical suggestions to motivate students and develop more sophisticated self-management skills:

- Publicly praise the value of the student's project in front of department teachers.
- Create study plans designed with smaller objectives and more visible success markers.
- Develop a new research plan that has a clear focus.
- Encourage students to present a conference paper to renew their passion.
- Suggest taking a short break.

Promoting a break does involve a degree of risk because students might not return and become All But Dissertation (ABD). Therefore, mentors must be discerning about their advice. A brief break enables people to engage in leisure activities to recharge emotionally and mentally and return to work with a new sense of purpose and dedication to their studies.

Mentoring ethical issues

Mullen (2007) notes how the literature gives limited attention to chairs who abuse their power. Pyhalto et al., (2012) relates tragic student narratives of mentors involved in unethical practices such as verbal abuse, discrimination and unauthorized use of student research for personal publication (Pyhalto et al., 2012). Mentors must be aware of any potential ethical risks due to having a power advantage and always considering how to serve their students best. Johnson (2016) notes that "Ethical mentors assume responsibility for benefiting mentees, avoiding harm, protecting mentee autonomy, remaining loyal, protecting mentee privacy, and acting with fairness and prudence at all times" (p. 132). Mentors should be role models for their integrity in professional relationships.

Student cohorts

There have been only a few studies on the educational value of doctoral cohorts. Ford & Vaugh (2011) conducted a year-long study with 14 educational administration doctoral students, and the virtual sharing did enhance student and faculty communication. The face-to-face meetings were more problematic with students, frustrated about being away their families. Also, the cohort meetings fostered more social conformity instead of independent thinking. Mullen (2005) argues for having students take leadership of the activities with an emphasis on activities that foster reflective thinking, give people the freedom to take intellectual risks, promote a diverse membership and encourage taking responsibility to support colleagues.

Positive student outcomes

Research studies in faculty mentoring of protégés or mentees have highlighted an assortment of positive outcomes such as career advancement, enhanced research skills, psychological growth (e.g. self-esteem) and self-efficacy (Rose, 2003). Leadership books and business articles frequently encourage people to seek a mentor for professional development due to the potential benefits in career advancement. Allen, Eby, Poteet, Lentz and Lima (2004) conducted a meta-analysis of career mentoring and found their advice enhanced the individual's compensation and promotion opportunities.

Implications for online doctoral dissertation chairs

There are many implications of this body of research for online doctoral dissertation chairs. Clearly, dissertation success is multi-dimensional with many important factors playing into completion. Some of the premier practices chairs can undertake to support successful completion of the dissertation are establishing trust and decreasing student vulnerabilities of their academic skills and personal information (Rademaker, Duffy, Wetzler & Zaikina-Montgomery, 2016). Some of the ways online doctoral dissertation chairs can establish trust is through consistent and detailed dissertation feedback. The feedback assists in establishing a working relationship built on a firm foundation. Feedback along with building rapport with students via various methods such as web conferences, text, phone, etc… also sets a foundation for a trusting relationship (Rademaker, Duffy, Wetzler & Zaikina-Montgomery, 2016).

As to vulnerabilities, acknowledging students' academic skills and strengths and providing support for building their academic prowess are effective methods to ease student vulnerability (Rademaker, Duffy, Wetzler & Zaikina-Montgomery, 2016). Online faculty can point to the myriad of resources available through university workshops, writing centers, and services to encourage students to grow their academic skills. Not only academic skills, but fostering social concepts for learning provide opportunities for meaningful, consistent exchanges with others to help build further skills (Liechty, Liao, & Schull, 2009). Providing guidance to students from wherever they are, meeting them where they need assistance and providing ever increasing challenges and support is the role of dissertation chairs. Online doctoral faculty can work with students in each of their courses to assist in the evolution of students' thinking, ask insightful questions and challenging the thinking and structure to promote advanced thinking.

Providing support to online doctoral dissertation students enhances their research confidence and professional development (Burkard, Knox, DeWalt, Fuller, Hill & Schlosser, 2014). Support can be provided by regularly checking in with students to see how their progress is going and what assistance might be needed. Especially with online studies, students may feel removed and isolated when working on her/his dissertation so providing touch points throughout the dissertation process can be helpful to send a message of care, concern and support. Providing structure and connection with students during the dissertation process is a role all doctoral faculty, chair and committee members alike.

Developing and sustaining a vibrant learning community is a challenging goal and requires faculty to be dedicated to the school's mission, pursue scholarly endeavors and have a passion for student success (Brill, Gogarty, Balcanoff, Turner & Land, 2014). Mentoring is a challenging endeavor that transcends teaching regular university classes (Crisp & Cruz, 2009). Dissertation supervision can promote student growth in their knowledge, independent research skills, and resiliency (Samuel & Kohun, 2010). The literature affirms that the best mentoring relationships "…become increasingly transformational (personally engaged, reciprocal, and inspiring) over time" (Johnson, 2016, p. 41). Therefore, Dissertation Chairs must have the autonomy and administrative support to freely share their expertise. Wise administrators will strive to honor

mentoring relationships by identifying ways to foster enduring and productive mentoring relationships.

Conclusion

Creating the foundation for successful completion of the doctoral dissertation is an important role that dissertation chairs play. There are many factors that contribute to or detract from the ability for students to be successful in completing their dissertations. This multi-dimensional topic has a number of strong themes through course, research and writing. The importance of the mentor relationship and the support, feedback and guidance given to the candidate during the dissertation process are consistently found to contribute to success. Online doctoral dissertation chairs aiming to improve dissertation completion rates would do well to support, encourage, give detailed feedback to, and provide guidance and resources to students on such topics as time management which is a consistent challenge for students.

References

Ali, A. & Kohun, F. (2007). Dealing with social isolation to minimize doctoral attrition: A four stage framework. International Journal of Doctoral Studies, 2, 33-49.

Allen, T. D., Eby, L. E., Poteet, M. L., Lentz, E. & Lima, L. (2004). Career benefits associated with mentoring for protégés: A meta-analysis. Journal of Applied Psychology, 89(1), 127-136. http://dx.doi.org.contentproxy.phoenix.edu/10.1037/0021-9010.89.1.127

Barnes, B. J. & Randall, J. (2012). Doctoral student satisfaction: An examination of disciplinary, enrollment, and institutional differences. Research in Higher Education, 53, 47-75. doi: 1007/s11162-011-9225-4

Beck, M. (2013, April 15). How long is the average dissertation? Retrieved from https://beckmw.wordpress.com/2013/04/15/how-long-is-the-average-dissertation/

Bitchener, J., Basturkmen, H. & East, M. (2010). The focus of supervisor written feedback to thesis/dissertation students. International Journal of English Studies, 10(2), 79-97.

Black, R. (2012). The dissertation marathon. Contemporary issues in educational research, 5(2), 97-104.

Blum, L. D. (2010). The 'all-but-the-dissertation' student and the psychology of the doctoral dissertation. Journal of College Student Psychotherapy, 24(2), 74-85. doi: 10.1080/87568220903558554

Brill, J.L., Gogarty, M. M., Balcanoff, K. K., Turner, F. & Land, D. (2014). Best practices in doctoral retention: Mentoring. Higher Learning Research Communications, 4(2), 26-37. http://dx.doi.org/10.18870/hlrc.v2i2.66

Burkard, A. W., Knox, S., DeWalt, T., Fuller, S., Hill, C., & Schlosser, L. Z. (2014). Dissertation experiences of doctoral graduates from professional psychology programs. Counselling Psychology Quarterly, 27(1), 19-54. doi:10.1080/09515070.2013.821596

Clark, R. A., Harden, S. L. & Johnson, W. B. (2000). Mentor relationship in clinical psychology doctoral training: Results of a national survey. Teaching of Psychology, 27(4), 262-268. doi: 10.1207/S15328023TOP2704_04

Crisp, G. & Cruz, I. (2009). Mentoring college students: A critical review of the literature between 1990 & 2007. Research in Higher Education, 50(6), 525-545. doi; 10:1007/S11162-009-9130-2

Damrosch, D. (2006). Vectors of change. In Golde, C. M., & Walker, G. E. (Eds.). Envisioning the future of doctoral education: Preparing stewards of the discipline, 34-43. San Francisco, CA: Jossey-Bass.

Dickson, S.C. & Johnson, W. B. (2000). Mentoring in clinical psychology doctoral programs: A national survey of directors of training. The Clinical Supervisor, 19(1), 137-152.

Ford, L. & Vaugh, C. (2011). Working together more than alone: Students' evolving perceptions of self and community within a four-year educational administration doctoral cohort. The Qualitative Report, 6(6), 1645-1668.

Gardner, S. K. (2010). Contrasting the socialization experiences of doctoral students in high and low completing departments: A qualitative analysis of disciplinary contexts at one institution. The Journal of Higher Education, 81(1), 61-81. doi: 10.1353/jhe.0.0081

Golde, C.M. & Dore, T.M. (2001). At Cross Purposes: What the experiences of doctoral students reveal about doctoral education (www.phd-survey.org). Philadelphia, PA: A report prepared for The Pew Charitable Trusts.

Golde, C. M., (2005). The role of the department and discipline in doctoral student attrition: Lessons from four departments. The Journal of Higher Education, 76(6), 669-700.

Gravis, J. (2007). In humanities, 10 years might not be enough to get a Ph.D. Chronicle of Higher Education, 53(47), A1.

Haggard, D. L., Dougherty, T. W., Turban, D. B. & Wilbanks, J.E. (2011). Who is a mentor? A review of evolving definitions and implications for research. Journal of Management, 37(1), 280-304. doi: 10.1177/0149206310386227

Holmes, B. D., Robinson, L. & Seay, A. D. (2010). Getting to finished: Strategies to ensure completion of the doctoral dissertation. Contemporary Issues in Education Research, 3(7), 1-8.

Johnson, B. W. (2016). On being a mentor: A guide for higher education faculty, (2nd Ed.). New York, NY: Routledge.

Johnson, B. W. (2002). The intentional mentor: Strategies and guidelines for the practice of mentoring. Professional Psychology: Research and Practice, 33(1), 88-96. http://dx.doi.org.contentproxy.phoenix.edu/10.1037/0735-7028.33.1.88

Kamler, B. & Thomson, P. (2006). Helping doctoral students write: Pedagogies for supervision. New York, NY: Routledge.

Ku, H. Y., Laham, M. K.E., Yeh, H. T. & Cheng, Y. (2008) Into the academy: Preparing and mentoring international doctoral students. Educational Technology Research & Development, 56(3), 365-377. doi: 10.1007/s11423-007-9083-0

Liechty, J. M., Liao, M., & Schull, C. P. (2009). Facilitating dissertation completion and success among doctoral students in Social Work. Journal of Social Work Education, 45(3), 481.

Linden, J., Ohlin, M. & Brodin, E. M. (2013). Mentorship, supervision & learning experience in Ph.D. education. Studies in Higher Education, 48(5), 639-662. doi: 10.1080/03075079.2011.596526

Martin, D. (2012). Six reasons graduate schools pays off. US News & World Report. Retrieved from http://www.usnews.com/education/best-graduate-schools/articles/2012/06/29/6-reasons- why-graduate-school-pays-off

Menand, L. (2010). The marketplace of ideas: Reform and resistance in the American University. New York, NY: W. W. Norton & Company.

Muirhead, B. & de Charon, L. (2012). Dissertation advice for online doctoral students. International Journal of Instructional Technology and Distance Learning, 9(4), 3-11.

Muirhead, B., & Blum, K. D. (2006). Advising Online Dissertation Students. Educational Technology & Society, 9(1), 1-8.

Mullen, C. A. (2007). Trainers, illusionists, tricksters and escapists: Changing the doctoral circus. The Educational Forum, 7(14), 300-315. doi: 10.1080/0031720709335021

Mullen, C. A. (2005). The mentorship primer. New York, NY: Peter Lang.

Noonan, M. J., Ballinger, R., Black, R. (2007). Peer and faculty mentoring in doctoral education: Definitions, experiences, and expectations. International Journal of Teaching and Learning in Higher Education, 19(3), 251-262.

Nyquist, J. D.; Manning, L.; Wulff, D. H.; Austin, A. E.; Sprague, J.; Fraser, P. K.; Calcagno, C.; Woodford, B. (1999). On the road to becoming a professor. Change, 32(3), 18-27.

Pyhalto, K., Toom, A. Stubb, J. & Lonka, K. (2012). Challenges of becoming a scholar: A study of doctoral students of becoming a scholar. ISRN Education, 1-12. doi: 10.5402/2012/934941

Rademaker, L. L., O'Connor Duffy, J., Wetzler, E., & Zaikina-Montgomery, H. (2016). Chair perceptions of trust between mentor and mentee in online doctoral dissertation mentoring. Online Learning, 20(1), 1-13.

Rose, G. L. (2003). Enhancement of mentor selection using the Ideal Mentor Scale. Research in Higher Education, 44(4), 473-494. doi: http://dx.doi.org/10.1023/A:1024289000849

Sands, R.G., Parson, L.A., & Duane, J. (1991). Faculty Mentoring Faculty in a Public University. The Journal of Higher Education, 62(2), 174-193. doi: 10.2307/1982144

Samuel, R. E. & Kohun, F. G. (2010). Managing perceived coping behavior while mentoring doctoral students. International Journal of Doctoral Studies, 5, 29-37.

Shore, B. M. (2014). The graduate advisor handbook: A student-centered approach. Chicago, IL: The University of Chicago Press.

Single, P.B. (2010). Demystifying dissertation writing: A streamlined process from choice of topic to final text. Sterling, Virginia: Stylus Publishing.

Taylor, S. & Beasley, N. (2005). A handbook for doctoral supervisors. New York: NY: Routledge.

The National Academy of Sciences (1997). Advisor, teacher, role model, friend: On being a mentor to students in science and engineering. Washington, D.C.: National Academy Press.

About the authors

Brent Muirhead Ph.D. is an educator and writer with numerous publications in educational technology has a BA in social work, master's degrees in religious education, history, administration, e-learning, computing in education/cognitive psychology, adult education and two doctoral degrees in education. He has graduate degrees from a diversity of schools such as Columbia University, New York City and the University of Georgia and has received five university teaching and leadership awards. Dr. Muirhead has taught online university classes for over 15 years. He is the Senior Online Editor of *International Journal of Instructional Technology & Distance Learning*. Latest book: *Beyond Wisdom: Ideas That Matter.*

E-mail: drmuirhead@yahoo.com

Anastasia Metros, Ph.D., has over 20 years of experience working in higher education as an administrator, faculty member, and consultant. Dr. Metros earned a Ph.D. in Educational Administration from the University of Wisconsin-Madison and has dedicated her career to higher education and technology. Dr. Metros served on the Higher Education User Group Board of Directors and on the Board of Directors of Trans-Atlantic Environmental. Dr. Metros has more than 12 years of experience as an educator of ground and online doctoral courses at University of Phoenix. Metros has been honored with many awards including Faculty Member of the Year. Metros has presented more than 30 times at professional conferences on such topics as technology and higher education. Dr. Metros has an active consulting career and specializes in areas such as: leadership, higher education and technology.

Email: ametros@gmail.com

Return to Table of Contents

Editor's Note: This carefully planned and executed study examines cost/benefits and other factors that influence the adoption of cloud computing.

Adoption of cloud computing by higher education institutions in Maharashtra India: an investigative study

Avinash Appasha Chormale
India

Abstract

Academic study of cloud computing is an emerging research field in India. India represents the largest economy in the south Asia region, which makes it a potential market of cloud computing technologies. This cross-sectional investigative experiential research is based on a technology–organization–environment (TOE) framework, within a Maharashtra state of India targeting higher education institutions. In this study, the factors that affect the cloud adoption by higher education institutions were identified and tested using SPSS software, a powerful statistical analysis tool for structural equation modeling. Three factors were found significant in this context. Relative advantage, complexity and data concern were the most significant factors. The model explained 48.3% of the total adoption difference. The findings offer education institutions and cloud computing service providers with better understanding of factors affecting the adoption of cloud computing.

Keywords: Higher education, Adoption of cloud computing, Technology, organization, environment framework, Maharashtra India.

Introduction

Cloud computing services are expected to be the fastest area of growth [1]. Maharashtra government is investing heavily in e-government solutions to enhance public sector services. One of the initiatives of the second national e-government action plan is building a cloud computing delivery model for government agencies [2].

Several vendors in Maharashtra are offering cloud services through partnership with IT industry leaders. In the area of ERP and business intelligence solutions, an agreement was signed between Oracle to host ERP systems and analytical software in the cloud [3].

Customers in Maharashtra have started the adoption of cloud services. For example, Maharashtra Chamber Of Commerce Industries & Agriculture (MCCIA) and Microsoft to help SMBs Adopt IT & Cloud Computing for Growth. Maharashtra is home to thousands of SMBs. Microsoft's partners are gearing up to advise and guide SMBs in the state and help them through their cloud journeys. One Microsoft partner, Genie InfoTech Pvt. Ltd. (GITPL), has registered a 150% growth in business in the last 12 months in the cloud computing area, especially for Office 365. GITPL aims to extend this success to more SMBs in Maharashtra. Microsoft Office 365 helps SMBs collaborate, communicate, and connect better in their ecosystem and expand to more markets and customers. As per a study by global consulting firm, Boston Consulting Group (BCG), SMBs that embraced IT solutions grew faster than the ones that lagged in terms of IT adoption.

The study also shows that SMBs that decided to take the IT plunge created more new jobs and more revenue growth over the past three years compared to SMBs that trailed in this regard. The BCG study, *Ahead of the Curve: Lessons on Technology and Growth from Small Business Leaders* found that if more SMBs in India adopt the latest IT tools, there is potential for this sector to grow revenues by $56 billion and create as many as 1.1 million new jobs [4]. There are

potential benefits of adopting cloud computing technology in higher education institutions. Some cloud vendors offer programs for educational institutions. Examples of these programs are Microsoft Live@edu, Google Apps and IBM Cloud Academy [5]. Microsoft Live@eduservice has been transformed to Microsoft Office 365 recently. It includes Word, Excel, PowerPoint, Outlook, OneNote, Publisher, and Access.

The offer includes shared collaboration storage in the cloud to allow sharing documents among students in their projects. Google also provides a program for education through its Google Apps for Education Suite. This suite includes productivity applications such as Google Docs. The suite includes email service, classroom management system, shared storage represented by Google Drive, website creation and hosting, and collaboration tools. The case study of the University of Westminster indicated that the benefits and savings were attained by using Google Apps services. The primary purpose of the services is to use email, collaboration and storage services for non-sensitive information [6]. IBM Cloud Academy is a community cloud computing program. It provides best practices and consultation services in addition to the cloud solutions offered to higher education institutions. These solutions include collaboration solutions, infrastructure computing, integration solutions and virtual desktops solutions.

Cloud computing offers a shift from computing as a product that is owned to as a service that is delivered to consumers over the network from large scale data centers or clouds [7]. This shift created an efficient operation for higher education institutions. For example, Washington State University has achieved efficiency by adopting a virtualization environment which is considered an enabler for cloud computing. Saving also was recognized by using email services, CRM Sales-force, GoogleApps and ERP systems [8, 9].

Understanding the position of education institutions with respect to cloud computing adoption is an essential research area. The aim of this research is to explore the factors affecting cloud computing adoption. The results of this research study are expected to help both cloud computing providers and education institutions.

This paper is organized as follows: First, the research motivation and objectives, second, the literature review and research hypotheses are proposed, followed by methodology, results, discussions, and the contribution and implications for practitioners. Third, the paper's limitations are summarized and future research directions are suggested.

Research motivation and objectives

Cloud computing is one of the top 10 strategic technology trends for 2014 [10]. Current research on the use of cloud computing in education mainly focused on cloud computing frameworks, security, pricing mechanisms, and implementation [11, 9, 12, 13,14, 15, 16, 17, 18] and has not extensively addressed the use and adoption of cloud computing in education. A systematic literature review study found that several universities were interested in using cloud computing in their education systems; however, there is a lack of experimental studies focusing on the adoption of cloud computing by educational institutions [19].

The research objective is to identify and test technological, organizational and environmental factors that directly affect the adoption of cloud computing by higher education institutions in Maharashtra state. The focus of this study is on cloud computing solutions that are hosted outside the premises of higher education institutions (i.e. public cloud). Examples of cloud computing solutions being addressed by this study are institutional level solutions such as library systems, ERP, learning management systems and research solutions. Specifically, we attempted to answer the following research question: what are the technological, organizational and environmental factors affecting cloud computing adoption.

Literature review and research hypotheses

The National Institute of Standards and Technology (NIST) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models." [33].

Cloud computing model was evolved from several technologies. The model is an evolution of virtualization, grid computing, utility computing, and Internet services. High speed wireless network, low cost broadband, and low storage and HW cost, have contributed to the development of cloud computing. Cloud computing is more than outsourcing. According to the definition, there are five essential characteristics that distinguish cloud computing from outsourcing [11, 21, 22].

The theoretical foundation of this research is based on the technology–organization–environment (TOE) framework. TOE was proposed by Tornatzky and Fleischer [24] and is widely used in studying technology innovation adoption [25, 27, 28, 29, 30, 31, 32, 33, 34]. TOE serves as a taxonomy for factors that facilitate or inhibit the adoption of technology innovations [31]. TOE has advantage over the Diffusion of Innovation model because it accommodates organizational and environmental factors [27, 35]. According to the TOE framework, three sets of technology, organization and environment factors affect technology innovation adoption. In this paper, the technology innovation is cloud computing.

Technology factors

Technology factors focus on the attributes of technology innovation [14, 36]. Tornatzky and Klein [37] conducted a meta-analysis study and found that relative advantage, complexity, and compatibility were the main attributes associated with technology innovation behaviour. Higher education cloud computing was tested under TOE framework in developed countries. A study that was conducted in USA revealed that compatibility, top management support, and relative advantage made the most significant contributions to IT managers' interest in adopting cloud computing [38].

Relative advantage refers to the degree to which an innovation is perceived as providing more benefits than its predecessor [40]. Relative advantage can be used to measure the degree to which a technology is considered advantageous from an adopter perspective [36]. Relative advantage is associated with cost reduction and responsiveness to business requirements [6]. Cloud computing should increase the efficiency of educational institutions. Computing information system hosted in-house require capital investment to build data center infrastructure and high availability, trained operator staff, and more. In addition to capital investment, operational cost is required to run the system [40]. Based on this argument, I propose:

H1 Relative advantage will positively affect cloud computing adoption.

Compatibility is defined as "the degree to which the innovation fits with the potential adopter's existing values, previous practices, and current needs" [41]. Based on this definition, there are three dimensions of this factor. Cloud Computing is considered a revolution for Information Technology services. It is expected that compatibility with cloud computing will facilitate the adoption process [36, 40, 38]. Therefore, I propose:

H2 Compatibility will positively affect cloud computing adoption.

Complexity is the perceived difficulty by a firm to understand and use an innovation [36]. Adoption would be less likely if the innovation is considered more challenging to use [41]. It is

anticipated that cloud computing is less complex from a technical perspective. One of the objectives of cloud computing is to simplify the use of IT resources. Complexity may arise when integrating cloud computing with current processes. The complexity factor was found to be significant in previous studies [27]. Thus, I propose:

H3 Complexity will negatively affect cloud computing adoption.

Organization factors

Organizational context refers to the resources and characteristics of the firm that facilitate or constrain the adoption and implementation of the innovation [24]. Top management support is considered an important organizational factor in a cloud computing context [40, 38]. Other important factors in the context of cloud computing are data concerns and vendor lock.

Cloud computing can be influenced by top management support. Top management allocate the required resources to adopt a new technology. If the buying was not achieved for cloud computing, it is expected that management will let the innovation die and direct the resources to other initiatives that they support [42]. If the manager is risk adverse or satisfied with the current situation, he is likely not going to support the idea [27, 40]. Resisting and opposing the idea by top management are considered to be killers of innovation.

Top management support refers to the attitude of management toward the relevant technology and the level of support devoted for the adoption. Top management support is one of the most critical factors for promoting a supportive climate and for furnishing the resources necessary for adopting new technologies [40, 43]. Top management supports the adoption process by sending signals to the institution staff about the importance of cloud computing. Adopting new disruptive technology, like cloud computing, requires change management to reengineer business processes and align the structure of the institution with the new direction of cloud computing adoption. Therefore, I propose:

H4 Top management support will positively influence cloud computing adoption.

Vendor lock-in refers to the difficulty of switching to other cloud vendors due to cost or technical barriers [5, 44, 38]. When cloud computing services are used, institutions become dependent on the provider services and this constrains their ability to revert back to in-house computing because providers mandate the use of specific IT resources (e.g. database, operating system, hardware) and switching cost to another provider is high.

Research methodology

Development of survey instrument

In order to test the research hypotheses, the research variables have to be measured. Measurement items were either developed or adapted from relevant prior research studies [14, 36, 45, 40]. Some measurement items were rephrased or reworded to suit the context of this study. The variables in this study were measured using a five-point Likert scale, ranging from “strongly disagree” (1) to “strongly agree” (5). Additional items were used to collect data on the number of students, faculty and staff members, and position of IT held by the key informant who responded to the survey questions. The last part of the survey included open-ended questions to capture important qualitative data related to the advantages of and concerns with cloud computing adoption.

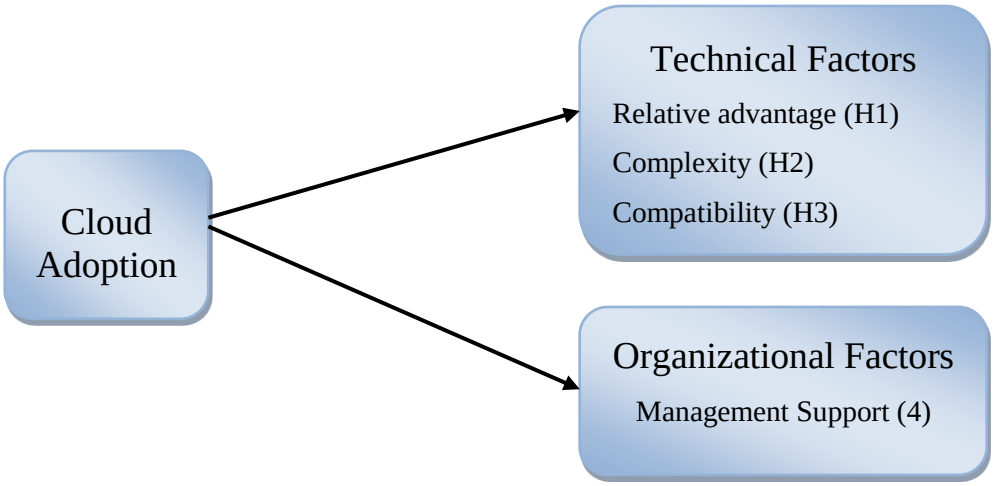


Fig. 1 The research model

The survey instrument was reviewed and validated by a panel of three experts knowledgeable in the area of cloud computing. The panels of experts was comprised of one university associate professor and two master degree students. The final items and their corresponding sources are listed in Table 1.

Data collection

The target population of the study is all Universities and Colleges that offer 4-year undergraduate or advanced degrees. Community colleges and military or security education institutions are not part of the study population. At the time of the study, there were 41 education universities operating in Maharashtra. The key informant persons were identified by visiting the official website of the college or the university. The head of IT or his/her delegate was assumed to be the key respondent person. In case the IT position was not available, a higher level person who could make the decision to adopt or not adopt the cloud computing, was invited to respond to the survey. The survey instrument was sent by email to the key informant persons or their delegates who were responsible for the decision making regarding information technology within the institution. The e-mail message included information about the objective of the research study, confidentiality handling, cloud computing definition and contact information of the researchers. After one week, a reminder was sent to all non-respondents. The final reminder was sent after one month of the first e-mail. Data collection took place between November 12, 2015 and December 21, 2014. In total, responses from 34 education institutions were received which represents a response rate of 59.8 %.

Table 1
Research variables and items of the survey instrument

Relative Advantage (RA)	
RA1	Cloud computing can shorten Information Systems deployment time [46]
RA2	Using cloud computing allows us to perform specific tasks more quickly [40]
RA3	Cloud computing can reduce IT expenses [46]—Dropped
RA4	The use of cloud computing offers new educational and research opportunities [40]—Dropped
Compatibility (CO)	
CO1	Cloud Computing is compatible with our academic institution's operations [40]
CO2	Cloud Computing is compatible with our IT infrastructure [45]
CO3	Using Cloud Computing is compatible with our academic institution's culture and values [40]—Dropped
Complexity (CX)	
CX1	The skills needed to implement cloud computing are too complex for our institution [47]
CX2	The skills necessary to using cloud computing are too complex for our employees [47]
CX3	The use of cloud computing is frustrating [40]
Management Support (MS)	
MS1	Top management provides resources for adopting cloud computing[31]
MS2	Top management supports the implementation of cloud computing [39]
MS3	Top university/college management understands benefits of adopting cloud computing [31]—Dropped
Vendor Lock-in (VL)	
VL1	Cloud computing mandates the use of specific IT resources (Authors)
VL2	Cloud computing make us dependent on the provider services (Authors)
VL3	Cloud computing restricts our ability to switch to another provider (Authors)—Dropped
VL4	The switching cost to another cloud computing provider is high (Authors)—Dropped
Data Concern (DC)	
DC1	We are concerned about the leakage of confidential data [23]
DC2	We are concerned that unauthorized people may access our student and research data (Authors)
DC3	We are concerned about storing our data in the cloud (Authors)
Government Regulation (GR)	
GR1	Saudi laws and regulations are sufficient to protect the use of cloud computing (Authors)
GR2	Saudi laws and regulations facilitate the use of cloud computing (Authors)
Peer Pressure (PP)	
PP1	Saudi universities and colleges are currently adopting cloud computing (Authors)
PP2	Saudi universities and colleges will be adopting cloud computing in the near future (Authors)

Sample characteristics

The management positions of respondents; the number of faculty, staff members and students; and the adoption stage of cloud computing, are shown in Table 2. The majority of respondents holds a position of IT manager/director (44.1 %). The institutions covered in this study vary from small to large. About 53 % employed 500 or less faculty and staff members, and 38 % had 10,000 or more students. Thirty-eight percent of the institutions were evaluating cloud computing and 26.5 % have already adopted cloud computing. The cloud services that have been adopted includes e-mail, learning management systems, library systems and website portals.

Table 2
Education institutions profile

Variable	Category	N	%
Position	IT Director	12	41.3
	IT Strategist	1	2.29
	Others	2	4.9
No. of faculty and staff members	300 or less	18	52.9
	301 - 500	6	18.3
	More than 300	10	29.4
No. of Students	5000 or less	8	25.8
	5001-10000	14	39.3
	More than 10000	14	37.8
Adoption stage	Not considering	4	11.8
	Have evaluated but do not plan to adopt cloud computing	3	8.8
	Currently evaluating cloud computing	11	36.2
	Have evaluated and plan to adopt cloud computing	5	14.7
	Have already adopted cloud computing	9	26.5

Results

The research hypotheses were tested using the partial least square (PLS) method using Statistical Package for the Social Sciences (SPSS) software. The evaluation of the research model follows a two-stage process. The first stage is the evaluation of the measurement model by calculating the reliability and the convergent and discriminate validity of the research variables. The second stage is the evaluation of the structural model by testing the significance of the path coefficients between the model variables.

The measurement model

Table 3 presents the factor loading, mean, standard deviation (SD), composite reliability (CR), and average variance extracted (AVE) for all research model variables. All CR scores exceeded the recommended value of 0.70 [50], indicating that all variables had good reliability.

Convergent validity “involves the degree to which individual items reflecting a construct converge in comparison to items measuring different constructs” [51]. A commonly applied criterion of convergent validity is the AVE, as pro-posed by Fornell and Larcker [52]. A variable

with an AVE value of 0.500 or more indicates that it explains more than half of the variance of its individual items and, thus, demonstrates sufficient convergent validity. All AVEs, shown in Table 3, ranged from 0.620 to 0.802, much higher than the cut-off value of 0.500. The items with factor loadings and their corresponding t-values exceeded 0.7 and 1.96 ($P < 0.05$), respectively, thereby demonstrating adequate convergent validity. Six items, marked with italic fonts (see Table 1) violated this rule and hence they were dropped.

Table 3
Factor loadings, reliability, and descriptive statistics

Construct	Item	Loading	SE	T value	Mean	SD	CR	AVE
Relative advantage (RA)	RA1	0.852	0.151	5.627	4.265	0.554	0.773	0.631
	RA2	0.733	0.211	3.473				
Compatibility (CO)	CO1	0.909	0.167	5.457	3.897	0.726	0.903	0.823
	CO2	0.905	0.286	3.164				
Complexity (CX)	CX1	0.865	0.064	13.563	2.441	0.607	0.890	0.620
	CX2	0.840	0.073	11.513				
	CX3	0.711	0.107	6.640				
Management support (MS)	MS1	0.931	0.212	4.393	3.471	0.843	0.907	0.830
	MS2	0.890	0.152	5.872				
Vendor lock-in (VL)	VL1	0.829	0.347	2.385	3.221	0.947	0.809	0.679
	VL2	0.819	0.326	2.509				
Data concern (DC)	DC1	0.956	0.057	16.671	3.765	0.997	0.962	0.894
	DC2	0.965	0.079	12.156				
	DC3	0.913	0.198	4.606				
Gov. regulation (GR)	GR1	0.904	0.217	4.170	2.853	0.857	0.949	0.903
	GR2	0.995	0.069	14.368				
Peer pressure (PP)	PP1	0.683	0.334	2.044	3.485	0.691	0.815	0.693
	PP2	0.959	0.250	3.829				

SE standard error, *CR* composite reliability, *SD* standard deviation, *AVE* average variance extracted

To assess discriminate validity, Fornell and Larcker [52] suggested the use of AVE, the average variance shared between a variable and its measures. The AVE should be greater than the variance shared between the variable and other variables in the model (i.e., the squared correlation between two variables). For adequate discriminate validity, the square root of AVEs should be greater than the intercorrelations in the corresponding rows and columns. In Table 4, the square root of all AVEs were greater than the corresponding inter-variable correlations.

Table 4.
Correlation coefficients and square root of AVEs

	RA	CO	CX	VL	DC	MS	GR	PP
RA	0.795							
CO	0.214	0.907						
CX	−0.158	−0.170	0.808					
VL	−0.147	−0.250	0.262	0.824				
DC	0.056	−0.434	0.092	0.361	0.945			
MS	0.317	0.278	−0.193	−0.257	0.167	0.911		
GR	0.053	0.306	−0.046	−0.086	−0.030	0.443	0.950	
PP	0.309	−0.081	0.682	0.658	−0.302	0.144	0.080	0.833

Diagonal elements are the Square Root of AVEs.

The structural model

Goodness of fit (GoF) was used to evaluate the overall research model. GoF is SQRT (average communality of variables multiplied by average R-Square for endogenous variables). According to Wetzels and Odekerken-Schorder [53], the GoF for a model with large effect sizes should be greater than or equal 0.36. The GoF score for our research model was 0.604, indicating that the model had an acceptable fit.

The proposed research model explained 48.3% of the variance in cloud computing adoption, providing good explanatory power. The results of the structural model, as shown in Table 5, indicate that relative advantage (H1), complexity (H3) and data concern (H4) were supported at the 0.05 level. The hypotheses related to compatibility (H2), management support (H4). The negative signs of b-coefficients mean that there were negative impacts of complexity and data concern on the adoption of cloud computing.

The hypotheses related to compatibility (H_2), management support (H_4), The negative signs of b-coefficients mean that there were negative impacts of complexity and data concern on the adoption of cloud computing.

Table 5.
Results of research hypotheses testing

Hypothesis	Path	Coefficient	SE	|T value|	P value	Support
H_1	RA —> Cloud adoption	0.2986	0.1279	2.3344	0.0260	Yes
H_2	CO —> Cloud adoption	−0.0583	0.1870	0.3120	0.7571	No
H_3	CX —> Cloud adoption	−0.4281	0.1675	2.5560	0.0155	Yes
H_4	MS —> Cloud adoption	0.2310	0.2035	1.1351	0.2648	No

Discussions

Relative advantage has a significant and positive effect on cloud computing adoption. The average score of relative advantage factor is 4.26 out of 5-point scale, which means, on average, the institutions rated relative advantage between agree and strongly agree. This indicates that the education institutions appreciate the value of cloud computing. The specific major advantage is agility that is shortening the development time of information systems and performing tasks more quickly. The agility emanates from rapid elasticity, the basic essential characteristic of cloud computing [20].

Compatibility has no significant effect on cloud computing adoption. This result differs from some previous research [20, 32] and agrees with others [4, 48]. This mixed result may be attributed to institutions that have not yet noticed major differences between cloud and in-house computing services or the cloud is as compatible with academic institution's IT infrastructure and operations as in-house computing. The result may mean that cloud computing is still in its early stages of adoption.

Top management support has no significant effect on cloud computing adoption. The average score of management support factor is 3.47 out of 5-point scale, which means, on average, management has a neutral position. They are neither for nor against cloud computing. The passive position of management towards cloud computing might be due to the immature implementation of the cloud technology in their institutions. Management needs to see tangible benefits to be convinced to allocate the necessary resources and financial support for successful adoption of cloud computing.

Data concerns have a significant and negative effect on cloud computing adoption, suggesting that data concern is a barrier that affects an institutional decision to adopt a cloud computing. Despite the advantage of cloud computing in education, some concerns have been identified in the literature like data concerns [54, 55]. As more data are stored in the cloud, institutions will be concerned about the privacy of their data, especially those data related to student grades and intellectual capital. This implies that cloud service adopters should take adequate risk mitigation measures against any possible unauthorized access or use of their institutional data.

Finally, peer pressure has no significant effect on cloud computing adoption. The average score of peer pressure factor is 3.48 on 5-point scale, which means, on average, the peer pressure is neutral. It seems there is not any form of peer pressure. Possible explanation is that only few institutions have adopted cloud computing. Only 26.4 % of Maharashtrian colleges and universities have already adopted one or more cloud computing services. The remaining institutions are not considering/planning (20.6 %), evaluating (38.2 %) or planning (14.7 %) to adopt cloud computing. They may follow "wait-and-see strategy". In addition, they have different concerns, capabilities and requirements. These institutions vary in size, budget and governance system (private vs. public).

Conclusion and suggested future research work

This paper presents a cross-sectional exploratory study. Longitudinal studies, which examine the same population at recurring intervals, can be carried out to better understand the shift in the cloud adoption and the change in the significance of the determining factors. This study can be repeated in different time periods and evaluate the progress and change of the significant factors. It is also recommended to include additional factors related to the bandwidth availability and reliability of the technology. Many of the respondents echoed their concerns on the issue of network connectivity to the cloud service provider.

References:

AlAlaa N. Tashkandi, Ibrahim M. Al-Jabri. (2015): Cloud computing adoption by higher education institutions in Saudi Arabia: an exploratory study. Springer Science+Business Media., Cluster Comput. 18:1527–1537

Alabbadi, M.M. (2011): Cloud computing for education and learning: education and learning as a service (ELaaS). In: 14th International Conference on Interactive Collaborative Learning, pp. 589–594. doi: 10.1109/ICL.2011.6059655

AlBar, A.M., Hoque, M.R. (2015): Determinants of cloud ERP adoption in Saudi Arabia: an empirical study. In: 15th ICCC. IEEE Xplore Digital Library. doi: 10.1109/CLOUDCOMP..7149637

Alshamaila, Y., Papagiannidis, S., Li, F.(2013): Cloud computing adoption by SMEs in the North East of England. J. Enterp. Inf. Manage. 26(3), 250–275

Al-Jabri, I.M., Alabdulhadi, M.H.: Factors affecting cloud computing adoption: perspectives of IT professionals. Int. J. Bus. Inform. Syst. (forthcoming)

Alshwaier, A., Youssef, A., Emam, A. (2012): A new trend for E-learning in KSA using educational clouds. Adv. Comput. Int. J. 3(1), 81–97

Angeles, R.: Purdue (2012): RFID supply chain for e-pedigree compliance: applying the technology-organisation-environment (TOE) framework. Int. J. Bus. Inf. Syst. 10(4), 447–480

Articles about Public Cloud - timesofindia-economictimes, http://articles.economictimes.indiatimes.com/keyword/public-cloud

Buyya, R., Yeo, C.S., Venugopal, S., Broberg, J., Brandic, I. (2009): Cloud computing and emerging IT platforms: vision, hype, and reality for delivering computing as the 5th utility. Future Gener. Comput. Syst. 25(6), 599–616

Buyya Rajkumar, Vecchiola, Christian, Selvi, S. Thamarai (2013): Mastering of Cloud Computing. Tata McGraw Hill Education Private Limited. http://www.buyya.com/MasteringClouds/ToC-Preface-TMH.pdf

Cearley, D.W.(2014): The top 10 strategic technology trends for 2014. Gartner Inc. http://www.gartner.com/doc/2667526? refval=&pcp=mpe. Accessed 25 Dec 2014 (2014)

Core e-Governance Infrastructure - E Governance in Maharashtra (2014): https://egovstatus.maharashtra.gov.in/feature_760.html

Daim, T., Basoglu, N., Tanoglu, I. (2010): A critical assessment of information technology adoption: technical, organisational and personal perspectives. Int. J. Bus. Inf. Syst. 6(3), 315–335

David, F.R. (2011): Strategic Management: Concepts and Cases. Pearson Education, Upper Saddle River

Dhar, S. (2012): From outsourcing to cloud computing: evolution of IT services. Manage. Res. Rev. 35(8), 664–675

Ercan, T. (2010): Effective use of cloud computing in educational institutions. Procedia Soc. Behav. Sci. 2(2), 938–942

Fornell, C., Larcker, D.F. (1981): Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. 18(1), 39–50

Gonzalez-Martínez, J.A., Bote-Lorenzo, M.L., Gomez-Sanchez, E. (2015): Cloud computing and education: a state-of-the-art survey. Comput. Educ. 80, 132–151

Haag, S., Eckhardt, A. (2014): Organizational cloud service adoption: a scientometric and content-based literature analysis. J. Bus. Econ. 84(3), 407–440

Hsu, P., Ray, S., Li-Hsieh, Y. (2014): Examining cloud computing adoption intention, pricing mechanism, and deployment model. Int. J. Inf. Manage. 34(4), 474–488

Hussain, M., Abdulsalam, H.M. (2014): Software quality in the clouds: a cloud-based solution. Clust. Comput. 17(2), 389–402

Ibrahim, M.S., Salleh, N., Misra, S. (2015): Empirical studies of cloud computing in education: a systematic literature review. In: Gervasi, O., et al. (eds.) ICCSA 2015, Part IV, LNCS 9158, pp. 725–737. Springer International Publishing, Switzerland

Kalpeyeva, Z.B., Mustafina, A.K. (2013): IT-infrastructure of university based on cloud computing. Int. J. Comput. Sci. Issues. 10(5): 176– 179. http://ijcsi.org/papers/IJCSI-10-5-1-176-179.pdf

Karla, H., Katz, R., Yanosky, R. (2010): Shaping the higher education cloud. http://www.nacubo.org/Documents/BusinessPolicyAreas/ShapingTheHECloudWhitePaper.pdf Accessed 13 August 2014

Klug, W. (2014): The determinants of cloud computing adoption by colleges and universities. ProQuest, UMI Dissertations Publishing

Kuan, K.K.Y., Chau, P.Y.K. (2001): A perception-based model for EDI adoption in small businesses using a technology-organization-environment framework. Inf. Manage. 38(8), 509–521

Li, D., Lai, F. (2010): E-business assimilation in China's international trade firms: the technology-organization-environment framework. J. Glob. Inf. Technol. 18(1), 39–65

Lian, J., Yen, D., Wang, Y. (2014): An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. Int. J. Inf. Manage. 34(1), 28–36

Low, C., Chen, Y., Wu, M. (2011): Understanding the determinants of cloud computing adoption. Ind. Manage. Data Syst. 111(7), 1006– 1023

MCCIA & Microsoft to help SMBs Adopt IT & Cloud Computing for Growth (2015): https://news.microsoft.com/en-in/mccia-microsoft-to-help-smbs-adopt-it-cloud-computing-for-growth/#sm.000qud90iigcf3w10cd2ngi2bd31x

Mell, P., Grance, T. (2011): The NIST definition of cloud computing. NIST Special Publication 800-145.. http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf (33)

Mircea, M., Andreescu, A.I. (2011): Using cloud computing in higher education: a strategy to improve agility in the current financial crisis. Communications of the IBIMA. Article ID. 875547. doi: 10.5171/2011.875547

Moore, G., Benbasat, I. (1991): Development of an instrument to measure the perceptions of adopting an information technology innovation. Inf. Syst. Res. 2(3), 192–222

Muehlen, M.Z., Nickerson, J.V., Swenson, K.D. (2005): Developing web services choreography standards–the case of REST vs SOAP. Decis. Support Syst. 40(1), 9–29

Nunnally, J.C., Bernstein, I.H. (1994): Psychometric Theory. McGraw-Hill, New York

Oliveira, T., Martins, M.F. (2010): Understanding e-business adoption across industries in European countries. Ind. Manage. Data Syst. 110(9), 1337–1354

Oliveira, T., Thomas, M., Espadanal, M. (2014): Assessing the determinants of cloud computing adoption: an analysis of the manufacturing and services sectors. Inf. Manage. 51(5), 497–501

Oracle and the Government of Maharashtra Sign Memorandum of Understanding to Help Accelerate Digital Transformation (2016): https://www.oracle.com/corporate/pressrelease/oracle-and-the-government-of-maharashtra-sign-mou-092016.html

Pan, M., Jang, W. (2008): Determinants of the adoption of enterprise resources planning within the technology-organization-environment framework: Taiwan's communications industry. J. Comput. Inf. Syst. 48(3), 94–102

Ratten, V. (2015): A cross-cultural comparison of online behavioural advertising knowledge, online privacy concerns and social networking using the technology acceptance model and social cognitive theory. J. Sci. Technol. Policy Manage. 6(1), 25–36

Rogers, E. (2003): Diffusion of Innovations. Free Press, New York

Sakr, S. (2014): Cloud-hosted databases: technologies, challenges and opportunities. Clust. Comput. 17(2), 487–502

Sarkar, P., Young, L. (2011): Sailing the cloud: a case study of perceptions and changing roles in an Australian University. In: ECIS 2011 Proceedings. Paper 124. http://aisel.aisnet.org/ecis2011/124

Shiau, W., Chao, H., Chou, C. (2012): An innovation of an academic cloud computing service. J. Softw. Eng. Appl. 5(11A), 938–943

Sultan, N. (2010): Cloud computing for education: a new dawn? Int. J. Inf. Manage. 30(2), 109–116

Tan, M., Lin, T.T.C.(2012): Exploring organizational adoption of cloud computing in Singapore. IN: 19th ITS Biennial Conference 2012, Bangkok, Thailand, pp. 18–21 Nov 2012. http://hdl.handle.net/10419/72509. Accessed 11 June 2014

Taweel, A. (2012): Examining the relationship between technological, organizational, and environmental factors and cloud computing adoption. ProQuest, UMI Dissertations Publishing

Tornatzky, L.G., Fleischer, M. (1990): The Process of Technological Innovation. Lexington Books, Lexington

Tornatzky, L.G., Klein, R.J. (1982): Innovation characteristics and innovation adoption-implementation: a meta-analysis of findings. IEEE Trans. Eng. Manage. 29(1), 28–45

Urbach, N., Ahlemann, F. (2010): Structural equation modeling in information systems research using partial least squares. J. Inform. Technol. Theory Appl. 11(2), 5–40

Wetzels, M., Odekerken-Schroder, C. (2009): Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration. MIS Q. 33(1), 177–195

Zissis, D., Lekkas, D. (2012): Addressing cloud computing security issues. Future Gener. Comput. Syst. 28(3), 583–592

About the author

Avinash Appasha Chormale is a Research Fellow at the School of Architecture Science and Technology at Yashwantrao Chavan Maharashtra Open University, Nashik, Maharashtra, India.

mr.avinash.ycmou@gmail.com

Return to Table of Contents

Return to Table of Contents

Editor' Note: This study of performance improvement meets Mager's critera of demonstrating what is learned, how well, and under what conditions. The ability of teachers to produce high quality interactive multimedia is the first step to improve learning by their students, and the first step in moving these students toward self-directed learning.

Role of smart classroom model in improving English teachers' multimedia content development skill in Bangladesh

S M Kamruddin Ropum
Bangladesh

Abstract

In recent years, ICT has been considered as one of the most effective tools for ensuring quality education. Dnet, a social enterprise in Bangladesh, innovated the Smart Classroom (SCR) model for incorporating ICT into teaching-learning process. The SCR model mainly targets empowering secondary school teachers through improving their multimedia content development skills. This study researched the role of the SCR model in improving English teachers' multimedia content development skills. Fifty English teachers were selected and the study was conducted through the experimental approach. The study found a very significant difference in performances of teachers between pre-test and post-test. The teachers' multimedia content development skills have been improved at a certain level. The teachers acknowledged that the SCR model made a great contribution to their improvement. They also identified SCR training, regular practices in lessons and monitoring and refresher training as effective aspects for their improvement.

Keywords: ICT, education, smart classroom, multimedia, content, teacher development, teaching-learning process, pedagogy, technology, e-content, English, training.

Introduction

In the present fast-moving world, Information and Communication Technologies (ICT) are making dynamic changes in society. They influence all aspects of life and their impact is felt more and more in education. ICT provides students and teachers with opportunities to adapt learning and teaching to individual needs, so society is encouraging schools to aptly respond to this technical innovation (Mikre, 2011). Tinio (2002) states that ICTs have the potentials to increase access and improve relevance and quality of education in developing countries. Furthermore, ICTs greatly facilitate acquisition and absorption of knowledge. They offer unprecedented opportunities to enhance educational systems in developing countries. They also improve policy formulation and execution, and widen the range of opportunities for business and poor people (Blurton, 1999).

Modern constructivist educational theory emphasizes critical thinking, problem solving, "authentic" learning experiences, social negotiation of knowledge, and collaboration – pedagogical methods that change the role of the teacher from disseminator of information to learning facilitator, to help students as they actively engage with information and materials to construct their own understandings. Students learn how to learn, not just what to learn (Lowenthal & Muth, 2008). ICT has the potential to be used in support of these new educational methods, as tools enabling students' learning by doing. ICT can make it possible for teachers to engage students in self-paced, self-directed problem-based or constructivist learning experiences and test student learning in new, interactive, and engaging ways that may better assess deep understanding of content and processes (Patil, 2012).

Many countries are welcoming and integrating interactive uses of ICT in education to ensure an enjoyable and effective learning environment. Like other countries, Bangladesh is adopting ICT in education. The government of Bangladesh recognizes that the traditional teaching-learning process is teacher-centric, which limits opportunities for students to get engaged in the learning process (Access to Information Programme, 2013). Besides the government's initiatives, a number of development organizations are innovating and implementing different models for incorporating ICT in education in Bangladesh. Among them, Dnet, a social enterprise established in 2001 that integrates ICT in their initiatives to provide its beneficiaries with optimum learning benefits. Integration of ICT into education for creating a sustainable learning environment in the schools and for empowering teachers is one of the major targets of Dnet. As the first attempt of ICT integration in classroom teaching-learning process, Dnet innovated and introduced a Smart Classroom (SCR) Model in secondary schools in Bangladesh in 2010.

What is the SCR model?

The Smart Classroom is equipped with various ICT equipment, creating the opportunities for teaching and learning in an interactive way by incorporating learning technology into the classroom teaching-learning process. Each Dnet equipped Smart Classroom has several ICT devices such as LCD TV, laptop computer, solar panel, speaker, and CD.

Target Points of SCR Model

The SCR model includes a 3-pronged target to be achieved. Target points with brief description have been given below:

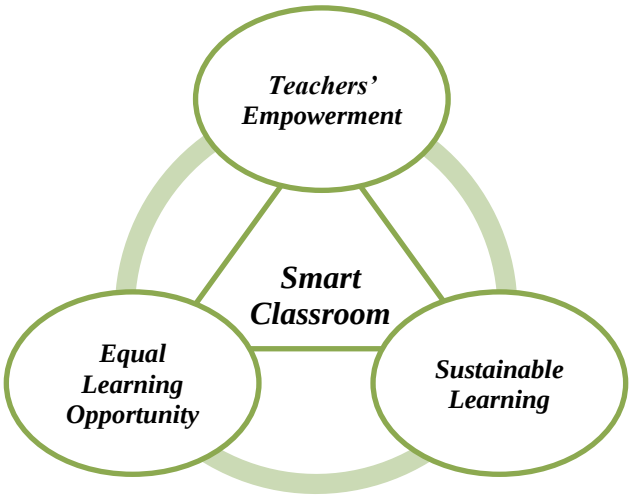


***Figure 1*: Target points of SCR**

Empower the secondary school teachers

The general situation in Bangladesh is that the secondary school teachers are burdened with administrative tasks those are not directly related to teaching. This reduces preparation time to conduct effective lessons. On the other hand, unavailability of proper teaching-learning materials hinder the effective lesson conduction. The traditional teaching-learning practices constrict the teachers' motivation and effort to make the class more interesting. The SCR model targets the teachers for enabling them to conduct their lessons in different interactive ways by the use of the learning technologies. Under the SCR model, teachers not only able to conduct interactive lessons, but also manage the class more effectively with more control over the whole teaching-

learning process. Since the teachers are more enable, they feel themselves more confident and empowered.

Ensure sustainable learning of the learners

The secondary school students are to learn about a number of topics and concepts from the textbooks. Some concepts are known to be hard to grasp. On the other hand, traditional process of teaching and learning includes only lecture most of the time. In consequence, students listen more in the classroom than watching, doing or involving. For this reason, the hard to grasp concepts remain somewhat unclear to the students as mentioned in the several studies. Students sometimes just memorize those concepts without understanding and forget after a certain time. Through a number of audio and video materials, games and animated contents, the SCR model targets to ensure clear understanding of the concepts rather than just to provide the knowledge so that the students' learning can be sustained for long time.

Create equal learning opportunities for the learners

Every student has different interest, motivation level and learning abilities. In a same classroom, there are slow learners besides quick and mediocre learners. On the other hand, the adverse teacher-student ratio in most of the secondary school classrooms creates unequal learning opportunities for the learners. The SCR model targets to ensure that everyone in the class has the same opportunity to learn. The materials and suggested teaching-learning approach under the SCR model attract the students to get involved in the learning process.

Components of SCR Model

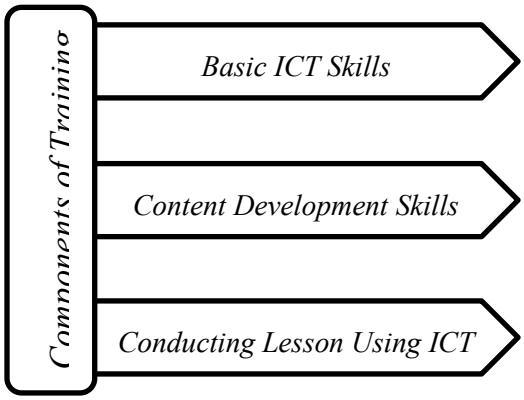


***Figure 2*: Components of SCR Training**

Teacher training

Conducting lessons in SCR is somewhat different from the traditional teaching-learning process. To develop the skills of teachers for conducting lesson in SCR, a four-day basic training program is arranged prior to running of the model. The training includes three learning areas; basic ICT skills, multimedia content development skill and lesson conduction skill using ICT. Conducting technology enhanced teaching-learning process requires to have basic ICT skills. Moreover, multimedia contents are very effective to ensure interactive lessons. Teachers need to have a certain level of skills for developing multimedia contents. Teachers also need to know what the best way is to incorporate ICT into classroom teaching-learning process. Therefore, the training includes all three very important components for smooth operation of the SCR model.

Multimedia contents

Another important component in SCR model is multimedia educational contents. Through a rigorous process, Dnet selects different topics/concepts from the textbooks which seem complex and hard to grasp to the learners. To finalize the topics, Dnet takes feedbacks and opinions from respective teachers, students, subject specialists and curriculum specialists. Once the topics are finalized, the multimedia content development process starts. The types of the multimedia contents vary depending the nature of the selected topics. The common types are video, audio, animation, game, power point slides etc. Going through various reviews and try-outs, the contents get finalized. In addition to developing multimedia contents, Dnet collects contents from other organizations working in the same area. Comprising the developed and collected contents, Dnet makes a CD, which than provided to each of the schools implementing the SCR model. However, Dnet never wants the number of the contents to get limited. For this reason, the teachers are provided with training on developing multimedia contents as mentioned earlier. As a result, teachers themselves can develop more contents. The SCR model suggests the teachers to use the related multimedia contents while discussing a particular topic in the classroom.

Monitoring

Monitoring is a very essential task for ensuring the proper implementation and for tracking the progress of a model. Keeping this in mind, monitoring is included in the SCR model. The monitoring is accomplished through a checklist, which contains two sections; one is for different aspects of a lesson conduction in SCR and another is for operational aspects, like, ICT equipment and materials, learner attendance and lessons' frequency etc. The frequency of monitoring is usually decided by the project which the SCR model is implemented in.

Refresher training

Besides monitoring, the refresher training is also a very important component of the SCR model. It is generally evident that some of the teachers forget what they learnt in the training. For this reason, refresher training is arranged for every teacher implementing the SCR model. Based on the data gathered from monitoring, the contents for refresher training are determined. The frequency of refresher training is once again is decided by the project which the SCR model is implemented in.

Technical support

The SCRs are equipped with various ICT devices. Any technical problem can hinder the continuity of class conduction in the SCR. The Dnet technical team continuously monitor the condition SCR equipment. In case of any technical problems, immediate action is taken so that the teachers can conduct lessons in SCR without any interference.

According to the SCR model, each SCR school is provided with a CD containing a number of multimedia contents. In addition to using the provided contents in SCR, the English teachers receive training on developing more multimedia contents. The study targets the English teachers' improvements in developing multimedia contents as the consequence of training and regular classroom practices.

Significance of the study

Dnet introduced SCR in purpose getting the fruits of ICT through incorporating it into classroom teaching-learning process. It is expected that the SCR model will improve teachers' skills in developing multimedia contents and simultaneously empower teachers and create an enjoyable learning environment in schools. The study will explore how effective the SCR model in improving English teachers' multimedia content development skills.

As the core agent of education, teachers need to have certain level of skills to incorporate ICT into education. Among them, multimedia content development skill is most important. The findings of the study reveal the effectiveness of SCR model in improving English teachers' multimedia content development skills, which may help Dnet to find out more about the effectiveness of its training program and improvements areas of the model.

Different models have been being implemented in Bangladesh for incorporating ICT in education. If the SCR model found effective, it can be replicated. The study might be helpful for designing any further training program on developing multimedia contents. As a whole, the study may be convenient to the policy makers to think about different concerning factors for implementing any initiatives to incorporate ICT in education in Bangladesh.

Objectives of the study

The objectives of the study are to:

- Measure the level of improvement of English teachers in developing multimedia contents;
- Discover reasons behind their improvement or deterioration in developing multimedia contents.

Methodology

The study was conducted following the experimental method and mainly concentrated on the primary data collection through a mixed approach of inquiry. One-group pre-test and post-test mode was employed in this study. Moreover, quantitative data was given priority and the qualitative part was used for supporting the quantitative part. The study methodology consists of the following activities:

Sample and sampling technique

Under the SCR model, 150 secondary school teachers who teach English received training. Among them, a total of 50 teachers were selected randomly for this study. These 50 teachers participated in multimedia content development skill test in both the pre-test and post-test. In addition, 10 teachers out of the selected 50 teachers were chosen randomly for the in-depth interview conducted during post-test. An overview of the sample and sampling technique has been given below:

Table 1
Overview of the Sample and Sampling Technique

Type of respondents	Number of respondents	Purpose	Selection technique
English Teachers	50	Participating in multimedia content development skill test	Random
English Teachers	10 (from primarily selected 50 teachers)	Participating in in-depth interview	Random

Data collecting method

Two data collecting method were used in this study. Multimedia content development skill test was conducted for assessing the teachers' multimedia content development skill. Moreover, in-depth interview was included mainly to know 'how'.

Multimedia content development skill test

In the training under SCR model, teachers get skills of developing multimedia contents using different software and computer applications. Among them, Microsoft PowerPoint and Movie Maker are the mentionable ones. In this study, teachers' content development skills using these two computer applications were judged. Every selected teachers was asked to develop two contents, one content using MS PPT and the other using Movie Maker, on any of the English contents of secondary level in both the pre-test and post-test. The teachers had to develop the contents in front of the data collectors. The developed contents were assessed considering the two facets, technical and pedagogical. The data collectors assessed the technical aspects while teachers developing the contents. Once the contents were developed, the content specialist tested them again considering the pedagogical aspects. For categorizing teachers' performance, the evaluation includes a performance indicator scale, which indicates teachers' performance level according to their scores achieved in multimedia content development skill test. The scale is like below:

Table 2
Teachers' performance indicator scale

Score	Performance level
Below 25%	Low
26% - 50%	Average
51% - 75%	Good
Above 75%	Excellent

In-depth interview

In the post-test, the selected teachers had to go through an in-depth interview. A semi-structured guideline was used in this regard. The guideline mainly focused on the effectiveness of the training for improvement in content development skills, tendency of the teachers to develop and use multimedia contents, reasons behind their improvement or deterioration in content development skills, enthusiasm of the students in learning through multimedia contents etc.

Data analysis process

The numeric data of the study followed a descriptive analysis which includes the calculation of mean, standard deviation and standard score. Furthermore, significance of the changes in the post-test was calculated through weighted mean and pooled standard deviation. Additionally, the qualitative data followed thematic approach for analysis.

Findings and discussion

Based on the data collected in pre-test and post-test, the findings have been revealed here.

Skills of Developing Contents Using MS PPT

Technical Aspect

The data show that there is a significant improvement in the technical skills regarding MS PowerPoint. Most of the teachers showed low technical skills of PPT in the pre-test. However, more than 50% of the teachers were technically good at using PPT in the post-test. Moreover, there was less fluctuation in teachers' number in both average and excellent category.

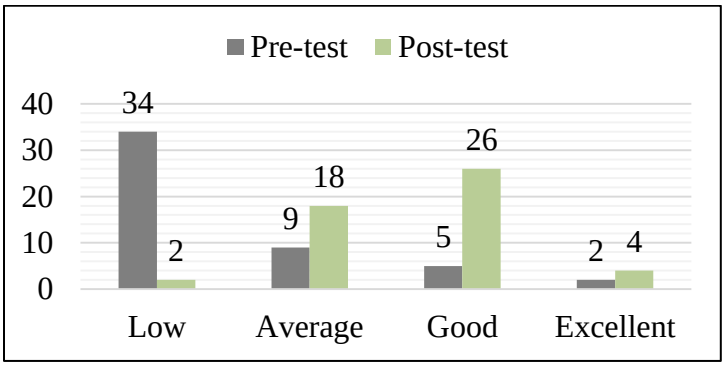


***Figure 3*: Teachers' technical skills in developing PPT contents**

Pedagogical aspect

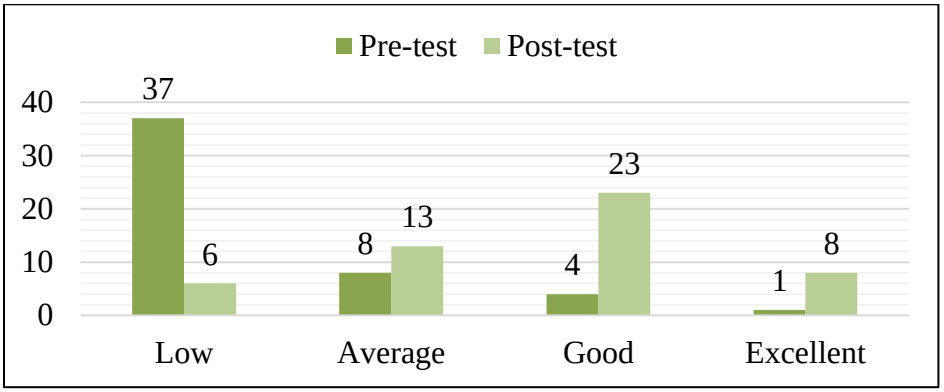


***Figure 4*: Teachers' pedagogical skills in developing PPT contents**

The data are more or less same as the technical aspects. The data clearly show that more than 70% of the teachers performed low in pre-test in terms of pedagogical aspects. The condition radically improved in post-test. Only 6 teachers belonged at low level in post-test, whereas 23 in good category and 8 in excellent category.

Skills of developing contents using Movie Maker

Technical Aspect

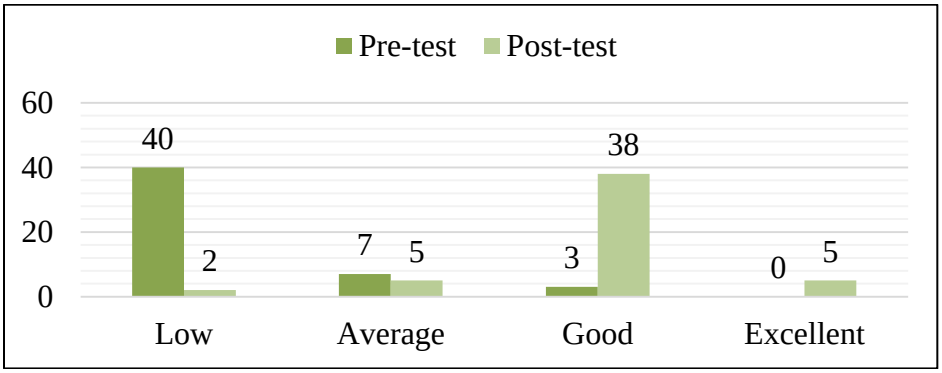


***Figure 5*: Teachers' technical skills in developing contents using Movie Maker**

The teachers' technical skills in using movie maker were comparatively lower than that of in using PPT. Exactly 80% of the teachers belonged at low level, whereas no teacher found

performed excellent in the pre-test. In contrast, around 80% of the teachers were technically good and at the same time 5 teachers showed excellent performance in the post-test. The number of teachers performed average lessens by 2 and only 2 teachers performed low in the post-test.

Pedagogical aspect

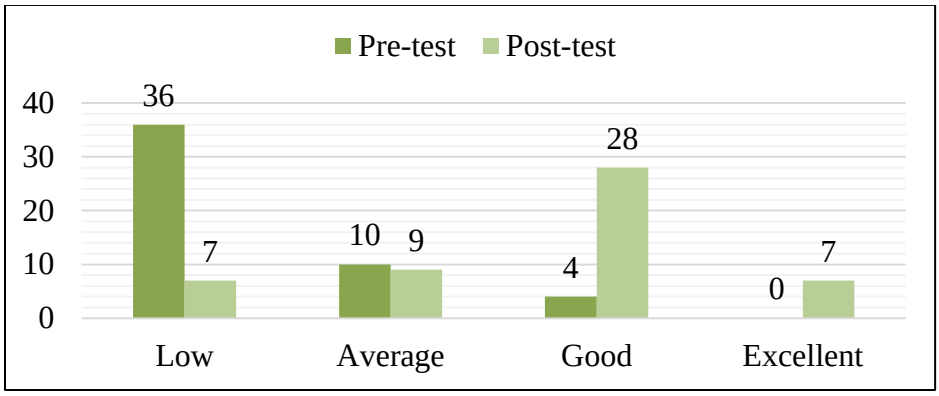


***Figure 6*: Teachers' pedagogical skills in developing contents through Movie Maker**

Figure 6 shows the teachers' pedagogical performance in developing multimedia contents through movie maker. It is evident that more than 70% of the teachers showed low performance in the pre-test, whereas 10 teachers were at average, 4 teachers at good and no teachers was at excellent level. However, in the post-test, most teachers were belonged at good category. The number of teachers raised by 7 at excellent category in the post-test, and 7 teachers and 9 teachers performed respectively low and average in the post-test.

Teachers' Overall Performance

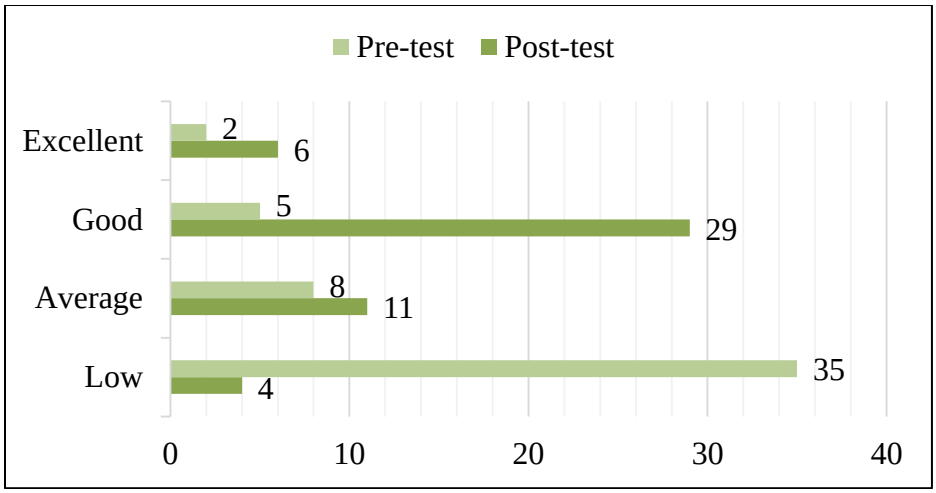


***Figure 7*: Teachers' overall skills in developing Multimedia Contents**

Figure 7 shows the teachers' overall performance in developing multimedia contents in both pre-test and post-test. The data reveal that there is a significant improvement in teachers' overall performance in developing multimedia contents in the post-test. Considering both applications' technical skills and pedagogical aspects, it is evident that exactly 35 teachers performed low in the pre-test, which was only 4 in the post-test. Most of teachers showed good performance in the post-test and the number was 29. Moreover, excellent and average performers were respectively increased by 4 and 3 in the post-test.

Reasons behind the Changes in Teachers' Performance

Effectiveness of the SCR training

Most of the teachers was of the views that they got the related skills from the SCR training, which helped them a lot being skilled at multimedia content development. A teacher explained training's effectiveness by saying,

> "We were not only provided with the basic ICT skills in the training, it was ensured that we can conduct lessons through proper management of ICT equipment."

Some teachers opined that the demonstrations in the training are very important. The SCR training encompasses demonstration, which the teachers think was very helpful for sustaining their skills. A teacher added,

> "In the training, we had to develop different contents and take more than three lessons through our developed contents. After one demonstration, trainer would give suggestions and feedbacks for more improvement. We tried to incorporate the feedbacks in our next demonstration."

Regular practices in lessons

The teachers identified the regular practices in lessons as another reason behind their improvement in multimedia content development. The teachers found it easy to conduct lessons through ICT devices. For using in the lessons, the teachers develop many multimedia contents, which helped them to retain and improve their skills. A senior teacher viewed,

> "Before the SCR model came to our school I had conducted lessons in a traditional way, which seemed boring to the students. When I started using computer in the classroom, the students seemed very curious and interested, which encouraged me to develop multimedia contents and use them in the lessons. By this way, I developed around 20 contents and now I enjoy developing multimedia contents."

Regular monitoring and refresher training

Dnet ensured regular monitoring and after every monitoring there was a refresher training session, which many teachers consider very effective for retaining their skills. One of the teachers thinks,

> "I got many skills in the training, but I forgot some of them. Refresher training helps me a lot for recalling the knowledge and skills."

Some teachers revealed that monitoring and refresher training is very important for ensuring continuous development of the multimedia content development skills.

Discussion

The result of the study clearly shows a significant improvement of the teachers' content development skill, what is basically caused by the activities under the SCR model as the teachers themselves stated. However, during the pre-test and post-test, all the sample teachers were under observation and regular monitoring was carried out. Besides, refresher training was also conducted in a regular basis confining the needs of the primarily trained teachers. Therefore, it can be said the improvement occurred not only because of setting smart classrooms and providing basic training but also due to monitoring, refresher training and obviously proper technical support. One conclusion can be drawn at this point that the technology based classroom alone cannot help to achieve the objectives of integrating ICT in education, regular touch with the respective institutes through monitoring, refresher training and other possible arrangements are

indispensable for getting the fruit of ICT. On the other hand, most of the organizations who are working in the field ICT in education originally emphasize on providing teachers with ICT skills and expect that the teachers eventually will be able to develop digital content for their lessons. However, it should not be forgotten that how the contents will be incorporated in the lessons. Besides the ICT skills, teacher's pedagogical skills for using the contents in their lessons in a proper way are also important. Therefore, providing the pedagogical skills should be emphasized in the basic training as well as in the refresher training.

Recommendations

Based on the findings and features of the SCR model, following can be the possible measures for innovating more effective models or ideas to integrate ICT in education:

- More emphasis on pedagogical knowledge besides the content development skills should be carried out.
- Where there is ICT device, the technical problems are possible consequence. Hence, strong technical support system should be developed. Engagement of local vendors can be a possible solution regarding this.
- A proper and feasible monitoring framework can be developed for accomplishing the monitoring activities in an accurate way.
- There are number of applications in computer by which digital contents can be developed. It is next to impossible task to train the teachers on all the applications. Therefore, it is always better to motivate the teachers to gain the skills by themselves as well as make them understand the potentials of ICT in education so that they feel impulse to use ICT in their lessons.

Conclusion

Due to lack of sufficient number of teachers, the secondary school teachers of Bangladesh get very limited time to prepare themselves for conducting an effective lesson. Still, many of the teachers try to change the condition and show maximum dedication. However, proper training and effective use of ICT in the classroom make the teachers skilled and empowered, which are very important for ensuring quality education. The SCR model shows a way to incorporate ICT into education and this study found the model as very effective. More effective models can be developed and the initiatives can be scaled up throughout the country. For ensuring better quality in education, it was high time to innovate more models for incorporating ICT into education.

References

Blurton, C (1999). *New Directions of ICT-Use in Education.* Retrieved on September 20, 2016, from http://www.unesco.org/education/educprog/lwf/dl/edict.pdf

Lowenthal, P., & Muth, R. (2008). *Constructivism*. In E. F. Provenzo, Jr. (Ed.), Encyclopaedia of the social and cultural foundations of education. Thousand Oaks, CA: Sage.

Mikre, F (2011). The Roles of Information Communication Technologies in Education: Review Article with Emphasis to the Computer and Internet. *Ethiopian Journal of Education and Science.* 6(2). Retrieved on September 15, 2016, from http://www.ajol.info/index.php/ejesc/article/viewFile/73521/62437

Patil, S. V. (2012). *The Role of ICT in Educational Sector. Lokavishkar International E-Journal*. 1(4), 91. Retrieved on September 21, 2016, from http://www.liirj.org/liirj/oct-nov-dec2012/09.pdf

Access to Information Programme (2013). *Report on Assessment of Multimedia Classrooms (MMC) and Teacher-led Content Development.* Dhaka, Bangladesh. Retrieved on September 17, 2016, from http://www.a2i.pmo.gov.bd/resources/publications/

Tinio, V. L. (2002). *ICT in Education: UN Development Programme*. Retrieved on September 18, 2016, from http://wikieducator.org/images/f/ff/Eprimer-edu_ICT_in_Education.pdf

About the author

S M Kamruddin Ropum is the Head of Innovations at Dnet. He generates new initiatives for people, especially women, children and youth, through a design thinking approach as well as research and development. He has extensive experience in education sectors of Bangladesh including research, material development, mentoring, monitoring, training, program development, management, and entrepreneurship. He has several published articles in various national and international journals, national dailies and magazines. His key interest is to work with UX engineering, learning technology and technological interventions.

smkropum@gmail.com

Return to Table of Contents

Return to Table of Contents

Editor's Note: The history of computers and networking has many transformations as processing power, storage, and number of users continue to increase. In the 1980s, the PC improved performance by providing local processing and storage. Improved networks opened up global resources to users worldwide. The cloud increased power, access and system capacity by harnessing unused processing power and storage. Fog computing goes a step beyond cloud computing in using local (edge of cloud) devices to further improve performance and reduce cost.

Fog computing: a new approach in the world of cloud computing

Uttam A. Deshmukh and Sunanda A. More
India

Abstract

Fog computing is the pattern that extends cloud computing and services to the edge of the network. This is similar to cloud computing. Fog provides data compute storage and application services to end users. The motivation of fog computing lies in a series of real scenarios such as smart grid, smart traffic lighters in vehicular networks and software defined networks. This paper discusses the new emerging technologies that lie within cloud computing. We can see many differences between cloud computing (CC) and the fog computing (FC). These two emerging technologies have similarities, differences, drawbacks, etc. and this paper elaborates on the advantages and disadvantages of both fog computing and cloud computing, how fog computing will overcome cloud computing in the future, and how Internet of things (IoT) is flexible with fog computing. Finally this paper suggests the future scope of fog computing in the both smart grid and in the computing based SDN (software defined networking).

Keywords: Fog computing, Cisco, cloud computing, Edge, Internet of Things, software defined networking, smart grid; cloud service provider.

Introduction

Fog computing is a term created by Cisco that refers to extending cloud computing to the edge of an enterprise's network. It is also known as Edge Computing or fogging. Fog computing facilitates the operations like compute, storage and networking services between end devices (Edges) and cloud computing data centres [1]. Fog computing, also known as fogging/edge computing, is a model in which data, processing and applications are concentrated in devices at the network edge rather than existing almost entirely in the cloud [2]. The concentration means that data can be processed locally in smart devices rather than being sent to the cloud for processing. Fog computing is one approach to dealing with the demands of the ever-increasing number of Internet-connected devices sometimes referred to as the Internet of things (IoT). Cisco recently delivered the vision of fog computing to run applications on connected devices that would run directly at the network edge. Customers can develop, manage, and run software applications on the Cisco framework of the networked devices. This includes the difficult routes and switches. Cisco brought this new innovation where they combined the open source Linux and network operating system together in a single network device. [3]

Existing cloud computing system

Cloud computing is a type of Internet-based computing that provides shared computer processing resources and data to computers and other devices on demand. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources (e.g. computer networks, servers, storage, applications and services), which can be rapidly provisioned and released with minimal management effort. Cloud computing and storage solutions provide

users and enterprises with various capabilities to store and process their data in third-party data centres that may be located far from the user. This distance could ran from across a city to across the world. Cloud computing relies on sharing resources to achieve coherence and economy of scale, similar to a utility (like the electricity grid) over an electricity network.[4] Cloud computing provides many opportunities for the enterprises by offering their customers a range of computer services like Pay-As-You-Go (PAYG), flexible computing, data insurance, etc.

The cloud computing model is an efficient alternative to owning and running private data centers for customers using web applications. The private cloud gives you free space from 10 GB to 20GB. If the user wants extra storage, they have to pay only $1USD/67rs per month; this is very cost- effective. According to the cloud computing model, the more data you use, the cheaper it will be. If you are a regular and trusted customer they might give you a data insurance facility as well.

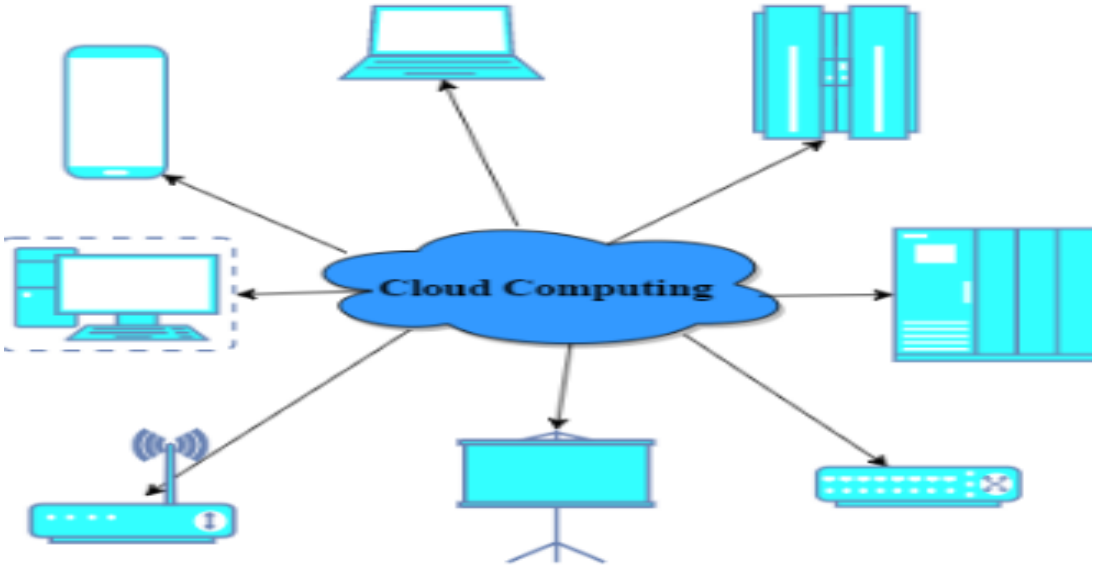


Fig 1.Existing cloud computing system

Cloud computing services

Cloud computing services are useful for students as well as teachers. These are virtual machines (VM) that are changing the whole world of education in a good way. We use cloud computing for the education infrastructure, application, platform, and Software as a Service (SaaS). This service is helping to build Education as a Service (EaaS). EaaS is a specially designed service for online education (synchronized/unsynchronized). Cloud computing services are managing all the infrastructure, study services, study material and inventory. The services can be designed according to the machine the service is able to run on like the laptop, mobile, palmtop, personal computers or servers without internet connectivity. The service can also run from school/college servers, a data centre or third party servers that are accessed via the Internet. EaaS provides the updated tools that are useful for short operations like editing, inserting, deleting, etc. A private cloud can be best for establishing the EaaS at very low cost. EaaS is designed especially for education; that's why the purpose of this service is to be cost -effective, secure, reliable and flexible. The institution can totally rely on this service; everything is designed under the institution's circumstances. EaaS stores lesson plans for various subjects (as data storage) in private clouds that allow teachers and students to access the files anywhere and at anytime.

Software as a Service (SaaS)

Software as a Service is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted [5]. Software as a Service is needed for computer laboratories. For educators, teaching materials are accessed via a web browser and are available on a paid basis (monthly/annually) according to the Cloud Service Provider (CSP). SaaS is different from the traditional model where the educational institute buys a license and ownership which requires installation and maintenance by the institute. SaaS is faster than the traditional way (Cluster Computing) and is a cost–effective option. Also, SaaS vendors provide the recent updates of software services.

Platform as a Service (PaaS)

Platform as a service (PaaS) is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app.[6] It is another variation of SaaS and delivers developmental environment as a service. Students and teachers can build their own application that is connected to the vendor's server. You can define your own data limit and make your own software too.

Infrastructure as a Service(IaaS)

Infrastructure as a Service (IaaS) is a form of cloud computing that provides virtualized computing resources over the Internet. [7] This service of cloud computing provides the whole setup and infrastructure. The Consumer owns his/her own appliances like a server, machines, cooling equipment, etc. An organization is responsible for housing, running and maintaining it. The client typically pays on a per-use basis.

Types of clouds

Private cloud

A private cloud is a data center owned by a single company for their own purpose, and the main purpose is to create their own network and to provide flexibility, scalability, provisioning, and automation and monitoring. The work of a private cloud is not to sell "as-a-service" offerings to external customers but instead to gain the benefits of cloud architecture without giving up the control of maintaining your own data center. A private cloud is more expensive compared to other clouds. The private cloud is not the best option for SMEs (small medium enterprises) or small businesses, startups, schools, or institutions. The maintenance of the private cloud is very high compared to other private clouds which are driven by concerns around security and compliance, and keeping assets within the firewall.

Public cloud

The public cloud is basically the Internet. Everyone can use it and it is free. Some companies are offering the free data usage limit of 10GB to 20GB. The public cloud is also known as Software as a Service (SaaS). Examples of public clouds include: Amazon Elastic Compute Cloud (EC2), IBM's Blue Cloud, Sun Cloud, Google AppEngine and Windows Azure Services Platform. These services are for common users. CSPs provide value for money offers to end/common users. This service is manageable because the user pays nothing for hardware, maintenance, and all is covered under the provider itself. The public cloud works under the pay-as-you-go (PAYG) model. You can pay only for what you use, including for extra storage. But in the public cloud, there are some limitations. It might not be the right fit for organizations because the public cloud has low security. It is hard to secure your valuable data in the public cloud because of the security.

Hybrid cloud

The hybrid cloud is the median cloud type of both private and public cloud services. Organizations rely on hybrid clouds when they use the private cloud during peak time. Public clouds die because of traffic. During that time, hybrid clouds help both the private and public clouds which is why they are called as the emergency cloud. The hybrid cloud is also beneficial during predictable outages, hurricane, warnings, scheduled maintenance windows and rolling brown/blackouts. The ability to maintain an off- premises disaster recovery site for organization is impossible due to cost. That's why most cloud customers rely on this hybrid cloud computing system.

Advantages of cloud computing

- Reduced IT costs. With the help of cloud computing, the IT infrastructure cost is reduced. People don't need too many servers.
- The cost of system upgrades, new hardware and software may be included in your contract.
- No longer need to pay wages for expert staff.
- Energy consumption costs reduced.
- Fewer time delays.
- Scalability of business: Institution scaled up and down. Cloud computing is always flexible and easily adjusts itself for any situation.
- Flexible cloud computing allows teachers as well as employees to use it.
- Access to automatic updates about schools and institutions. It can be automatically updated with their new features and be bug-free.

Disadvantages of cloud computing

- Downtime cloud computing systems are dependent upon the Internet. When there is no Internet your system won't work.
- The security and privacy is a big issue for the cloud computing in these days. The AWS EC2 console was hacked and all data deleted. This is enough reason for closing the company because of pressure. By leveraging a remote cloud based infrastructure, a company basically outsources everything it has.
- Limited Control and Flexibility: cloud users have very limited control on their function infrastructure. Cloud provider EULAs and management policies might impose limits on what customers can do with their deployments.

How does fog work?

- Many times sensitive data is analyzed on the nearest fog node (near to any appliance) to generate the data in Cisco smart grid distribution network. For example, the most time urgent requirement (requirement is very sensitive and private) is to verify that the protection and the control loops are working properly or not. Therefore, fog nodes are close to them. Look for this particular sign problem and then prevent them by sending rescue (control) commands to that.

- The data that need seconds or minutes to do action is passed through to the cluster node for analysis and action. In the smart grid example, each substation might have its own cluster node that tracks and reports the operational status of each downstream feeder
- Data that is less time sensitive (normal data) is sent to the cloud (Historical analysis, big data analytics, and long-term storage).

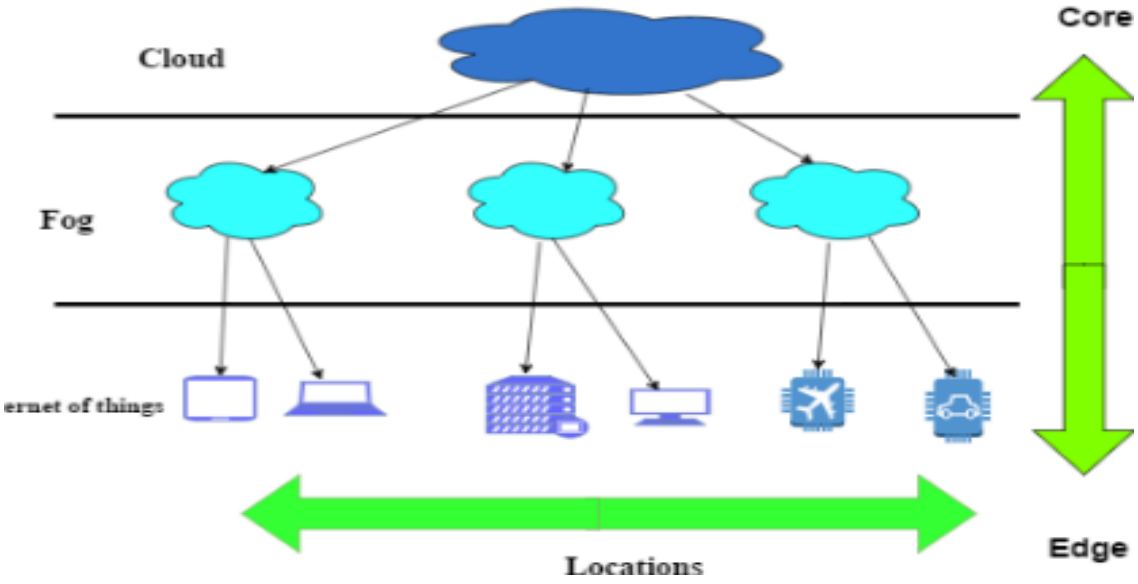


Fig 2.Proposed Fog Computing System

The above figure shows that each smart device (mobile phone, laptop, car, CPU etc.) Is connected with the fog devices, which are interconnected to the cloud.

What is the need of fog computing?

Fog Computing extends the cloud computing pattern to the edge of the network. While fog and cloud both use the same resources (networking, compute, and storage) and share many of the same mechanisms and attributes (virtualization, multi-tenancy), the extension is a non-trivial one in that there exists some fundamental differences stemming from the reason that fog computing was developed: to address applications and services that do not fit the paradigm of the cloud .

Disadvantages to overcome in fog computing

- Reduction in data movement across the network resulting in reduced traffic problem.
- Obliteration of bottlenecks resulting from centralized computing systems.
- Improved security of encrypted data as it stays closer to the end user.

What happens in the fog and the cloud?

- Fog nodes
- Receive data from IoT devices using any protocol, in real time.
- Run IoT-enabled applications for real-time control and analysis,
- In nanosecond response time.

- Provide erratic storage, continually for 1–2 hours.
- Send periodic data summaries to the cloud.

Cloud platform

- Receives and aggregates data summaries from many fog nodes.
- Performs analysis on the IoT data and data from other sources to gain business insights.
- Cloud computing can send new application rules to the fog nodes based on these insights.

The following table shows that difference between Fog Computing and Cloud Computing.

Table 1
Services for fog computing vs. cloud computing

Service	Cloud Computing	Fog Computing
Latency	high	low
Delay jitter	high	very low
Location of server nodes	within internet	at every edge of local network
Distance between die and server	one or more hops	one hop
Security	undefined	can be defined and it's good
Attack on data encounter	high possibility	less possibility
Geographical distribution	centralized	distributed
Number of server nodes	less	more
Support for mobility	limited	more supported
Real time interactions	supported	more supported
Type of last mile connectivity	leased/wired	wireless

Security issues in fog computing

The main security issues are authentication at different level of gateways as well as at the smart meters installed in the customer's home. Each smart meter and smart appliance has an IP address.

A malicious user can tamper with its own smart meter, repeat false readings, or spoof an IP address.

Let's take one example of Man-In-Middle-Attack

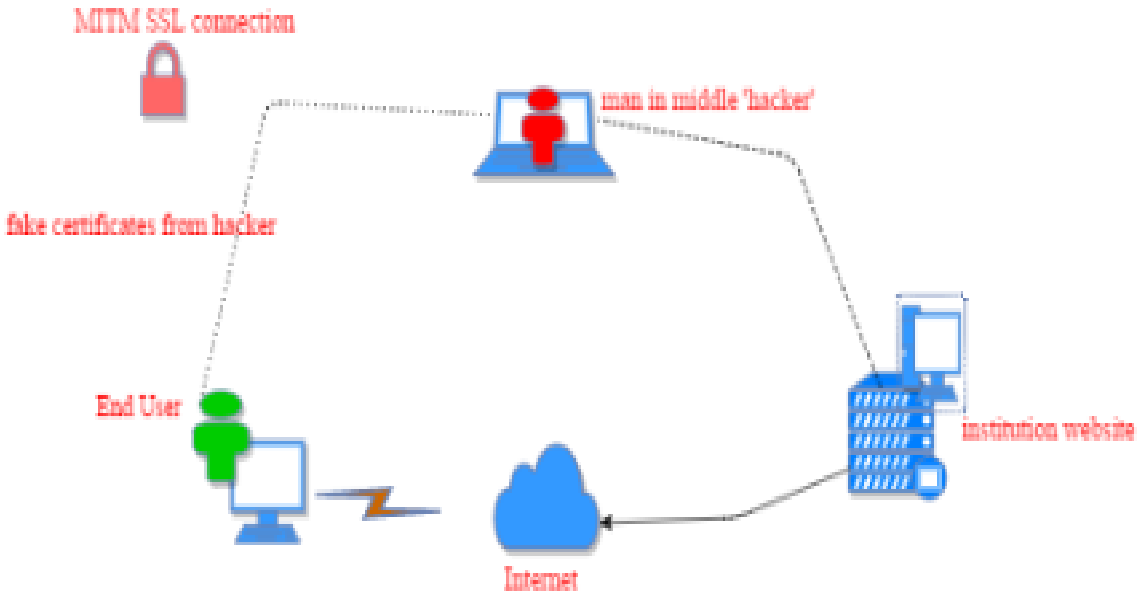


Fig 4. Man-In –Middle-Attack

This paper overlooks the security of fog computing, for that purpose, we take the example of MAN-IN-THE-MIDDLE-ATTACK. This is the security problem of gateways services of fog devices. Fog edges are decrypted or one can change edges with fake devices. In this attack, gateways serving as fog devices are compromised or replaced by fake ones.

Privacy issues in fog computing

In smart grid computing, the issues are related with privacy. Secured information in the grid system such as appliances and priorities (which the fog machine is used for the allocation of time) get stolen often, because it isn't private. These privacy issues occur with the allocation of a specific task for a specific appliance, and then the machine's information is not safe. This privacy issue still remains.

As with many new concepts, IoT's roots can be traced back to the Massachusetts Institute of Technology (MIT), from work at the Auto-ID Centre. Founded in 1999, this group was working in the field of networked radio frequency identification (RFID) and emerging sensing technologies. The labs consisted of seven research universities located across four continents. These institutions were chosen by the Auto-ID Centre to design the architecture for IoT. [7]

IoT Today

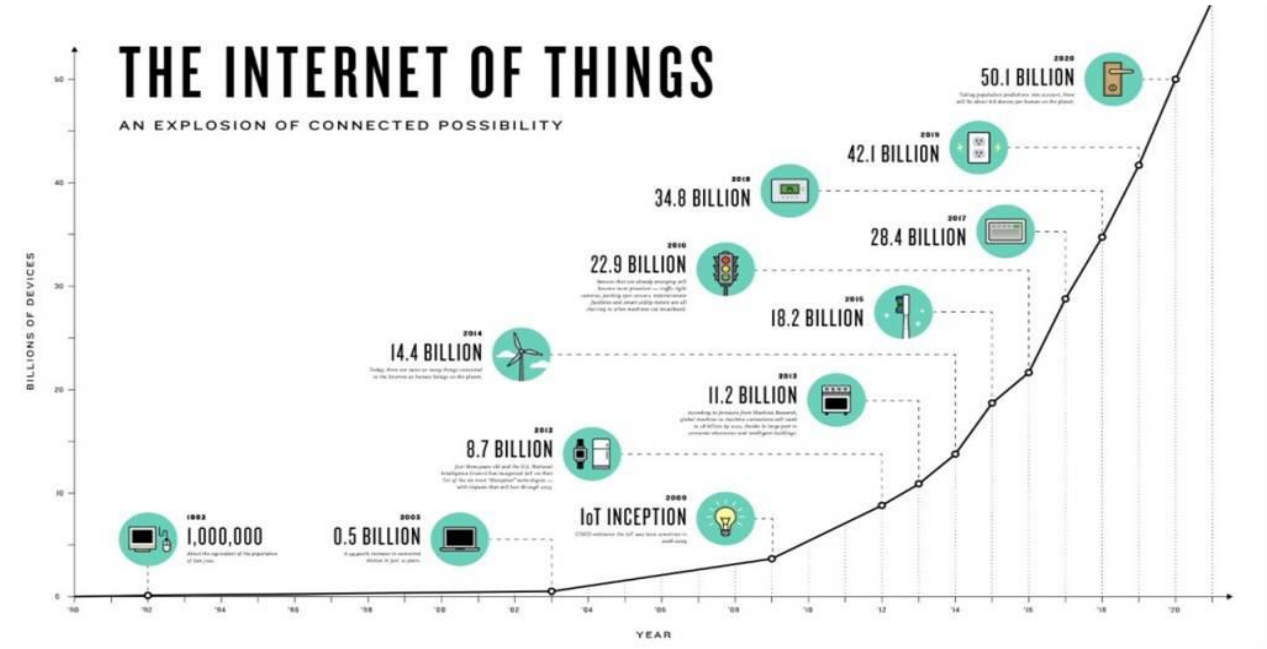


Fig 5. The Internet of Things, users in billions.
(Info graphic The Connectives based on Cisco data)

Conclusion

Fog computing advantages for services are in several domains, such as Smart Grid, wireless sensor networks, Internet of Things (IoT) and software defined networks (SDNs).This paper examined the general security issues and main privacy issues in fog and cloud computing.

Fog computing has a great future ahead partly because of its flexibility and reliability. However, the security issues, like internet distribution, are still big in fog computing compared to cloud computing.

Future scope

Future work will concentrate on the fog computing paradigm in the smart grid. In this case, two models for the fog devices can be developed. Separate fog devices can communicate with each other directly. They can share information and regulate with each other for the periodic updates on economical things like price, demand, etc.

Also, fog computing based SDN (software defined networking) in transportable or movable (vehicular) networks needs more attention.

References

Andrei Zuzin, (2011), Cisco and/or its affiliates. Research at Cisco,(2011),1-9.

Brandon Butler, (2013). PaaS Primer: What is platform as a service and why does it matter?. Network World, (2013)

Cisco the network in review http://newsroom.cisco.com/featurecontent?type=webcontent&articleId=1365576

Cisco White paper https://www.cisco.com/c/dam/en_us/about/ac79/docs/innov/IoT_IBSG_0411FINAL.pdf

From how to geek website http://www.howtogeek.com/185876/what-is-fog-computing/

The definition of IaaS http://searchcloudcomputing.techtarget.com/definition/Infrastructure-as-a-Service-IaaS

Ziff Davis, Paul, Gil. (2014). What Is 'SaaS' (Software as a Service). PC Magazine Encyclopedia,(2014),

About the authors

Uttam A. Deshmukh is a PhD Research Fellow at the School of Science and Technology, Yashwantrao chavan Maharashtra open University, Nashik, Maharashtra, India.

uadeshmukh@hotmail.com gauravdeshmukh030@gmail.com

Dr. Sunanda A. More is Associate Professor, School of Science and Technology, Yashwantrao chavan Maharashtra open University, Nashik, Maharashtra, India.

sunandarun@yahoo.com

Return to Table of Contents

Return to Table of Contents

Editor's Note: Curriculum development is a combination of art and science. Here is yet another a designed to cover all bases.

Designing a media literacy college course: an auto-ethnography

Luis Camillo Almeida
USA

Abstract

The late increase in computer technology adoption in society has resulted in uncontrolled use in millions of college students. In this autoethnography, the author explains through his own lenses the processes for developing a media literacy course for a medium sized university in the south strictly based on sound principles of instructional design and technical communication.

Keywords: technology, adoption, autoethnograhy, media literacy, technical communication, instructional design.

Introduction

The millennial generation is using computer technology at alarming rates in contemporary America, which to a degree results in societal pressure and high expectations for youngsters to be always connected and celebrating the advances in technology (Gutnick et al., 2011). Well-crafted media literacy courses addressing both the positives and negative sides of technology are rare and almost never available for college students to take. Even though there are millions of millennials in the United States today, there are very little if any courses that truly addresses both the positives and negatives of technology. The fact that best explains this lack of media literacy courses designed to show both sides of media in university campuses is directly tied to the industry of technology. Claiming that technology may be bad (Almeida, 2014) tends to generate discontent in a large number of users among the youth.

In this auto-ethnography article, I will take the readers through the actual steps in order to complete a tiresome yet innovative course based on solid principles of both instructional design and distance education. Through his autobiographical account, the author explains the importance of learning the university system, selecting the best book for the task, designing and developing class assignments and evaluation rubrics, along with putting together a four-hour training program for faculty. This newly designed media literacy course will be used by faculty members to teach a number of Mass Communication course sessions of MC 250, titled, "Media Literacy," which is believed to have a positive impact on Jackson State University students.

Autoethnography

I decided to use the auto ethnography method of research in this study. This method is understood as a written description of an experience focused on how people live their lives and how one's beliefs help them to better understand their world in first person (Muecke, 1994; Akella, 2016). Auto ethnography is a form, perhaps a dimension, of ethnography (Akella, 2016) with the distinction that the method focuses on the person rather than the group (Akella, 2016). As a method, auto ethnography combines elements of both autobiography and ethnography (Ellis et al., 2011), and tries to make one's personal accounts and experiences attractive through the use of texts (Goodall, 1998).

The author "does need to not live through these experiences solely to make them part of a published document; rather, these experiences are assembled using hindsight" (Ellis et al., 2011, p. 2). Auto ethnography is a method of qualitative research where the author seeks to describe and

analyze step-by-step systematically one's personal experiences as an attempt to better understand the future (Ellis et al., 2011). It is a method that helps a researcher to tell a story by describing and sharing personal accounts through decoding biographical documents, along with selected cognitive processes (Vickers, 2007). When researchers engage in an auto ethnographical study, they selectively write about their intuitive perceptions which are inevitably a part of one's cultural identity (Ellis et at., 2011).

My personal account

I am currently an associate professor of mass communication of a medium size university located in central Mississippi. My job is to assist the school Dean with advancing the academic unit forward. One of my main academic responsibilities is to design and develop new curriculum, as well as to investigate and research new methods of course content delivery, to help to increase student enrollment. In my very first semester as a new Associate Professor of Emergent Strategic Communications, I was asked to create a brand new course titled, "Media Literacy" maximizing the use of technology in the classroom. Although I once conceptually designed a proposal for a media literacy course back in Pennsylvania, I really had to start the assignment from scratch.

In reality, my first step was to understand the style of operation of my Dean and the needs and wants of our Provost. I knew that if I was going to be successful in my quest to develop the very best Media Literacy course in the United States, I had to better understand the chain of command and what they really wanted from me. To my fortune, both my Dean and Provost were caring, professional, and patient with me. Having great support is critical for succeeding in curriculum development for face-to-face and distance learning. Coming in as a brand new faculty member to a division one school in the south with the duty to produce a media course wasn't easy.

My second step was to try to better understand the learning styles and wishes of our students. Were they more visual learners? Kinesthetic or auditory learners? The former was much more challenging to figure it out as isolating likes and dislikes of a large student population body is rarely an easy task. Although I still don't have a clear idea about the student body's preferred "learning styles" and "wishes," I believe I have a much better idea about who they are and what they like and dislike simply by having the opportunity to teach four courses at the university with students from different departments. It was clear to me, after one semester, that the student population valued experience versus theory, tradition over progress, and simply doing things practically.

In fact, producing any kind of college course is challenging and requires a great deal of careful planning and instructional design. Although the former might not be clear to constituents outside higher education, post-secondary educators, in their vast majority, do understand the challenges course developers experience, especially in terms of how university-wide curriculum committees and university senates operate. It is just not that simple to get academic coursework approved in colleges and universities in the United States.

My reasons for pursuing and developing the whole media literacy course, despite the numerous challenges I encountered along the way, were attributed to having the freedom to create the course shell the way I wanted to, along with the technology I felt was the most appropriate to use. I then came up with my own theoretical spins (Banathy, 1996) about how this course should look. How empowering! At that point I knew that this new innovation (Rogers, 1995) would literally have a significant impact on hundreds of incoming freshman and sophomores each year. I got excited. At that point, I realized that I had the liberty to use the principles of user-design (Carr-Chellman, 2006) to develop the course the way I wanted and to use video game technology as a means to reinforce course content. I realized that what I was really doing was constructivism along with constructionism methodology.

Constructionism and constructivism supply course developers with two unique approaches in applying prior knowledge and experience into the development of course content. The former shares the supposition that knowledge is unique to each individual and that construction is a valid way build knowledge. Cannings and Stager (2003) reported that students construct their knowledge base from individual experiences and environmental factors. Constructivism is based on the study of learning methods that can be utilized to take advantage of a learner's prior knowledge and experience (Ackermann, 2001). Constructionism is simply learning by making (Paper & Harel, 1991).

What my realizations about constructivism and constructionism really meant was that I had to design the course with the students in mind and allowing them to design and develop their own experiences in the classroom. By designing this new media literacy course with a high degree of student empowerment in mind, I felt that buy-in from students would be paramount for the success of this innovation. These former conclusions lead me to generate assignments in perfect alignment with the theory of constructivism and the principles of constructionism.

Figure 1: Proposed Assignments

A quick description of these assignments are as follows:

Critical Thinking Assignments – In this class, students will be asked to complete ten critical thinking assignments relating to the contents of the book and the recommendations of the instructor, as it relates to media literacy. Each assignment will be worth 2% of the grade totaling 30%. Each assignment MUST be edited prior to submission.

No Smartphone for a Week Project — Students in this course are to work in groups of three and prepare a presentation to the class about *"how it felt*" to live life without a smartphone for a week. A minimum of fifteen presentation slides is required, along with the collective summary of the groups's experiences to be posted in a blog.

Pros and Cons of Technology Paper — Students will be required to write a positional paper about the pros and cons of technology in society, based on the contents of this class and demonstrate in practice through writing their mastery of course content. Students are to construct and defend a particular position.

Table 1
Rough draft of syllabus

Week #1	Chapter 1, Introduction; DUE: Read Harvard's principle of media literacy; Read: Work of art in the age of mechanical reproduction.
Week #2	Chapter 2, Discussion about week #1 readings in groups. DUE: Critical Thinking Assignment #1.
Week #3	Chapter 3, "Likability? What does it mean to be likable?" Critical Thinking Assignment #2. *Watch TEDx talk, "The art of becoming likable."*
Week #4	Chapter 4, "24 hour without media experiment" DUE: Critical Thinking Assignment #3. *Watch TEDx talk, The first 20 hours."*
Week #5	Chapter 5, "24/7 Connectivity: Alone together" DUE: Critical Thinking Assignment #4; No Smartphone for a week project.
Week #6	Chapter 6, "Technological Determinism Debate" DUE: Critical Thinking Assignment #5; *Watch TEDx talk, Breaking Free From Technology.*
Week #7	Chapter 7 & 8, "Technology and the Brain debate" DUE: Critical Thinking Assignment #6; *Watch TEDx talk, "How to control someone's art with your brain."*
Week #8	Chapter 9, "Technology, music, and social justice" DUE: Critical Thinking Assignment #7.
Week #9	Chapter 10, "Race, gender and diversity: National museum of African American history and culture." DUE: Critical Thinking Assignment #8.
Week #10	Chapter 11, "Media advancements and war" DUE: Critical Thinking Assignment #9; *Read Photography piece at New Yorker about photography and war in the new age.*
Week #11	Chapter 12, "Media and democracy discussion" DUE: Critical Thinking Assignment #10, *Watch TEDx talk, "How digital media and dig data are redefining democracy."*
Week #12	Chapter 13, "The need to belong: The social media phenomenon" DUE: Pros and cons of technology paper; *Watch the TEDx talk, "The power of vulnerability."*
Week #13	Chapter 14, "Alone together" DUE: *Watch TED talk, Together but alone."*
Week #14	FALL BREAK
Week #15	Chapter 15, "The politics of technology and elections" DUE: Study for Final examination
Week #16	DUE: Final examination.

Once I passed these assignments to my Dean for approval, she was ecstatic. I received buy-in from her almost immediately. She then informed the Provost that the Media Literacy course development was going well as planned. The Provost immediately

wanted to check and see the progress as this course was a part of his vision to have a media literacy course in the general education curriculum by the following year. He requested a syllabus for review, my Dean informed me. After a long meeting with her, which was called by my Dean in an attempt to finalize a draft of the weekly assignments that would be included in the final syllabus, the document was sent via interoffice mail to the office of the Provost. Table 1 shows the weekly assignments which I developed and were approved by the Dean.

Each week students were to be presented with pre-planned class content and the opportunity to construct knowledge (Ackermann, 2001) most of the time. The benefit of creating a course in media literacy with pre-planned activities the way it was presented in the table, is that the course would then be quickly adaptable for distance education delivery. All that would then need to be accomplished to deliver this course at a distance is to design and develop the shells in a content management system since the overall structure was pre-planned to be implemented in both face-to-face and distance learning formats.

Like in most new innovations, the course will get better as delivery occurs. The very first draft was created with enough flexibility and support from administration. This course can in fact be a big hit in colleges and universities whose goals are to advance the mission of media literacy in their curriculum.

Conclusion

In this article, I shared with you some of the required steps to create a college course in Media Literacy in a division one university in the south, from the eyes of an auto-ethnographer. A theoretical justification, the reasons and some policies and procedures on how to develop and implement a college course for both face-to-face and distance education was revealed in this paper. This study had a number of limitations, ranging from the method itself, my own personal bias and quite possibly lack of more extensive qualitative data in order to better explain the study itself. However, the accounts presented in this article could inform practitioners of higher education about the importance of taking into account the construction of a college course through the eyes of constructionism.

References

Ackermann, E. (2001) Language Games, Digital Writings, Emerging Literacies: Enhancing kids' natural gifts as narrators and notators. Retrieved September 15, 2016 from http://learning.media.mit.edu/content/publications/EA.paper.Languagegames.02.final.pdf

Ackermann, E. (2001) Piaget's constructivism, Papert's constructionism: What's the difference? In Future of Learning Group Publication: Retrieved September 15, 2016 from http://learning.media.mit.edu/content/publications/EA.Piaget%20_%20Papert.pdf

Akella, N. (2016). An Autoethnography: Designing a veteran recruiting training program. International Journal of Instructional technology and Distance Learning, 13, (1), 25-31.

Almeida, L. (2014). The impact of Computerized Devices on College Students Behavior. International Journal of Instructional technology and Distance Learning, 11, (1), 31-43.

Banathy, B. (1996). Designing social systems in a changing world. New York, Plenum.

Cannings, T., & Stager, G. (2003). Online constructionism and the future of teacher education. Paper presented at the ICT and the Teacher of the Future - Selected Papers from the International Federation for Information Processing Working Groups 3.1 and 3.3 Working Conference, Melbourne, Australia.

Carr-Chellman, A. (2006). User-Design. Lawrence Erlbaum Associates.

Ellis, Carolyn; Adams, Tony E. & Bochner, Arthur P. (2010). Autoethnography: An Overview [40 paragraphs]. Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, 12(1), Art. 10, http://www.qualitative-research.net/index.php/fqs/article/view/1589/3095

Goodall, H.L. (1998). Notes for the autoethnography and autobiography panel. Paper presented at the National Communication Association Convention, New York.

Gutnick, A. L., Robb, M., Takeuchi, L., & Kotler, J. (2010). Always connected: The new digital media habits of young children. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Muecke, M.A. (1994), "On the evaluation of ethnographies", in Morse, J.M. (Ed.), Critical Issues in Qualitative Research Methods, Sage, Thousand Oaks, CA.

Papert, S. & Harel, I. (1991). Situating Constructionism. Constructionism, Ablex Publishing Corporation: 193-206. Retrieved from http://www.papert.org/articles/SituatingConstructionism.htm

Rogers, E. (1995). Diffusion of Innovations. New York: Free Press. Vickers, M. H. (2007). Autoethnograhy as sense making. A story of bullying. Culture and Organization, 13 (3), 223-237.

About the author

Dr. Luis C. Almeida is an educational technologist by training, media college professor by practice, who brings public awareness about the responsible use of computing for instruction and productivity by speaking and writing about the need for techno-moderation in education and society. Upon delving into the technology field, he has discovered many positives and negatives. The negatives effects have sparked his interest in relaxation and led to the co-ownership and public sale of "I Do Therapy." He is currently an Associate Professor of Emergent Strategic Communications at Jackson State University in Missisippi, USA. almeida@luiscalmeida.com

Return to Table of Contents