Athens Institute for Education and Research
ATINER

ATINER's Conference Paper Series
EDU2012-0159

Using Action Research for Verification that Technology Impacts Student Achievement

Dr. Joel Levine
Associate Professor
Barry University
USA

Dr. Gladys Arome
Program Coordinator
Valdosta State University
USA

An Introduction to
ATINER's Conference Paper Series

ATINER started to publish this conference papers series in 2012. It includes only the papers submitted for publication after they were presented at one of the conferences organized by our Institute every year. The papers published in the series have not been refereed and are published as they were submitted by the author. The series serves two purposes. First, we want to disseminate the information as fast as possible. Second, by doing so, the authors can receive comments useful to revise their papers before they are considered for publication in one of ATINER's books, following our standard procedures of a blind review.

Dr. Gregory T. Papanikos
President
Athens Institute for Education and Research

This paper should be cited as follows:

Using Action Research for Verification that Technology Impacts Student Achievement

Dr. Joel Levine
Associate Professor
Barry University
USA

Dr. Gladys Arome
Program Coordinator
Valdosta State University
USA

Abstract

Educators have been making significant strides toward integrating technology into their classroom instruction (USDOE, 2003). Often, educators themselves feel their efforts are worthwhile in respect to positive changes they see in outcomes, including student learning, attitudes, and motivation. The literature indicates that quantitative and/or qualitative research conducted to date does not consistently verify such positive changes when technology is integrated (NCEE 2009). Societal members, including educators, want to see documented positive results, especially gains in academic achievement, in order to continue to fund the purchases of technology for classroom use. Assessing academic achievement may not always be simple and clear-cut. The literature indicates that it may be difficult to accurately measure academic achievement due to many factors that cannot be controlled, as a result of the differences in teachers and how they teach, students and how they learn, and the learning environments established and managed by school staff and teachers (Akey 2006; Cawelti, 2004). The authors of this paper recommend that it may be advantageous to look at how academic achievement verification may be researched by investigating how specific teachers and specific students interact within specific learning environments. The use of action research may provide a better perspective about the factors that may be involved in maximizing student academic achievement.

Contact Information of Corresponding author:

Introduction

As technology tools increasingly become available and accessible in our schools, they continue to reshape the learning experiences of students in profound ways, yet the impact of technology on student achievement remains a controversial topic. Lowther, Inan, Strahl, & Ross(2008) Posit that "It is common knowledge that two emergent themes serve as the driving force for integrating technology into K-12 environments: preparing students for the workforce and increasing student knowledge and skills (p.197).The proliferation of information and communication technologies in the recent past, including desktop and laptop computers, handheld devices, cell phones, portable video players, and the Internet, has transformed the world in which we live (Friedman, 2005). The teaching and learning environment in today's world is influenced by many unique educational technologies (Day-Black,& Watties-Daniels, 2006). Educators have made a many contributions toward integrating available technologies into their teaching and student's learning. In trying to understand the concept of technology integration, we need to understand the definition of technology integration as it relates to teaching and learning. Although so many groups have tried to come up with the definition, and have used many different words, the overall theme still centers on the fact that technology should be seen as a tool or a means to an end goal, not the end in itself.

Technology integration is defined as "using computers effectively and efficiently in the general content areas to allow students to learn how to apply computer skills in meaningful ways… Integration is incorporating technology in a manner that enhances student learning. Technology integration is using software supported by the business world for real-world applications so students learn to use computers flexibly, purposefully and creatively. Technology integration is having the curriculum drive technology usage, not having technology drive the curriculum. Finally, technology integration is organizing the goals of curriculum and technology into a coordinated, harmonious whole (Dockstader, 1999. P.1).

In trying to understand the impact of technology on student learning, specifically achievement, one would need to understand what constitutes effective integration of technology. Although educators understand that technology includes a combination of several tools, without appropriate use of those tools, there would be no impact on student learning. Curriculum integration with the use of technology involves the infusion of technology as a tool to enhance the learning in a content area or multidisciplinary setting. The technology should become an integral part of how the classroom functions — as accessible as all other classroom tools. The focus in each lesson or unit is the curriculum outcome, not the technology. (Chapter 7: Technology Integration, U.S. DOE, 2008). Effectiveness of educational technology is involved in the kind of pedagogy employed. Many factors determine the approach in which students use technology tools to learn as well as how teachers use the tools to teach. Carroll, (2011) posits that "computers are a tool and can be used in a didactic or constructivist way in the classroom. Like a three cord rope, learning consists of three intertwined cords- the teacher, the student and a medium" (p. 29).In essence, effective integration plays an important role in the processes of human learning and teaching, and there should be a focus on making technology integration routine, seamless, efficient and effective in supporting school goals and student outcomes.

Effective integration of technology involves many factors and variables. Educators continue to explore best practices and their own trial and error strategies and activities that hopefully lead to improved learning, specifically student achievement. These ongoing changes involving teaching, learning, and technology may verify the valuable impact that technology can have on student achievement. The use of research that is effectively conducted and results that are accurately documented and shared can provide such verification.

Research on the Impact of Technology on Student Achievement

Educators have been making significant strides toward integrating technology into their classroom instruction [USDOE, 2003]. Often, educators themselves feel their efforts are worthwhile in respect to positive changes they see in outcomes, including student learning, attitudes, and motivation. The literature indicates that quantitative and/or qualitative research conducted to date does not consistently verify such positive changes when technology is integrated [NCEE 2009]. In addition, the report of research conducted on technology initiatives in K-12 schools over the past 30 years have identified key barriers that inhibit successful technology integration efforts. Among the list of those factors are: availability and access to computers(Barron, Kemker, Hermes, & Kalaydjian, 2003; Norris, Sullivan, Poirot, & Soloway, 2003), teachers' beliefs (Ertmer, 2005; Lumpe & Chambers, 2001; Vannatta & Fordham, 2004; Wozney, Venkatesh, & Abrami, 2006); teachers' technological and content knowledge (Pierson, 2001) and technical, administrative, and peer support (Ringstaff & Kelly, 2002; Sandholtz & Reilly, 2004; Van Melle, Cimellaro, & Shulha, 2003). As a result, Lawther, et. al (2008) posits that evidence of these barriers influenced the structure and requirements of many technology initiative grants (p.198).

Although the barriers have been identified, and some literature indicates that quantitative and/or qualitative research conducted to date does not consistently verify positive changes when technology is integrated, it can, under the right conditions, have a positive impact on learning and teaching in the primary and secondary grades (Honey, 2001; Norris, Smolka, & Soloway, 2000). In fact, "there is a range of beneficial impacts, such as increased time on task, higher test scores, lower cost, and increased motivation" and improved student learning and educational outcomes (Norris, Sullivan, Poirot, & Soloway, 2003. P.15; Hanna& de Nooy, 2003).Other studies have reported that the use of technology as an instructional tool in schools increased student engagement; motivation; active participants in their learning; improved students standardized test results, encouraged positive behaviors, attendance and dropout rates; enhances effectiveness and mastery of learning, and improved retention; increases student motivation, satisfaction and enjoyment in learning; promotes cognitive development; improved development of literacy, writing and mathematics skills, (Williams, Atkinson, Cate, &O'Hair; 2008; Roschelle, Kafanan, Bhanot, Estrella, Penuel, Nussbaum, & Claro, 2010; Gustafson, 2003;Branford, Brown, & Cocking, 2000;Mouza, 2005).

The 2011 issue of the Review of Educational Research contains an article that endeavors to bring together more than 40 years of investigations on the general question, "Does computer technology use affect student achievement in formal face-to-face classrooms as compared to classrooms that do not use technology?" An article

by Tamin et al (2011) titled "What 40 Years of Research Says about the Impact of Technology on Learning: A Second-Order Meta-Analysis and Validation Study", reveals that the use of technology in instruction shows small to moderate gains in student learning over instruction that does not use technology. Technology used to support instruction has slightly stronger effects than applications that deliver direct instruction. Strawn (2011) agrees that this study supports findings from one of the contributing meta-analyses that "computer technology used as 'support for cognition' were significantly greater than those related to computer use for 'presentation of content. For example, students learn more from teachers who use an model technology as tools for learning, than when they learn directly from an educational website, CD, or educational software program (p. 38). This also supports many researches findings that educators are instrumental to the success of technology integration in the classroom. Although there is a danger of adopting an overly socially deterministic understanding of the impact of technology on learning, according to Brown (2012), the paper supports Clark's (1983, 1994) view that technology serves at the pleasure of instructional design, pedagogical approaches, and teacher practices. Tamim, et. al. (2011) similarly states that they generally agree with the view of Ross, Morrison, and Lowther (2010) that "educational technology is not a homogeneous 'intervention' but a broad variety of modalities, tools, and strategies for learning" (p.19). What this means is that the effectiveness of educational technology depends on how well it helps teachers and students achieve their desired instructional goals" (p. 19). Following this avenue of thought, the key point is that '...it is aspects of the goals of instruction, pedagogy, teacher effectiveness, subject matter, age level, fidelity of technology implementation, and possibly other factors that may represent more powerful influences on effect sizes than the nature of the technology intervention' (Tamim, et. al., 2011, p. 17).

Refocused Research on the Impact of Technology on Student Achievement

Technology alone is not the only component of effective teaching and learning, However, one cannot separate technology as a component of teaching and learning from the many other contexts that influence student learning outcomes. The literature indicates that it may be difficult to accurately measure the impact on academic achievement due to many factors that cannot be controlled, a result of the differences in teachers and how they teach, students and how they learn, and the learning environments established and managed by school staff and teachers (Akey 2006; Cawelti, 2004). Tamin, et. al. (2011) suggested that it is incumbent on future researchers to unpack these past nuances, so that technology is used as effectively as possible to support the aims of teaching and learning. In order words, there is a need for more ecological research on the conditions under which educational technology contributes to learning.

Although this is not a new argument, this study as well as other studies make the case for integrating technology into instruction, and that technology improves student achievement the most when teachers integrate technology tools into the teaching and learning process. Research should now move beyond the question of impact of technology to how technology can be used effectively in teaching to enhance learning. Many teachers according to Donnison, (2007), have been colonized by dominant

models of technology, but do not use them efficiently in their classrooms (p.9).Although there have been some arguments relating to access to technology, indeed, educational systems across the country have embraced the potential of technologies to improve schooling. In the past 10 years, all levels of government have invested significant resources to support the integration of school-based technologies in teaching and learning practices (p.1US DOE: EETT: 2008). Further research should be undertaken to better understand the impact of technology on student achievement, and how manipulation of factors and variables can maximize the student achievement results.

Promise of Action Research

The research conducted to date has definitely added to the body of knowledge about the impact of technology on student achievement. Full verification of technology's impact relies on additional research and different research approaches. In addition, research should look at all factors that contribute to the impact on technology on student achievement (Trucano, 2005). These factors involve the teacher, the student, and the learning environment and its resources. The teacher can influence how effectively technology is integrated into classroom instruction, based on many variables, such as their teaching style, teaching strategies and models used, learning style, creativity, adoption/change orientation, personality, attitudes, pre-service and in-service training, and years of successful teaching. The students can influence how technology is successfully used in courses, based on many variables, such as their learning style, creativity, adoption/change orientation, personality, attitudes, age, and support. The learning environment and resources can influence how technology is effectively integrated into classroom instruction, based on many variables, such as school/classroom climate, ergonomics, quality instructional staff members, functioning technology, timely accessibility to technology and resources, and a safe, non-threatening environment. All of these factors and variables, in addition to others not mentioned, can individually and/or in multiple combinations, and/or collectively contribute to the impact of technology on student achievement.

Many of these factors and variables cannot easily be controlled or accounted for in many quantitative, qualitative, and mixed methods studies, since the researcher has often planned a more clinical, formal approach, usually void of their direct interaction and influence(Hofstede, G., Neuijen, B., Ohayv,D., Sanders, G.,1990) Determining the specific impacts of technology on student achievement may be enhanced by having the researcher become interactively involved in investigating which factors and variables have the most impact, how, and why. In this capacity, the researcher would play the role of researcher and teacher, a teacher attempting to integrate and control a variety of variables. This is just one scenario that is promising among various types of research cited in the literature. This scenario most closely resembles Action Research. Action research is a process of systematically evaluating the consequences of educational decisions and adjusting practice to maximize effectiveness (McLean, 1995). An action research approach would enable classroom teachers to be interactively involved with their own students, while they simultaneously take on the roles and responsibilities as researchers. Research indicates to that there is much promise in the art of teaching, the science of research,

and a merging of the two (Zuber-Skerritt, 1996).However, this would require the teacher to obtain significant knowledge and skills about research, and then apply their knowledge and skills in providing technology integrated instruction while modifying the factors and variables to optimize the impact of technology on student achievement. Varied use of quantitative and qualitative methods would be implemented.

Advantages for teachers conducting action research include the ability for the teacher to conduct the study in a natural setting while controlling which variables are to be manipulated for what purposes, and to effectively document the results (Pedretti & Hodson, 1995; Briscoe & Wells,2002; Zambo, 2005). Through action research, teachers learn about themselves, their students, their colleagues, and can determine ways to continually improve (Ferrance, 2000). The literature also indicates that teachers become more flexible, open-minded, critical, analytical, proactive, self-directed, and reflective (Cardelle-Elewar, 1993; Darling-Hamond & McLaughlin, 1995; Holly, 1090;Oja & Smulyan, 1989). Challenges that teachers may have when using action research include their inability to: vary the research design, control certain variables, generalize the results, commit to the time needed, avoid subjectivity/bias impacting validity, and become well-trained in the understanding and use of research methods (Waters-Adams, 2006). Most of these challenges may be reduced or eliminated with appropriate planning and implementation (Ferrance, 2000).

Beneficial Action Research Strategies and Approaches

Action research could certainly be advantageous to verifying the impact of technology on student academic achievement. Getting the buy-in from educators at all levels may be challenging. Buy-in should emphasize the importance of using research in order to make school, program and teaching improvements. Barker and Barker (1994) found the action research model to be an effective approach for reducing employee resistance to fundamental and necessary organizational changes. Their results suggested that the participatory model promoted positive staff morale, open communication, lower turnover, team problem solving, and improved goal attainment. A focus on strategies and approaches could be crucial for recognition of the valuable role action research could have. Some action research strategies and approaches are presented. First, providing appropriate training for teachers is crucial. Training is should build understanding, skills, and self-confidence. Second, clarifying the important research roles of teachers. Teachers are often clear about their teaching roles, but they often need help in understanding their research roles and responsibilities. Literature indicates that teachers need to know what they are supposed to do, why, when and how. Third, developing in teachers an understanding that action research is a political and social endeavor. Carr and Kemmis (1986) amongst others, have explored the potentially political nature of analysis, and have promoted action research as a means of social change. They see action research as being 'emancipatory', producing an understanding of the workplace that is empowering professionally (Carr &Kemmis, 1986). Fourth, insuring that accurate data is recorded and analyzed effectively. Effective observation is crucial (Stringer, 2007). Fifth, effectively utilizing data analysis to modify what variables and changes

are implemented. According to Dick (1997), action learning and action research are similar processes, as they both involve acquiring knowledge from experiences and focus on implementing interventions (actions) and reflection in a cyclical manner. Sixth, providing support for teachers effectively utilizing various research methods. Support involves training, professional development, and mentoring. Seventh, encouraging teachers to work collaboratively with other teachers in one school or multiple schools to conduct similar research. It is often collaborative, especially when the goal is to improve some aspect of practice at the school level rather than in a single teacher's classroom (Armstrong & Moore, 2004; James, Milenkiewicz, &Bucknam, 2008), Professionalism and professional communities might be a direct outcome of individual and school-wide use of action research. Eighth, promoting partnerships with non-educational entities may also lead to improved action research. We can learn from the health field that partnerships are strengthened by joint development of research agreements for the design, implementation, analysis, and dissemination of results (Macaulay, et al.1999). Ninth, synthesizing of many similar quantitative and qualitative results would help to reinforce teacher's studies (Sandelowski & Barroso, 2007; Barnett-Page & Thomas, 2009). Evidence of effective outcomes based on effective strategies and activities would be a desired goal. Some generalizations may result from synthesis. Tenth, encouraging educators to conduct and publish action research on the technology impact on student achievement. This would enable full verification to be realized.

Conclusion

Action Research provides an orientation to research, a form of professional practice, a research process, and a reflective way of teaching (Arhar, Holly, & Kasten, 2001). It enables practioners to fulfill the roles of both the researcher and teacher. In so doing, factors and variables can be manipulated and studied in order to maximize learning gains using various technologies. The research from many diverse educators teaching many diverse students at all age levels could be documented and analyzed in order to provide verification that technology does impact student academic achievement, as measured by a variety of qualitative and quantitative instruments. Such evidence, synthesis, and possible generalizations could be regularly published, shared, and used for classroom, school, district, state, and national decisions regarding technology integration for effective instruction.

References

Arhar, J., Holly, M., & Kasten, W. (2001). *Action research for teachers: Traveling the yellow brick road.* Upper Saddle River, NJ: Prentice Hall, Inc.

Armstrong, F., & Moore, M. (2004). Action research: Developing inclusive practice and transforming cultures. In F. Armstrong & M. Moore, M. (Eds.), *Action research for inclusive education: Changing places, changing practices, changing minds* (pp. 1-16). London: RoutledgeFalmer.

Barker, S. B., and Barker, R. T. "Managing Change in an Interdisciplinary Inpatient Unit: An Action Research Approach." *Journal of Mental Health Administration,* 1994, *21*(1), 80–92.

Barnett-Page, E & Thomas, J (2009) Methods for the synthesis of qualitative research: a critical review. *BMC Medical Research Methodology* 2009, 9:59

Barron, A.E., Kemker, K., Harmes, C., & Kalaydjian, K. (2003). Large-scale research study ontechnology in K-12 schools: Technology integration as it relates to the National TechnologyStandards. *Journal of Research on Technology in Education, 35*, 489–507.

Black, D. C., & Watties-Daniels, D. (2006). Cutting Edge Technology to Enhance Nursing ClassroomInstruction at Coppin State University.*The ABNF Journal.* 103-106

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind,experience and school.* Washington, DC: National Academy Press

Briscoe, C., & Wells, E. (2002). Reforming primary science assessment practices: A case study of one teacher's professional development through action research. *ScienceEducation, 86*, 417-435.

Brown, M., (2012). *Reflections on Distance Education and Learning Futures*. Pass the SoLT. Available from: http://turwww1.massey.ac.nz/~wwtdu/cadelblog/blog6.php/2011/03/03/what-40-years-of-research-says-about-the Retrieved 4/10/12.

Cardelle-Elawar, M. (1993).*The teacher as researcher in the classroom*. Action in Teacher Education, 15, 49-57.

Carr, W. & Kemmis, S. (1986) *Becoming Critical: education, knowledge and action research*. Lewes, Falmer.

Carroll, J., (2011). From Encyclopedias to Search Engines: Technological Change and its Impact on Literacy Learning. *Literacy Learning: the Middle Years.* 19(2) 27-34.

Chapter 7: *Technology Integration*, U.S. Department of Education, December 9, 2008

Darling-Hammond, L. & McLaughlin, M. L. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan*, 76(8), 587-604.

Dick, B. *Action Learning and Action Research*, 1997. http://www.scu.edu.au/schools/gcm/ar/arp/actlearn.html. Accessed Mar. 23, 2012.

Dockstader, J. (1999).Teachers of the 21st Century Know the What, Why, and How of Technology Integration. *T.H.E Journal* http://thejournal.com/Articles/1999/01/01/Teachers-of-the-21st-Century-Know-the-What-Why-and-How-of-Technology-Integration.aspx?p=1 Retrieved 4/10/2012

Donnison, S. (2007). Digital generation Pre-service Teachers as Change Agents: A Paradox *Australian Journal of Teacher Education*, *32* (4) 1–12.

Ertmer, P.A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technologyintegration? *Educational Technology Research and Development, 53*(4), 25–39.

Ferrance, E. (2000), *Themes in Education: Action Research,* The Education Alliance: Brown University, Providence, Rhode Island.

Gustafson.K. (2003).The impact of technologies on learning.*Planning for Higher Education, Society for College and University Planning,* 32(2). 37-43.

Hanna, B. E., & de Nooy, J. (2003). A Funny Thing Happened on the way to the Forum: Electronic Discussion and Foreign Language Learning. *Language Learning & Technology*, 7 (1), 71–85.

Hofstede, G., Neuijen, B., Ohayv,D., Sanders, G. (1990) *Measuring Organizational Cultures: A Qualitative and Quantitative Study Across Twenty Cases*, Administrative Science Quarterly, Vol. 35.

Holly, M. L. (1990). *Teachers' theorizing research and professional growth*. Paper presented at the annual meeting of the American Educational Researcher Association, Boston.

James, E. A., Milenkiewicz, M. T., &Bucknam, A. (2008).*Participatory action research for educational leadership: Using data-driven decision making to improve schools*. Los Angeles: Sage.

Jones, Kip.(2004) Mission Drift in Qualitative Research, or Moving Toward a Systematic Review of Qualitative Studies, Moving Back to a More Systematic Narrative Review

The Qualitative Report Volume 9 Number 1 March 2004 95-112 http://www.nova.edu/ssss/QR/QR9-1/jones.pdf

Lowther, D, Inan, F., Strahl, D. & Ross, S. (2008). Does technology integration "work" when key barriers are removed? *Educational Media International.*Vol. 45(3) 195-213.

Lumpe, A.T., & Chambers, E. (2001).Assessing teachers' context beliefs about technology use.*Journal of Research on Technology in Education, 34*(1), 93–107.

Macaulay AC, Commanda LE, Freeman WL, et al. (1999)Participatory Research Maximises Community and Lay Involvement. *North American Primary Care Research Group*, *BMJ* , 319:774–778

McLean, J.E. (1995). *Improving education through action research: A guide for administrators and teachers*. Thousand Oaks, CA: Corwin Press

Mouza, C. (2005).Using Technology to Enhance Early Childhood Learning: The 100 Days of School project.*Educational Research and Evaluation.*11(6), 513-528

National Center for Educational Statistics (NCES-2003).*Technology in Schools. Suggestions, Tools and Guidelines for Assessing Technology in Elementary and Secondary Education*

Norris, C., Sullivan, T., Poirot, J., & Soloway, E. (2003). No access, no use, no impact: Snapshotsurveys of educational technology in K-12. *Journal of Research on Technology in Education,36*(1), 15–27.

Noyes J, Popay J, Pearson A, Hannes K, Booth A. Chapter 20: Qualitative research and Cochrane reviews. In: Higgins JPT, Green S (editors). *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.0.1 [updated September 2008]. The Cochrane Collaboration, 2008.Available from www.cochrane-handbook.org. http://www.igh.org/Cochrane/tools/Ch20_Qualitative.pdf

Oja, S.N., &Smulyan, L. (1989).*Collaborative action research: A developmental approach.* New York: Falmer Press.

Pedretti, E.&Hodson, D. (1995). From rhetoric to action: Implementing STS education through action research. *Journal of Research in Science Teaching*, 32(5), 463-485.

Pierson, M.E. (2001). Technology integration practice as a function of pedagogical expertise.*Journal of Research on Computing in Education, 33*(4), 413–430.

Ringstaff, C., & Kelly, L. (2002).*The learning return on our educational technology investment: Areview of findings from research.* San Francisco, CA: WestEd RTEC.

Roschelle, J., Rafanan, K., Bhanot, R., Estrella, G.,Penuel, B., Nussbaum, M., &Claro, S. (2010).Scaffolding group explanation and feedback with handheld technology: impact on students' mathematics learning.*Education Tech Research & Development* 58:399–419

Ross, S.M., G.R. Morrison, G. R., & Lowther,D.L.(2010). Educational technology research past and present: Balancing rigor and relevance to impact school learning. *Contemporary Educational Technology* 1(1) 17–35.

Sandelowski M, Barroso J (2007): *Handbook for Synthesizing Qualitative Research*. New York: Springer Publishing Company.

Sandholtz, J.H., & Reilly, B. (2004). Teachers, not technicians: Rethinking technical expectationsfor teachers. *Teachers College Record, 106*(3), 487–512.

Strawn, C. (2011). *What does the research say? Learning & Leading with Technology.* September/October 2011.

Stringer, E. (2007). Action Research (3rd ed.). Thousand Oaks, California: Sage Publications

Tamim, R., Bernard, R., Borokhovski, E., Abrami, P., & Schmid, R. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. Review of Educational Research, 81(1), 4-28

Trucano, Michael. 2005. *Knowledge Maps: ICTs in Education*. Washington, DC: *info*Dev / World Bank.

Vannatta, R.A., & Fordham, N. (2004).Teacher dispositions as predictors of classroom technologyuse.*Journal of Research on Technology in Education, 36*(3), 253–271.

Van Melle, E., Cimellaro, L., & Shulha, L. (2003).A dynamic framework to guide the implementationand evaluation of educational technologies.*Education and Information Technologies, 8*(3), 267–285.

Waters-Adams, S. (2006). *Action Research in Education*, www.edu.plymouth.ac.uk/resined/ actionresearch/arhome.htm, accessed March 22, 2012

Williams, L.A., Atkinson, L. C., Cate, J.M., & O'Hair, M. J. (2008).Mutual Support Between LearningCommunity Development and Technology Integration: Impact on School Practices and Student Achievement. *Theory Into Practice,* 47:294–302.

Wozney, L., Venkatesh, V., & Abrami, P. (2006).Implementing computer technologies: Teachers'perceptions and practices.*Journal of Technology and Teacher Education, 14*(1), 173–20

Zambo, D. (2005). The promise of action research.*Academic Exchange Quarterly (http://rapidintellect.com/AEQweb/).*

Zuber-Skerritt, O. (1996). *New directions in action research*. Philadelphia, PA: RoutledgeFalmer