Promoting Excellence in Preparation and Excellence in Practice

Volume XXXIII, 2007
No. 1 Winter 2007
No. 2 Spring 2007

The Journal of Technology Studies

A refereed publication of Epsilon Pi Tau The International Honor Society for Professions in Technology.

The Journal of Technology Studies

A refereed publication of *Epsilon Pi Tau* The International Honor Society for Professions in Technology.

The Journal of Technology Studies (JTS) (ISSN 1071-6048) is the flagship, peer-reviewed journal of Epsilon Pi Tau, Inc., a nonprofit, academic and professional honor society. Headquarters and editorial offices are located at the Technology Building, Bowling Green State University, Bowling Green, OH 43403-0296. Use this address or jots@bgsu.edu for subscription matters or purchases.

The opinions expressed by the journal's authors are not necessarily those of the Board of Directors, staff, or members of Epsilon Pi Tau.

Two print issues per year are mailed to all members of the society upon request and to academic and general libraries around the globe. Issues that are published online only, the aforementioned printed issues, and past issues are available online at scholar.lib.vt.edu/ejournals/JTS.

The journal is currently indexed in Current Index to Journals of Education (USA), International Bibliography of the Social Sciences (IBSS) (UK) and the International Vocational Education and Training and Research Database at http://www.ncver.edu.au (Australia).

Separate articles or complete issues are also available in a variety of media forms from National Archive Publishing Company, P.O. Box 1346, Ann Arbor, MI 48106-1346 or EBSCO Publishing, 10 Estes Street, Ipswich, MA 01938-0682, USA

The JTS welcomes original manuscripts from scholars worldwide focused on the depth and breadth of technology as practiced and understood past, present, and future. Epsilon Pi Tau, as perhaps the most comprehensive honor society among the technology professions, seeks to provide up-to-date and insightful information to its increasingly diverse membership as well as the broader public. Authors need not be members of the society in order to submit manuscripts for consideration. Contributions from both academics and practitioners are equally welcome.

A general guide to the breadth of topics of potential interest to our readers can be gained by consideration of the 17 subclasses within "Technology" of the classification scheme of the Library of Congress, USA <lcweb.loc.gov/catdir/cpso/lcco/lcco_t.pdf>. This includes engineering and allied disciplines, informatics in its many manifestations, industrial technology, and education in and about technology.

Authors are strongly urged to consult the journal's "Guidelines for Authors," included in this publication, or available at the society's Web site (www.eptglobal.org) or provided upon request. It provides additional details on the breadth and nature of topics of interest, the journal's scholarly writing standards, submission guidelines, and review and publication processes.

Printed in the United States of America by Kennedy Printing Company, Findlay, Ohio.

Table of Contents

Volume XXXIII, Number 1, Winter 2007

Who are the stakeholders?

Kerry Lee

The New Zealand technology curriculum requires children to solve problems to meet people's needs. So who are these people? Are they the users of the product, people who are affected by the product or someone else? This article investigates the confusion that exists in the New Zealand curriculum about the terms society, community, consumer, user, and people and justifies the replacement of some of these designations with the term stakeholder.

Introduction

Terms such as "society" and "community" are all encompassing. As these terms are used in the New Zealand curriculum this creates problems for teachers and students. It would be difficult if not impossible to consider or consult with every member of a community or society. Using the term stakeholder narrows the focus from the whole community to those people in the community who have an interest in what is occurring. This allows students to consider the appropriate groups and individuals that should become involved in the process. This ensures students question those affected rather than a few people they know will answer a survey.

In the current technology curriculum (Ministry of Education, 1995) the term stakeholder is never used but rather numerous alternatives are used interchangeably. In 2006 the Ministry of Education published a new national curriculum statement as a draft for trial and consultation (Ministry of Education, 2006b). This is a draft document, which asks for and expects feedback from practitioners and those involved in education in order to develop the final curriculum document. In this document the term stakeholder is used to replace the multitude of terms previously used. This will be the first time many teachers will have seen the term stakeholder used in education and yet at no time does this new curriculum define or explain the term.

This paper will outline the importance of considering others in all technological activities. It will highlight the confusion and limitations of current terms such as community, society, people, consumer, client and end-user. It will present a strong argument to ensure the multiple terms used in the earlier curriculum are now replaced with the word 'stakeholders' and a justification given as to why a clear explanation needs to be included within or alongside this new curriculum.

The New Zealand Curriculum (1995 version)

Technology involves people. It operates within, and has an effect on, society. "The technology curriculum aims to develop technological literacy… to enable students to participate fully in the technological society and economy in which they will live and work" (Ministry of Education, 1995 p.5). The curriculum leaves no doubt that technology should operate within the context of society as a whole "understanding the nature of the relationship between technology and society is vital to technological practice" (Ministry of Education, 1995 p.41).

While teachers are aware of this requirement of the curriculum it appears to be common practice to attempt to satisfy this by superficial attempts to use a survey, to be seen to be involving the community. Often children survey 'someone at home', possibly because this is easy but also perhaps because students and teachers are unaware of who the stakeholders actually are. Rarely does this consultation actually consider all the groups that may have an interest in the exercise. The curriculum document recognizes that a wide range of groups are affected by technological processes. Each of these groups has its own views about an issue or design. "Decisions about technological innovation are governed by this complex balance of factors, and groups or individuals may have markedly different attitudes towards technological practice" (Ministry of Education, 1995 p.41).

The curriculum also acknowledges that there needs to be a strong focus on understanding people and their needs. The importance of people is easy to ignore as "the characteristics of the people and the social and physical environment that gave rise to the developments are sometimes overlooked" (Ministry of Education, 1995 p.41).

Values

The curriculum also highlights the importance for students to "become aware of the diversity of valid ways in which different groups of people respond to technology and to innovation, and appreciate the impacts that technological changes have on different peoples" (Ministry of Education, 1995 p.7). Students need to be encouraged to identify the groups who will be affected and to find out how, and to what degree, this will occur. Students need to take this information into consideration when designing an appropriate solution. Students need to evaluate their product by considering its impact on society, both positive and negative from the perspectives of everyone involved (Burns, 1991). "Technological outcomes are judged in terms of their effectiveness, from different points of view" (Burns, 1991, p.23). It is important that students gain an understanding of the differing needs and values in humans (Mulberg, 1992). Technology is driven by values because of human needs and wants. People are different and therefore have diverse needs, causing cases where some groups may see a technological solution as good, and others may see it as an environmental or societal catastrophe (Stables, 1997). Students need to be aware that not every group will feel positive about the solution. Prime (1997), believes that it is critical for students to be equipped with the ability to recognise and handle these underlying values.

Confusion and subsequent questions

The curriculum often uses the words community, society and people interchangeably. Yet at no point are the terms explained. Did the writers wish to differentiate among these terms and if so do teachers possess the same understanding? Throughout the curriculum reference is also made to the needs of the consumers, markets, groups, individuals and users (Ministry of Education, 1995 p.9, 16, 36). Again these terms are not defined. The achievement objectives refer to the 'local community', 'wider community,' and singularly the term 'community', the distinction among these are also never given (Ministry of Education, 1995 p.88-90). Who are these communities and how do they differ from each other? When does a local community convert into a wider community?

An example of this ambiguity is when the curriculum states students "should recognize the importance of meeting consumer needs and being responsive to the community" (Ministry of Education, 1995 p.36). At no point is the reader able to determine to whom the student needs to be responsive. Is it acceptable for a child who is making a personal alarm to consider himself or herself the consumer and therefore only meet their needs as long as they are responsive to the community? In this case could the community be the babysitter? What about others who have to see and hear the product? What about the parent/s who probably helped fund the product? Are the public who are slowly becoming de-sensitised to alarms seen in the guise of consumer or community?

Numerous people will be affected by the design, placement and use of the product but will they be considered? It must therefore be necessary to consider a wide range of views, rather than just consumers (Burns, 1997). The question of what and whose interests and purposes technology is intended to serve is a vital question at the heart of technological literacy (Jenkins, 1998). Students and teachers need to be encouraged to look broader than personal or family needs when devising solutions.

Strand C focuses on the inter-relationship between technology and society. Students focus on views, values, ethics, feelings, beliefs and factors which promote or constrain technological developments and which influence attitudes towards these technological developments. The achievement objectives are worded in such a way that any development can be investigated, not necessarily their own. For example, level 3 requires students to " identify and consider different views and feelings of people in relation to some specific technological developments or effects, such as fitness equipment, noise pollution" (Ministry of Education, 1995 p.88). It is only at level 5 that students are asked to concentrate on the implications of "their own technological activities" (Ministry of Education, 1995 p.43).

Children at present are therefore able to design and make a product with minimal consultation. If the term 'stakeholder' was used when referring to those involved with the product, the teacher and student would be encouraged to consider multiple views and perspectives.

The term stakeholder was not used in the 1995 New Zealand curriculum document (Ministry of Education, 1995). It is however a requirement of New Zealand's tertiary standardised qualification, National Certificate of Educational Achievement (NCEA), that a year 11 student's design brief should include acknowledgment of all stakeholders, with the use of stakeholder statements, expressing beliefs, ethics, social position, concerns and needs. It is expected that students identify and consult with stakeholders who are directly or indirectly affected by their product. Students need to identify all legal and regulatory aspects of their design, such as, legislation, standards, codes of practice, codes of ethics and global and future technological trends. Students need to develop knowledge bases associated with their products or solutions (Douglas & McGregor, 2001). If the term is accepted as suitable and appropriate for senior students surely it is also appropriate for younger students. If teachers encouraged children to think more specifically of those who are affected rather than those who they can easily survey, students would achieve a product which clearly demonstrates fitness for purpose.

The New Zealand Curriculum (Draft for consultation 2006)

The "revision of the New Zealand Curriculum, currently in its draft form, had its beginnings with the Curriculum Stocktake, a comprehensive review of the current curriculum that was completed in 2002" (Fancy, 2006 p.1). The new curriculum is intended to emphasize "the importance of making stronger connections between what goes on in schools and the wider communities, society, and employers" (Fancy, 2006 p.1). The aim of technology in the new curriculum document is the same as the original document, that being for the "students to develop a broad technological literacy" (Ministry of Education, 2006b p.23). As stated previously the earlier document expected students to identify and consider the needs and views of the community, society, groups, individuals and an assortment of other terms. These generic terms have been eliminated in the new curriculum document, which refers to these people as 'stakeholders'. In the strand of Technological Practice students are required to identify, access and take into account stakeholder feedback. As this is now a critical part of the new technology curriculum it is vital that teachers and their students understand who this group includes.

Stakeholder

One could think the reason for the term stakeholder not being used in the 1995 curriculum, may have been because it is a modern term. The term stakeholder however, has been used widely in business journals since the 1960's. At least seven articles which mention stakeholders in technology education are used in discussions prior to the publication of the New Zealand curriculum (1995). All of these articles however refer to the people who must be consulted when developing the technology curriculum rather than those people the children should consult when developing their solutions. If the term was being used at the curriculum development stage to identify those who should be consulted why was the term not used in the curriculum document?

The reason for this oversight may be due to the fact there currently is no single clear definition of who a stakeholder is, in fact 'there is a deep divide in definitions of what it is to be a stakeholder' (Kaler, 2002 p.92). Many people confuse the term stakeholder and shareholder. Although there may be only a difference of two letters between the terms, there is a considerable difference in who is being consulted and considered. In a survey of 28 definitions over a period of 1963 to 1995, it was found that there was more or less an even split between definitions which see stakeholders as people for whom businesses have to take responsibility and definitions which see them as people who have to be taken account of but not necessarily because of any responsibility for them (Mitchell, Agle, & Wood, 1997).

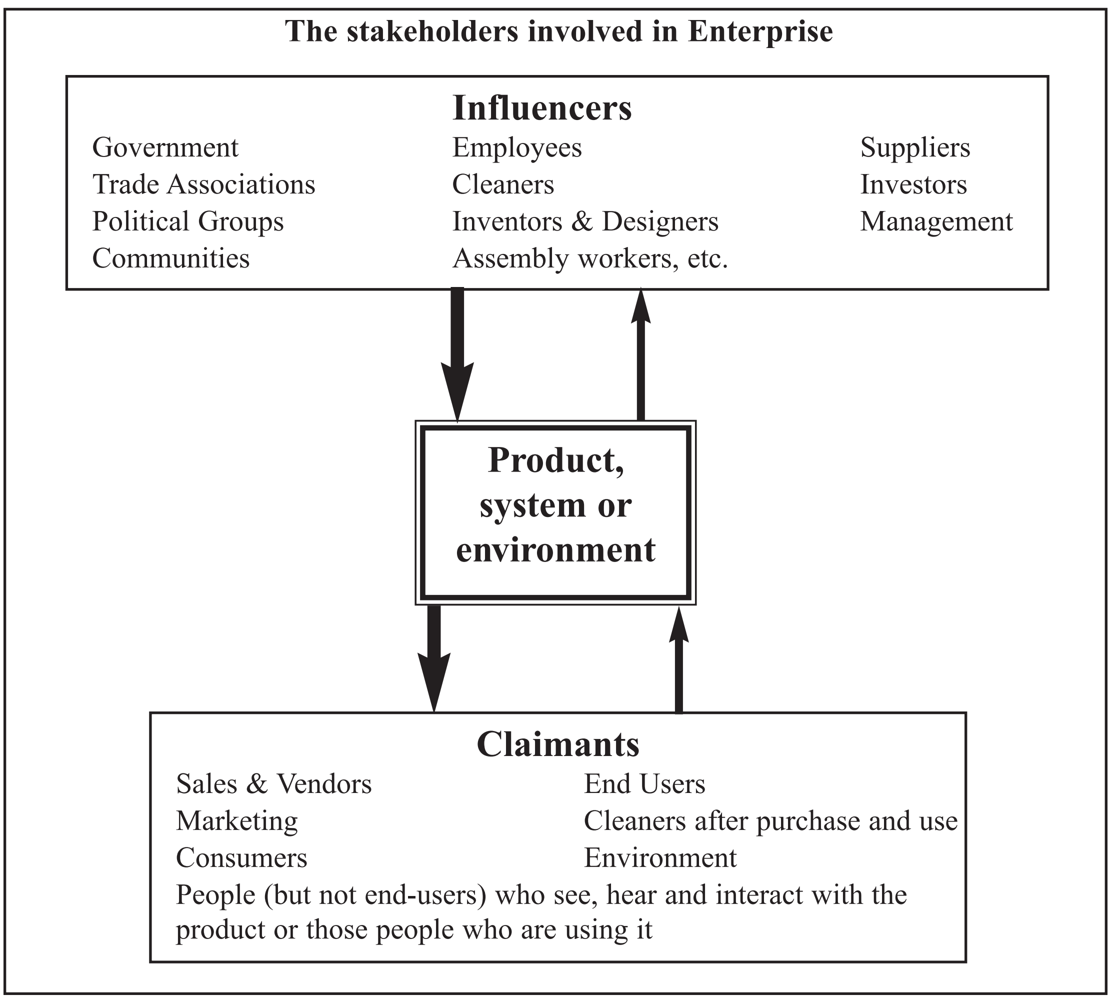
Volumes have been written about the definition and the importance of stakeholders (Hendry, 2001, 2002; Kaler, 2003; Mongoven, 2003). Kaler states a starting point would be to assume that all stakeholders have something at stake in relation to the activities of the business (Kaler, 2002 p.93). If the reason for not continuing with the term was because of this plethora of terms maybe the student could identify which definition was appropriate for their project.

The articles and quotes citing stakeholder usually refer to businesses, firms and entrepreneurs. If it is important for businesses and entrepreneurs to consider others and the possible impact of these decisions (stakeholders and stakeholder theory), it could be argued that it is equally important to develop these skills in our current innovators and future entrepreneurs, thus preparing the students to be "the technological innovators of the future" (Ministry of Education, 1995 p.5).

Stakeholders include those who have some kind of claim on the services of the organization ("claimants") or those who can influence the workings of the business in some way, i.e., "influencers" (Mitchell, Agle, & Wood, 1997 p.859). Some stakeholders can be "affected by" as well as "affect" organizations (Kaler, 2002 p.93). The new curriculum expects children to "understand how society impacts on and is influenced by technology" (Ministry of Education, 2006a p.3).

Figure 1 demonstrates the numerous stakeholders, which may be involved in a classroom or school technological enterprise. Some of these stakeholders may be influencers who affect the development of the enterprise. Governments, trade associations and political groups all restrict worker practices and product designs. This is usually to ensure safety for the user or producer of the product, system or environment. These can form limitations or specifications for designs or the production process. The new technology curriculum acknowledges the importance of "understanding and taking into account ethical considerations, legal requirements, protocols, the needs of and potential impacts on stakeholders, the development site, and where the outcome will be used" (Ministry of Education, 2006b p.23). If the students work as a company they may have designated roles or 'jobs' similar to an actual enterprise. People in these roles will influence the design of the process of manufacturing or the design of the product itself. The people making and assembling the product will have a large influence on the quality and hence success of the product. Pacey (1983) identifies many of these roles as part of the organisational and cultural aspects of technological practice. Communities' values and needs will influence the design of the product. The new curriculum requires children to develop an understanding of the "ways which individual and group beliefs, values and ethics can constrain or encourage technological development" (Ministry of

Figure 1. Stakeholders which may be involved in a school technological enterprise.



Education, 2006b, p.23). The inventors and designers have invested a great deal of time and energy into the conceptual stage of the product. They often have an idea of how the finished product is to look and function. This at times can be at odds with those producing and selling the product. Suppliers of materials, tools, equipment and services can affect the product. In a classroom, the manufacturing process may need to be altered to take account of cleaners' and school timetabling requirements. The management (principal and governing body) of a school will have set ideas about how a product, system or environment, which represents their school, should look and behave. Lastly parents or those paying for the product to be developed will often have expectations of and for the product. If these people do not understand that the philosophy of the curriculum is no longer based on creating identical technically correct products, in order to gain set skills, but rather to learn through a process which encourages diversity and risk taking, then conflict can arise. These influencers have a large impact on the design and manufacture of the product, system or environment but may also be influenced themselves (usually to a lesser extent) by its success or failure.

Other stakeholders involved in a school enterprise may be claimants who are affected by the product or its use. The design of the product will affect those who sell and buy the product but also those who have to promote it. Those people who have to see, hear or interact with the product will also be affected. For example a child who designs an alarm for their bedroom will affect the whole household even though they are not the persons directly using the alarm, or the child who designs a T-shirt is not the person who has to read or look at it. These people are affected by the product, even though they have not purchased it nor are they the direct users of it. The environment may be affected by the packaging and use of the product. Designs where packaging or part of the product is discarded after use, e.g., ice-block sticks can greatly alter the environment and may add considerably to a cleaner's job. These claimant stakeholders are affected by the product or its use and they in turn may affect the product or its manufacturing process in some way but this is usually to a lesser extent.

Students need to critically reflect on their own practice. In order to develop 'technological integrity' (Pretzer, 1997), students must gain a deeper understanding of the nature of technology when they consider beliefs, ethics and values of all stakeholders as well as social, cultural and environmental implications (Compton & Harwood, 2003).

The Stakeholder Theory

Most articles using the term 'stakeholder' appear in business or ethics journals. So who are these stakeholders and "what is the appropriate balance between shareholders and other stakeholders?" (Elkington, 2004 p. 6). Unfortunately the stakeholder theory has had its greatest influence on theorists and academics rather than practictioners, yet the challenges of the current environment are making the stakeholder perspective more relevant than ever for the practicing entrepreneur (McVea & Freeman, 2005, p.59). Stakeholder theory offers a "unique and neglected contribution to decision-making processes, particularly in innovative and entrepreneurial fields" (McVea & Freeman, 2005, p.59).

Mitchell, et al. (1997) believe it is important to identify issues of "legitimacy" and "power" of the stakeholders (claimants and or influencers) but also the urgency of their claim and/or influence (p. 865-868). If claimants who are recognized stakeholders influence those affected by and those who affect the organization, then there will be times when their views are conflicting. "We should make students aware that conflicts of interests exist" (Hodson & Farmer, 1992) and that conflict in what is considered the best solution will most likely occur in every technological context (Mulberg, 1992). It is important that stakeholders are consulted throughout the whole of the technological process.

The managerial stakeholder theory, ethical managerial stakeholder theory and stakeholder-agency theory are just a few versions of the debate over who has the right to have a say in the decision making and whose rights take precedence (Freeman, 1984). This is a debate that could and should be taken up by children. Who do they have to consider when they design a new product? Do they have to consider the people influenced during the manufacturing process (cleaners, classmates, teachers, etc.), those who pay for the product (investors/parents), those who use the product (end-users), those who have to see, hear and deal with the consequences of the product although they may not directly use it themselves, to name a few examples. We need to consider who is benefiting and at whose expense (Prime, 1997). If we do not consider negative consequences "we make the value statement that progress must be made at any cost and that financial gain is the major factor to be considered in technological advancement" (Prime, 1997, p.31).

Part of a technological activity should be to determine who is going to be affected and how the views of these people are going to be obtained. It may not always be possible to obtain these views, but being aware that all actions affect others is an important part of being a valued member of society.

Conclusion

The term stakeholder should be used in the new New Zealand technology curriculum. Teachers and/or students will need to determine who the stakeholders are and whether it is feasible or appropriate to canvas their views. In effect they would need to develop their own stakeholder theory. This process could be as simple or as complex as the teacher feels appropriate. It should be seen as a vital part of the technological process. The term 'stakeholder' eliminates confusion over the multitude of terms currently in use such as consumer, community, society, user, client, and people and helps to ensure consultation isn't trivialized but rather is a key part of the process. There appears to be a lot at stake if this term isn't understood or included in classroom practice.

Kerry Lee is senior lecturer in Technology Education at the Faculty of Education, University of Auckland, New Zealand.

References

Burns, J. (1991). Technology - What is it, and what do our students think of it? *The New Zealand Principal, 6*(3), 22-25.

Burns, J. (1997). Technology- Intervening in the world. In J. Burns (Ed.), *Technology in the New Zealand curriculum: Perspectives on practice* (pp. 15-30). Palmerston North: Dunmore Press.

Compton, V., & Harwood, C. (2003). Enhancing technological practice: An assessment framework for technology education in New Zealand. *International Journal of Technology and Design Education, 13*, 1-26.

Douglas, M., & McGregor, G. (2001). *Department handbook for implementing Year 11 technology for NCEA in 2002.* Wellington, New Zealand: Learning Media.

Elkington, J. (2004). Enter the Triple Bottom Line. In A. Henriques & J. Richardson (Eds.), *The Triple Bottom Line does it all add up? Assessing the sustainability of business and CSR* (pp. 1-16). London: Earthscan.

Fancy, H. (2006). Forward. In *The New Zealand Curriculum. Draft for consultation 2006* (pp. 3). Wellington, New Zealand: Learning Media.

Freeman, E. (1984). *Strategic management: A stakeholder approach.* Boston: Pitman.

Hendry, J. (2001). Missing the target: Normative stakeholder theory and the corporate governance debate. *Business Ethics Quarterly, 11*(1), 159-176.

Hendry, J. (2002). The principal's other problems: Honest incompetence and the specification of objectives. *The Academy of Management Review, 27*(1), 98-113.

Hodson, D., & Farmer, B. (1992). Technology education: The need for breadth and balance. *Delta, 46*, 31-39.

Jenkins, E. (1997). Technological Literacy: Concepts and Constructs. *Journal of Technology Studies, Spring/Summer,* 2-6.

Kaler, J. (2002). Morality and strategy in stakeholder identification. *Journal of Business Ethics, 39*(1/2), 91-100.

Kaler, J. (2003). Differentiating stakeholder theories. *Journal of Business Ethics, 46*(1) 71-83.

McVea, J., & Freeman, E. (2005). A names - and - faces approach to stakeholder management: How focussing on stakeholders as individuals can bring ethics and entrepreneurial strategy together. *Journal of Management Inquiry, 14*(1), 57-70.

Ministry of Education. (1995). *Technology in the New Zealand Curriculum.* Wellington: Learning Media.

Ministry of Education. (2006a). *Supplement to the New Zealand Curriculum - Draft for consultation 2006.* Wellington: Learning Media.

Ministry of Education. (2006b). *The New Zealand Curriculum - Draft for consultation 2006.* Wellington: Learning Media.

Mitchell, R., Agle, A., & Wood, D. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *The Academy of Management Review, 22*, 853-886.

Mongoven, A. (2003). Duties to stakeholders amidst pressures from shareholders: Lessons from an advisory panel on transplant policy. *Bioethics, 17*(4), 319-340.

Pacey, A. (1983). *The culture of technology.* Oxford: Blackwell.

Pretzer, W. (1997). Technology education and the search for truth, beauty and love. *Journal of Technology Education, 8*(2), 5-20.

Stables, K. (1997). Critical issues to consider when introducing technology education into the curriculum of young learners. *Journal of Technology Education, 8*(2), 1-15.

A Discussion of Past, Present, and Future Articulation Models at Postsecondary Institutions

Ron O'Meara, Teresa Hall, and Mindy Carmichael

Abstract

This article provides a synopsis of how articulation agreements serve postsecondary education institutions and their constituents, provides an overview on the types of agreements, and discusses some of the issues associated with development of these agreements. The following questions frame the narrative: As community colleges grew in number and format, what prompted the development of articulation agreements? What types of articulation agreements have been and are currently being developed? What are the incentives for either administrators or faculty to pursue development of articulation agreements?

Introduction

The growth in the number and type of articulation agreements and transfer arrangements between two- and four-year institutions during the past 100 years could be described as a work in progress. Procedures to move students progressively along the education continuum have become increasingly formal, yet the overriding objective has been to give students expanded access to learning opportunities at a reasonable cost. As a result, students, faculty, and administrators at community colleges and four-year institutions have usually experienced positive outcomes. Students, the key benefactor of these agreements, are offered new avenues of academic opportunity to pursue upon completion of their studies at the community college. Administrators at four-year institutions have access to a broader student population, thus experiencing growth in enrolled student numbers. Administrators at community colleges gain the opportunity to promote the articulated programs as pathways to bachelor degrees for students with the desire to transfer after graduation. Faculty are afforded insight into curricular content and trends at partnering institutions, giving impetus to integration of emerging issues or affirming the relevance of existing curricula.

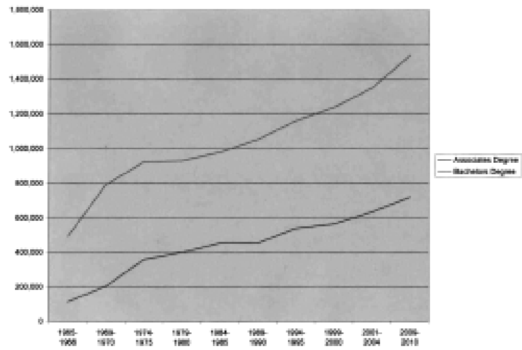
The Need for Establishing Formal Articulation Agreements

Transfer programs have been part of the academic landscape at the postsecondary level since the inception of the junior college in the 1900s. These early institutions were usually an extension of the local high school curriculum offering freshman- and sophomore-level college courses as well as advanced instruction in occupational and life skills, such as industrial arts or family and consumer sciences (Wattenbarger & Witt, 1995). In 1947, President Harry Truman's Commission report "Higher Education for American Democracy" concluded that community colleges could offer cost-effective alternatives for lower and middle class populations enabling completion of the first two years of college or university education and, additionally, providing occupational training for American workforce needs of the post - World War II economy (Young, 1996). The number of community colleges rapidly expanded as a result of state or local funding rather than federal initiatives and as a result, the number of associate's degrees conferred from community colleges grew rapidly, surpassing 100,000 per year in the mid - 1960s, and the trend is expected to continue as noted in Figure 1 (U.S. Department of Education, 2005).

Most community college students during the 1950s and 1960s sought lower-level college arts and science general education courses with the intent to transfer to a senior institution (Bryant, 2001; Cohen, 2001; Young, 1996). Student transfers to four-year institutions peaked in the 1960s, accounting for nearly two-thirds of community college students enrolled at that time (Kintzer & Wattenbarger, 1985). After this period of growth, transfer rates of students to four-year institutions steadily declined and bottomed out at 22 percent in 1984 and remain at this level today (Bryant, 2001).

Much of the reason for the decline in transfer rates was that the constitution of the student population at two-year degree granting institutions had evolved to follow the non-academic occupational training track rather than being the more traditional student seeking the bachelor's degree at another higher education institution after two years at the community college. Thus, while the number of associate degrees awarded in the United States consistently increased, within this data the percentage of occupational/technical program enrollees surpassed academic program enrollees in the mid 1970s.

Figure 1. Earned Associate and Bachelor's degrees, 1965–2004 with projections for 2010. Source: U.S. Dept. of Education, National Center for Education Statistics, Table 286 (2005).



An additional problem was that transfer arrangements were usually informal, often developed as a courtesy between regional institutions or as a cooperative endeavor between administrators. This exacerbated the transfer rate decline because students often lacked guidance on how to transfer courses, appropriate senior institutions for their skills/academic preparation, or career path selection (Menacker, 1975). The need for more formal arrangements, articulation agreements, was evident.

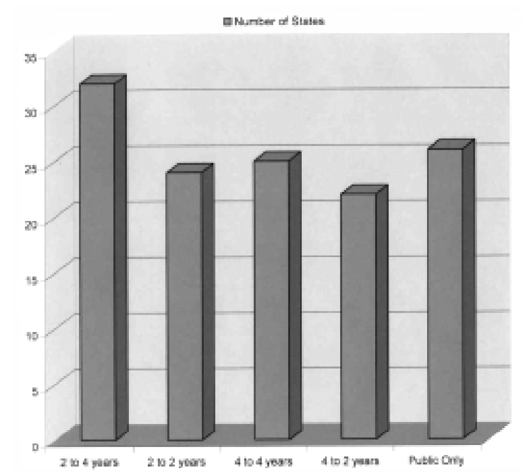
Articulation agreements have had a rather short history within the context of the two-year college movement. In 1971, four states simultaneously developed similar approaches to articulation; Florida launched the Florida Formal Agreement Plan, the Illinois Board of Higher Education approved an articulation/transfer plan, and Texas and Georgia adopted core curricula for their respective state colleges (Kintzer & Wattenbarger, 1985). By the end of the decade, a large number of states had endorsed some form of articulation or transfer agreement for students in two-year programs.

Current Articulation Models

Today, every state has some form of articulation or transfer program in place and, likewise, there are many ways to characterize these mechanisms for movement of students between academic programs (Ignash & Townsend, 2000, 2001; Kintzer & Wattenbarger, 1985). To distinguish between articulation and transfer programs, *articulation* is described as a formal collaborative agreement between education institutions that enables a student to complete a program of study at one institution and, using accumulated credits, attain a degree at another institution in a shorter period of time. There are those who further differentiate articulation as being vertical (progress to higher levels of academic achievement) or horizontal (internal transfer of credits within a system or at the same level at another institution), each having its place under the articulation heading (DeMott, 1999; Menacker, 1975). Transfer programs, which are more informal, acknowledge credits taken at one institution, not necessarily as part of a completed program or degree, that are subsequently accepted by another institution.

In a study evaluating the extent and strength of state-level articulation agreements, Ignash and Townsend (2001) found that 97 percent of the states responding to the survey had policies in place that supported the traditional two- to four-year transfer arrangement. Articulation between two-year colleges, between four-year colleges or universities, reverse transfers (four to two year programs), and agreements between public institutions were variations on this theme (see Figure 2). The researchers also found that 67 percent of responding states accepted associate degrees in the articulation agreements and 70 percent had distribution requirements for general education core courses within the state (p. 184).

Figure 2. Numbers of statewide articulation agreements. Adapted from Ignash & Townsend (2001).



Emerging trends in articulation indicate that the Tech Prep movement is having an impact in reshaping traditional agreement structures due, in part, to the requirements put forth by the Perkins Act of 1991 (Reese, 2002). The Act served to push states without firm articulation plans to develop plans to serve Tech Prep programs or risk losing federal funding. As an example of articulation across secondary and postsecondary systems, the 2 + 2 + 2 Tech Prep option's goal is to provide a seamless transition from high school to the community college technical degree, adding a twist with the last +2 component, which culminates in the conferral of a bachelor's degree from a college or university (Suba, 1997).

Bringing these diverse interests together to make the 2 + 2 + 2 alternative or any career-to-work program succeed is a challenge. In order to successfully develop agreements between secondary and postsecondary programs, a champion at one or more institutions involved in the process may be required. DeMott (1999) suggested that an individual coordinator serve as go-between or primary contact for the articulation process bringing administrative leaders, faculty, and curriculum planners together.

A typical 2 + 2 program consists of a student taking two years of courses at a community college and transferring them to a 4-year institution into a specific degree program. In theory, after transferring the student would have 2 years of coursework to complete to earn a bachelor's degree; however, in reality the length of time at the 4-year institution is closer to 2 + years. In comparison, a 2 + 2 + 2 program consists of approving specific courses taken in high school for coursework at the community college, reducing the time and courses needed to complete. The courses would then be articulated into a 4-year program for the completion of the final two years of study.

Other ways that articulation agreements have been constructed include block transfer of courses, experiential learning credits, dual credit programs and prorated audit systems. Instead of the traditional progression of students from two- to four-year institutions, reverse articulation (four-year to two-year), swirling (dual enrollment or taking courses at a community college and at a university concurrently or in an alternating fashion), public to private institutional articulation, and between four-year institutions are some examples. These are innovative ways to move students within the domain of postsecondary learning experiences.

At present, there appears to be a paradigm shift in the method and philosophy for student learning in the postsecondary education environment. This paradigm shift in higher education is occurring from an instructional paradigm to a learning paradigm (Barr & Tagg, 1995). The instructional paradigm can be described as the "sage on stage," and learning is dispensed or delivered solely by an instructor. The learning paradigm, on the other hand, is characterized by the "guide on the side." Learning is holistic and is focused on learning environments, experiences, and is student centered. To truly provide a broad array of formal education opportunities for students, education is being restructured with innovation, flexibility, and cooperative learning environments. Redefining what constitutes an articulation agreement is essential for change and progress to occur. In the end, the need for more effective use of increasingly limited resources such as faculty, classroom space, and laboratory equipment will drive the change process. Faculty and administrators with the foresight to take advantage of this dynamic situation in postsecondary education will reap the benefits early and have a voice in the shape of future agreements.

At the University of Northern Iowa (UNI), there have been over 330 articulation agreements written with all 15 community colleges within the state of Iowa. The two types of articulation agreements used at UNI are block transfer of courses from the community college to the university, or a program that is assessed on a course-by-course basis. The total combined transfer credit in college parallel education and equivalent UNI credit for technical-level work may not exceed 65 semester hours. All of the articulation agreements written at UNI are four pages in length. The first page of the agreement includes general information stipulating that the agreements are based on an analysis of program requirements as stated in the community college and university catalogs. In addition, the first page of the agreement states the names of the representatives that developed the articulation agreement and has signatures of approval for both cooperating institutions. Page two of the agreement contains the specific course-by-course outline of the agreement for the remaining requirements to complete a bachelor's of science degree as outlined in Figure 3.

Articulation Agreement
XYZ Community College: A.A.S. Program – Manufacturing Technology
UNI: B.S. Manufacturing Technology - Automation and Production, Design, or Metal Casting

The remaining requirements for students completing the A.A.S. Program in Manufacturing Technology seeking to complete a B.S. in Manufacturing Technology are stated below. All courses in the Manufacturing Technology major are listed except for the Liberal Arts Core and University Elective requirements. Transferring students must select one or more emphasis areas in the Manufacturing Technology program. Courses marked with an “X” are remaining requirements in the major.

Math/ Science.............15 hours Block Transfer _____ Course by Course __X__

__X__ (4 SH) 800:046 Elementary Analysis or 800:048 Condensed Calculus or 800:060 Calculus I

__X__ (3 SH) 800:072 Intro. to Statistical Methods

__X__ (4 SH) 860:044 General Chemistry I

__X__ (4 SH) 880:054 Physics I or 880:130 Physics I for Science and Engineering

See Recommendations (4th page) for Math/Science courses that could be taken at XYZ Community College to count towards the program.

Technical Core............38 hours Block Transfer _____ Course by Course __X__

__X__ (2 SH) 330:008 Manufacturing Materials & Processes – Metals

__X__ (2 SH) 330:009 Manufacturing Materials & Processes – Non-metals

_____ (3 SH) 330:017 Computer Aided Design & Drafting

_____ (4 SH) 330:024 Technical Drawing & Design I

_____ (3 SH) 330:060 Fundamentals of Automated Mfg.

__X__ (1 SH) 330:112 Industrial Projects I

__X__ (3 SH) 330:132 Applied Metallurgy

__X__ (3 SH) 330:142 Statistical Quality Control

__X__ (3 SH) 330:143 Managing Manufacturing Systems

__X__ (3 SH) 330:170 Statics and Strengths of Materials

__X__ (3 SH) 330:172 Industrial Materials

__X__ (1 SH) 330:179 Cooperative Education

__X__ (3 SH) 330:187 Applied Industrial Supervision & Management

__X__ (3 SH) 330:196 Industrial Safety

__X__ (2 SH) 330:197 Industrial Projects II

Emphasis Areas...........22 hours Block Transfer _____ Course by Course __X__

Automation & Production

_____ (3 SH) 330:014 Machining Principles

_____ (3 SH) 330:113 Manufacturing Tooling

__X__ (3 SH) 330:145 Work Measurement & Improvement

_____ (3 SH) 330:146 Advanced Numerical Control Systems

_____ (3 SH) 330:147 Computer-Aided Manufacturing

_____ (3 SH) 330:177 Advanced Manufacturing Processes

_____ (4 SH) 100 - level electives **(see below)**

Design

_____	(2 SH) 330:106 Geometric Dimensioning & Tolerancing
_____	(3 SH) 330:113 Manufacturing Tooling
X	(3 SH) 330:122 Advanced Modeling & CAD
X	(3 SH) 330 :135g Design for Manufacturing
X	(3 SH) 330:148 Machine Design
X	(3 SH) 330:155g Finite Element Analysis
_____	(5 SH) 100 - level electives **(see below)**

Metal Casting

X	(2 SH) 330:040 Fundamentals of Metal Casting Engineering Technology
X	(3 SH) 330:134 Molding Practices in Metal Casting
X	(3 SH) 330:136 Melting Practices in Metal Casting
X	(3 SH) 330:137 Tooling Practices in Metal Casting
X	(3 SH) 330:141 Foundry Research Practicum
X	(3 SH) 330:192 Non-Destructive Evaluation of Materials/Scanning Electron Microscopy
_____	(5 SH) 100 - level electives **(see below)**

Choose electives from any 100-level course in the Industrial Technology Department or 150:113; 150:119; 48C:141; 48C:173; 620:105; 650:142; 800:043; 980:102

Figure 3. Sample block transfer agreement.

Page three of three of the articulation agreement shows the breakdown of hours required for the major at the university, explains the hours accepted from the community college, and outlines the remaining hours for the degree program for the different emphases. It also includes some general recommendations for specific courses students could take at the community college to further reduce the remaining hours at the university as outlined in Figure 4:

Articulation Agreement
XYZ Community College: A.A.S. Program – Manufacturing Technology
UNI: B.S. Manufacturing Technology - Automation and Production, Design, or Metal Casting

Total Semester Hours (SH) for a B.S. in Manufacturing Technology

Total for Major	75 SH
Liberal Arts Core	38 SH
Total University Electives	13 SH
Total Hours, Bachelor of Science	126 SH

Semester Hours Accepted from ICCC

Math / Science	0 SH
Technical Core	11 SH
Liberal Arts Core	0 SH
Emphasis Area:	
Automation & Production	19 SH
Design	10 SH
Metal Casting	5 SH
University Electives	13 SH
Total	43 (AP), 34 (D), 29 (MC) SH *depending on selected emphasis area*

Remaining Hours at UNI – select one of the following emphasis areas:

Automation & Production (AP)	45 SH
Liberal Arts Core	38 SH
University Electives	0 SH
	83 SH
Design (D)	54 SH
Liberal Arts Core	38 SH
University Electives	0 SH
	92 SH
Metal Casting (MC)	59 SH
Liberal Arts Core	38 SH
University Electives	0 SH
	97 SH

Recommendations:

The following courses will reduce the number of hours needed to graduate:

1. If the student takes MAT-125 Principles of Statistics 1 as an elective, this will substitute for 800:072 in Category 1C in the LAC. MAT-166 Calculus and Analytic Geometry 1 will substitute for 800:060 in Category 1C in the LAC as well.
2. Taking the following optional courses in the A.A.S: ENG-101 & ENG-102 English 1 and 2 will meet 620:005 College Reading and Writing requirement 1A, PSY-151 General Psychology will meet 400:001 category 5B, SOC-121 Principles of Sociology will meet 980:001 category 5A.
3. PHY-157 General Physics I or PHY-161 Physics 1 can be used to satisfy requirements in the Math/Science Core of the Manufacturing Technology program in addition to satisfying the Liberal Arts Core Category 4B (includes lab requirement).
4. CHM-133 General Chemistry 1 or CHM-121 & CHM-122 General Chemistry & General Chemistry lab can be used to satisfy the Math/Science Core of the Manufacturing Technology program in addition to satisfying the LAC 4B (includes lab requirement). If a student takes both the Physics and Chemistry courses only one of these courses can be used in the Liberal Arts Core Category 4B but the other course can be applied to University Electives.

Figure 4. Sample block articulation agreement.

The fourth page of the articulation agreement includes approximately nine general advisory statements for transfer students. The advisory statements consist of items such as minimum grade requirements for admission to UNI, maximum number of approved technical courses accepted by UNI, and other general provisions for completing a four-year degree.

Incentives to Pursue Articulation

The reasons to make articulation agreements depend largely on the expectations of the participants and actual or perceived benefits derived from the process. The most important reason for developing articulation agreements is to improve access: giving students more options and smoothed pathways to achieving degree completion. This is also relevant to the central mission of the community college system - to provide service to local citizenry in the form of occupational or vocational training, remedial education, college preparatory courses, and specialized community service (McDuffie & Stevenson, 1995; Wattenbarger & Witt, 1995). Articulation agreements complement traditional community college roles by providing greater access to education in addition to their already established open-door admission policies, lower cost per credit, ability to live at home while working on a degree, and more extensive academic advisory support (Bryant, 2001; Cohen, 2001). Administrators can successfully market articulation agreements as another example of service to their constituency.

Altruistic incentives aside, the ability to increase the productivity of staff, faculty, and classroom or laboratory resources is a strong motivator for administrators trying to stretch shrinking budgets. Administrators at two- and four-year institutions seeking articulation agreements can benefit through improved student retention rates and cost savings by focusing course offerings from their respective institutions (Reese, 2002). Having one institution offer core classes or specialized education while the partnering institution supports prerequisite or capstone courses in a discipline can conserve effort, alleviate classroom space problems and improve faculty productivity by elimination of duplicate course offerings.

Faculty who participate in the development of articulation agreements can gain valuable insight into the methods, content, and efficacy of cohort programs. The collaborative environment required to make good articulation agreements opens the door for the exchange of ideas and mutually beneficial program development. Rather than expecting administrators to shepherd the articulation agreement through the system, it is important that faculty take responsibility for the process. As one of seven guiding principles for assessing the strength of state articulation agreements, Ignash and Townsend (2001) argued that faculty are the best judges of the quality in the curriculum. “Faculty from both two-year and four-year institutions have primary responsibility for developing and maintaining articulation agreements. As the content area experts, faculty should develop articulation agreements” (p. 178). Faculty ultimately determine the content, focus, and desired outcomes of the curriculum and, therefore, are in the best position to determine equivalency in order for the articulation process to be successful for students and institutions alike.

Conclusion

Building ties between academic institutions through the articulation agreement is a growing need in society where individuals who have completed degrees are not only desired, but also required. Universities, colleges, community colleges, and even high schools have a vested interest in the future growth of programs that offer less resistance to transition between successive levels of education. The need for a well-defined and accessible system for students who either elect to take or must take an alternative path to the bachelor’s degree is apparent. Institutions that lag behind or choose to ignore this growing trend of articulated programs, do so at their own risk.

This is not to say that the articulation agreement process or its outcomes are without problems, but are minor deterrents when compared to the extensive benefits derived by students, faculty, administrators, institutions, and, ultimately, national educational achievement. We believe that articulation has a role to play in future iterations of higher education. The form and expected outcomes depend on faculty, institutions, and government mandates. The needs of students and ultimately society, however, will determine how this comes to pass.

Dr. Ronald O'Meara is currently an Associate Professor in Industrial Technology and program coordinator of the Manufacturing Technology program at the University of Northern Iowa in Cedar Falls, Iowa. He is a member of Pi Chapter of Epsilon Pi Tau.

Mindy Carmichael is currently the Director of Education for the Associated General Contractors of Iowa.

Dr. Teresa Hall is Professor and Head of the Engineering Technology and Management Department at South Dakota State University. She is a member of Pi Chapter of Epsilon Pi Tau.

References

Barr, R. B., & Tagg, J. (1995). From teaching to learning: A new paradigm for undergraduate education. *Change,* 11, 13-25.

Bryant, A. N. (2001). ERIC review: Community college students: recent findings and trends. *Community College Review, 29* (3).

Cohen, A. M. (2001). Governmental policies affecting community colleges: A historical perspective. In B. K. Townsend and S. B. Twombly (eds.), *Community colleges: Policy in the future context* (p. 3-22). Westport, CT: Ablex Publishing.

DeMott, J. (1999). Seven steps to articulation success. *High School Magazine, 6*, 22-24.

Ignash, J. M., & Townsend, B. K. (2000). Evaluating state-level articulation agreements according to good practice. *Community College Review, 28* (3), 1-21.

Ignash, J. M., & Townsend, B. K. (2001). Statewide transfer and articulation policies: Current practices and emerging issues. In B. K. Townsend and S. B. Twombly (eds.), *Community colleges: Policy in the future context* (p. 173-192). Westport, CT: Ablex Publishing.

Kintzer, F. C., & Wattenbarger, J. L. (1985). *The articulation/transfer phenomenon: Patterns and directions.* Washington, DC: American Association of Community and Junior Colleges.

Menacker, J. (1975). *From school to college: Articulation and transfer.* Washington, DC: American Council on Education.

McDuffie, L., & Stevenson, J. (1995). The American community college: providing pivotal points of progress for students. *College Student Journal, 29,* 264-269.

Reese, S. (2002). Articulation agreements: ease the way. *Techniques, 77,* 37-38.

Suba, T. (1997). Some basics for tech prep articulation. *Tech Directions, 56,* 14-15.

U.S. Department of Education (2005). Earned degrees conferred: Projections of education statistics to 2011. *Higher Education General Information Survey* (HEGIS), Table 286. Washington, DC: National Center for Education Statistics.

Wattenbarger, J. L., & Witt, A. A. (1995). Origins of the comprehensive community college. *Community College Journal of Research and Practice, 19,* 565-570.

Young, R. J. (1996). Legacy of the post-WWII growth years for community college leadership programs. *New Directions for Community Colleges, 95,* 5-14.

Ethical Issues in Technology Education in Taiwan

Kuen-Yi Lin

Introduction

A significant trend in technology education has shown internationally widespread acceptance with the increasing needs of developing students' technological literacy on both the elementary and secondary level from manual training to basic competency. Therefore, more and more countries have developed their national technology standards in order to enhance students' technological literacy.

Standards of Technology Education in Taiwan

As standards have developed in technology education around the world, including countries such as the United States, the United Kingdom, Australia, New Zealand, and others, Taiwan is no exception. The standards of technology education in Taiwan can be divided into two different areas: (1) basic competency in developing standards of technology education for elementary and junior high schools (like Australia), and (2) developing standards of technology education in senior high schools (like the United States). No matter which area of standards is adopted, the major purpose of standards in technology education is to develop students' basic technological literacy on different educational levels. Therefore, the standards of technology education in Taiwan can be described as follows:

1. The elementary and junior high level

With the trends of educational reform, Taiwan has made many changes at the elementary and junior high levels. For the purpose of coherence and integration, a so-called "nine-year joint curriculum" was created. There are two major categories of competency indicators in technology education in the nine-year joint curriculum, which includes both "Technological Development" and "Design and Making of Products."

(1) Technological Development

The three levels of competency indicators in the nine-year joint curriculum are shown in Table 1.

(2) Design and Making of Products

There are two different levels of competency indicators in the nine-year joint curriculum as shown in Table 2.

2. The senior high school level

The recent reform in technology education at the senior high school level does not follow the trend of developing competency indicators in the nine-year joint curriculum. The reforms follow the form of content standards like that of the United States. The new temporary standards in technology education can be divided into two parts:

(1) Standards of the core course in technology education

In order to make sure that senior high students can possess the same basic competency, the Department of Education decided to formulate the common core curricula for senior high schools, including high schools and vocational-technical schools. Technology education was, therefore, also an important subject in the formulation of the common core curricula, and its standards are listed in Table 3.

(2) Standards of advanced and optional courses in technology education

In addition to the standards of core courses in technology education as mentioned previously, there are six additional standards of advanced and optional courses in technology education:

- Communication Technology,
- Construction Technology,
- Manufacturing Technology,
- Transportation Technology,
- Energy and Power Technology,
- Technology and Engineering.

Level	Grades	Category	Competency Indicators
1	3 & 4	The Nature of Technology	1. To understand the importance of technology in daily life. 2. To know the characteristics of technology.
		Technology	1. To feel the mutual relationships between personal life and Society and technology. 2. To know the products in common use in our daily life.
2	5 & 6	The Nature of Technology	1. To know the classification of technology. 2. To understand machines and tools, materials, and energy.
		The Evolution of Technology	1. To know the technology in the era of agriculture. 2. To know the technology in the era of industry. 3. To know the technology in the era of information. 4. To know the internal and overseas invention and innovation in technology.
		Technology and Society	To understand the traffic and leisure facilities in common use in the community.
3	7-9	The Nature of Technology	1. To understand the relationship of science, technology, and society. 2. To understand the relationship of science and technology. 3. To understand the relationship of science, technology, and engineering.
		The Evolution of Technology	1. To understand the development of technology in Taiwan through the technological products in daily life. 2. To understand the trends of technological development. 3. To have their own viewpoints about the development of technology.
		Technology and Society	1. To understand different kinds of technological industry. 2. To know the mutual relationship between the development of industry and technology. 3. To know related occupations in technology. 4. To know educational and training approaches in technology. 5. To realize the relationship between personal development in life and technology.

Source: Department of Elementary Education, (n. d.).

Table 1. Competency Indicators in Technological Development

Ethical Issues in Technology Education

Over the past several years there has been a considerable amount of professional pressure, and numerous position papers expressing a need for technological ethics in technology education. As a society experiences the trends of globalization and advanced technology, there is an increasing need to discover what people in the technological society should understand regarding new issues of technological ethics. For example, ethics and ethical decision making have become increasingly important as technology has permeated the workplace (Hill & Womble, 1997). In other words, to keep pace with change in society, new ethics have been suggested to help advance technological literacy by highlighting the relationships among humans, the environment, and technology (DeVore, 1980, 1991).

Reed, Hughes, Presley and Stephens (2004) mentioned that “a great deal of the technology education literature regarding ethics stress the need for teachers to include the social context inherent in science and technology studies (STS)” (p.171). In addition to the topic of STS, environment pollution, labor issues, nonrenewable energy sources, medical care for the aged population, and technological control of the

Level	Grades	Competency Indicators
1	5 & 6	1. To utilize thinking, brainstorming, and concept mapping in developing creativity and expressing a person's ideas in changing products. 2. To use many different ways of thinking, especially about function and shape in changing things. 3. To know and design the basic shape. 4. To understand the process of making prototypes.
2	7-9	1. To read both illustrations and manuals of technological products. 2. To use language, images, written words, pictures, drawings, and real items to express creativity and ideas. 3. To understand usable resources and analytic jobs in designing. 4. To design the procedure of solving problems. 5. To simulate the process of mass production. 6. To execute, test, and adjust a product during the process of making it or at the end of making it.

Source: Department of Elementary Education, (n. d.).

Table 2. Competency Indicators in Design and Making of Products

environment have been mentioned as content foci for ethics in technology education (Hill & Dewey, 2001; Hendricks, 1996). Reed and colleagues (2004) were curious about how many ethical topics were addressed in technology education textbooks. They used the 20 areas in the ITEA Standards for Technological Literacy for textbook vendors to identify in which of the categories their curriculum materials teach about ethics. Seventeen of the 20 areas mentioned some ethical issues.

This study focused on the junior high level, and for it a questionnaire was developed employing the same 17 competency indicators in Technology Education that were used in the Reed, Hughes, Presley, and Stephens (2004) study. In order to understand the technology teachers' viewpoints about ethical issues, technology teachers were selected as the participants instead of textbook vendors. In sum, this study attempted to clarify some of the issues facing technology education in Taiwan and then to compare the results of this research with findings in the United States.

Purposes of the study

Specifically the study sought the following:

1. To explore the ethical issues in technology education in Taiwan through a survey of technology teachers in junior high schools.
2. To distinguish the differences regarding ethical issues in technology education between Taiwan and the United States.
3. To generalize the major ethical issues in technology education and offer some suggestions to Taiwanese technology teachers and others teaching ethics in technology education.

Methodology

In order to achieve the purposes of this study, a questionnaire survey was employed. The participants, instruments and procedure are explained next.

Participants

Since the junior high technology teachers understand their students better than others, the major participants of this study were junior high technology teachers. However, the time for the "Living Technology" curriculum in junior high schools in Taiwan was sometimes utilized in teaching Natural Science curriculum. For that reason, the researcher selected junior high technology teachers according to their actual teaching situations. The participants were not randomly selected from a population. A total of 50 junior high technology teachers were invited to participate in this study in order to analyze ethical issues in technology education in Taiwan.

Category	Sub/category	Content Standards
The Nature of Technology	The Meaning of Technology	1. To explore the nature and meaning of technology, and its relationships with life, society, and culture. 2. To discuss the problems of ethics, morals, and laws in technology.
	The Evolution of Technology	To explore the evolution and development of technology.
	The System of Technology	To explore the system, method, management, evaluation, and impact of technology.
Technology, Science, Environment	The Utilization of Resources	To discuss the situation of utilizing resources in the and development of technology.
	Technology and Science	1. To explore the relationship and differences between science and technology. 2. To solve technological problems by using scientific principles, technological knowledge, and engineering concepts.
	The Impact of Technology in the Environment	To discuss the problems of environmental change and pollution through technology, and to build the conception of environmental protection.
Technological World	The Scope of Technology	To understand the scope and classification of technology.
	The Outline of Technology	1. To understand the mass media, applications, services and their relationships with life in communication technology. 2. To understand the materials, methods, process, and their relationships with life and environment in construction technology. 3. To understand the materials, methods, products, and their relationships with life in manufacturing technology. 4. To understand carrying machines, logistics, systematic planning, and their relationships with life in transportation technology. 5. To understand the categories, development, application, the setting of power supply, and their relationships with life in energy. 6. To understand the situation, trends, influences of bio-related technology (such as medical treatment and agriculture) and other emerging technologies.
Creative Design and Making of Products	The Meaning, Method, and Procedure of Technology	To become aware of problems and think about the methods and steps in the daily life; furthermore, to generate many solutions and choose the best solution in order to achieve the purpose of innovation.
Creative Design and Making of Products	The Planning and Making of the Design of Products	1. To utilize written words, diagrams, engineering drawings, computer drawings, or other methods to express creativity and ideas clearly, and to arrange the process of complete production. 2. To display creativity, ideas, and design in making real objects.

Source: Department of Secondary Education, (n. d.).

Table 3. Standards in Technology Education in the Formulation of the Common Core Curricula

Instrument

The major instrument used in this study was called "The Importance of Ethical Issues in Technology Education Questionnaire." It contained two main parts: "Personal Data" and "Ethical Issues in Technology Education." The personal data included gender of teacher, school name, and major teaching grade. The ethical issues in technology education component included the 17 competency indicators in the nine-year joint curriculum. Participating technology teachers were asked to rate the importance of competency indicators in combination with ethical concerns by using the same 5-point scale ranging from "very important" to "very unimportant."

The creation of the questionnaire emphasized reliability and validity. The reliability of the questionnaire is demonstrated in Table 4. It indicates that each part and the whole of questionnaire was greater than .80. The content validity of the questionnaire was determined by one professor and two technology teachers who specialize in technology education. The instrument was designed particularly for this study.

Table 4. The reliability of the questionnaire

Questionnaire	Cronbach
Part 1: Technological Development	.8449
Part 2: Design and Making	.8370
Whole	.9101

Procedure

The researcher reached every participant through e-mail with a cover letter and an electronic questionnaire. Follow-up e-mail was sent to non respondents at 7- to 10- day intervals. These approaches were used to acquire the highest possible participation in the study. Forty of the 50 junior high technology teachers returned their surveys, resulting in an 80 percent return rate. Because the participants were invited by the researcher, any generalization beyond the persons who participated in the study should be made with caution. Information collected from the respondents' completed questionnaires were coded and analyzed using SPSS.

Results and Discussion

The Analysis of Participants' Data

There were 40 junior high technology teachers involved in this study. Among them, 25 are male teachers, and 15 are female (see Table 5). Twenty-four technology teachers lived in the north of Taiwan, 7 lived in the middle of Taiwan, and 9 lived in the south of Taiwan (Table 5). Furthermore, 14 technology teachers taught the seventh grade, 14 technology teachers taught eighth grade, and 12 technology teachers taught the ninth grade. There is no doubt that the selection of technology teachers contains different characteristics for the purpose of avoiding possible error.

Ethical Issues in Technology Education in Taiwan

The first research question focused on how junior high technology teachers view the importance of various competency indicators of ethics. The results of this analysis are shown in Table 6.

1. Nine important ethical issues are generated in technological development

According to the results of analysis, nine important ethical issues (*M* > or = 4.0) in technological development are "to realize the trend of technological development (*M* = 4.39, *SD* = .82)," "to understand the development of technology in Taiwan through the technological products in daily life (*M* = 4.38, *SD* = .68)," "to understand the relationship of science and technology (*M* = 4.34, *SD* = .75)," "to realize the relationship between personal development in life with technology (*M* = 4.21, *SD* = .74)," "to realize the related occupation in technology (*M* = 4.18, *SD* = .73)," "to understand the relationship of science, technology and engineering (*M* = 4.11, *S D*= .73)," "to show their own viewpoints about the development of technology (*M* = 4.11, *SD* = .99)," "to understand the relationship of science, technology and society

Table 5. Participants' data

	Gender		Location			Teaching Grade		
	Male	Female	North	Middle	South	7	8	9
N	25	15	24	7	9	14	14	12

Items	M	SD	Rank
Part 1: Technological Development			
1. To understand the relationship of science, technology, and society.	4.05	.80	8
2. To understand the relationship of science and technology.	4.34	.75	3
3. To understand the relationship of science, technology, and engineering.	4.11	.73	6
4. To understand the development of technology in Taiwan through the technological products in daily life.	4.38	.68	2
5. To know about trends in technological development.	4.39	.82	1
6. To share their own viewpoints about the development of technology.	4.11	.99	6
7. To know about different kinds of technological industries.	3.89	.80	10
8. To understand the mutual relationship between the development of industry and technology.	4.00	.70	9
9. To know about related occupations in technology.	4.18	.73	5
10. To understand educational and training approaches in technology.	3.87	.99	11
11. To realize the relationship between personal development in life and technology.	4.21	.74	4
Part 2: Design and Making			
1. To read both illustrations and manuals of technological products.	4.21	.96	3
2. To use language, images, written words, pictures, drawings, and real items to express creativity and ideas.	4.45	.76	1
3. To understand usable resources and analytic jobs in designing products.	4.21	.78	3
4. To design the procedure of solving problems.	4.45	.76	1
5. To simulate the process of mass production.	3.45	.95	6
6. To execute, test, and adjust a product during the process of making it or at the end of making it.	4.05	.98	5

Table 6. The Analysis of Ethical Issues in Technology Education

(*M* = 4.05, *SD* = .80),” and “to realize the mutual relationship between the development of industry and technology (*M* = 4.00, *SD* = .70).” Therefore, there are nine important ethical issues in technological development according to technology teachers’ opinions in Taiwan. In other words, if technology teachers want to teach ethical issues in technology education, they can plan either learning content or activities when they are teaching about technological development in a course on technology education.

2. Five important ethical issues are generated in design and making of products

In contrast, according to the results of analysis, the most important ethical issues (*M* > or = 4.0) in design and making are “to use the language, images, written words, pictures, drawings, and real items to express creativities and ideas (*M* = 4.45, *SD* = .76),” “to design the procedure of solving problems (*M* = 4.45, *SD* = .76),” “to understand usable resources and analytic jobs in designing products (*M* = 4.21, *SD* = .78),” “to read the illustration of combination and manual of technological products (*M* = 4.21, *SD* = .96),” and “to execute, test, and adjust a product during the process of making it or at the end of making it (*M* = 4.05, *SD* = .98).”

In light of that, there are five important ethical issues in the design and making of a product, according to technology teachers in Taiwan. Therefore, if technology teachers want to teach ethical issues in technology education, they can also incorporate such content or activities when they are teaching about product design and the making of products within technology education.

3. The most important issue suggested in this study corresponds with the literature

According to the results shown in Table 6, one of the most important issues was “to design the procedure of solving problems (*M* = 4.45, *SD* = .76)” in the standards of technology education in the nine-year joint curriculum in Taiwan. However, Hill and Womble (1997) mentioned that ethics and

Content Standards in United States	Competency Indicators in Taiwan: 1. To understand the relationship of science, technology, and society	2. To understand the relationship between science and technology	3. To understand the relationship of science, technology, and engineering	4. To understand the development of technology in Taiwan through the technological products in daily life	5. To know about trends in technological development	6. To share their own viewpoints about the development of technology	7. To understand the mutual relationships between the development of industry and technology	8. To realize the related occupation in technology	9. To understand the relationship between personal development in life and technology	10. To read both illustrationss and manuals of technological products	11. To use language, images, written words, pictures, drawings, and real items to express creativity and ideas	12. To understand usable resources and analytic jobs in designing products	13. To design the procedure of solving problems	14. To execute the test and adjust of product during the process of making it or at the end of making it
1. Characteristic and scope of technology														
2. Core concepts of technology										+	+	+	+	+
3. Relationships among technologies and connections between technology and other fields	+	+	+				+							
4. Cultural, social, economic, and political effects of technology									+					
5. The effects of technology on the environment														
6. The role of society in the development and use of technology				o	o	o								
7. The influence of technology on history														
8. Design											+	+	+	
9. Problem Solving										+	+	+	+	
10. The impacts of products and systems							o			+				
11. Medical								+						
12. Agricultural and biotechnology								+						
13. Energy and transportation								+						
14. Information and communication								+						
15. Transportation								+						
16. Manufacturing								+						
17. Construction								+						

NOTE: + high relationship, o low relationship.

Table 7. The Comparison of Ethical Issues in Technology Education

ethical decision making have become increasingly important as technology has permeated the workplace. Junior high technology teachers in Taiwan had the same viewpoints, and how to teach ethical decision making in the procedure of problem solving should be emphasized.

4. The most insignificant issues might be hard to incorporate with ethics

According to the results shown in Table 6, the most unimportant issue was "to simulate the process of mass production (M = 3.45, SD = .95)" in the standards of technology education in the nine-year joint curriculum in Taiwan. The main reason for this result might be that it is difficult to incorporate ethical considerations into the process of mass production.

5. There were no significant differences in the views of technology teachers with different backgrounds

Beyond the descriptive analysis of the questionnaire, a t-test and ANOVA also were used in comparing the differences in the views of technology teachers with different backgrounds. The factors of gender, teaching grade, and teaching area were insignificant in terms of technology teachers' views about the importance of incorporating competency indicators for ethics in technology education in Taiwan.

6. Similarities and Differences between Taiwan and the United States

The results in Taiwan (Table 6) can be compared to those seen in the United States (Reed et al., 2004). As the matrix results in Table 7 show, the lack of inclusion of ethical issues related to the "Characteristic and scope of technology," "The effects of technology on the environment," and "The influence of technology on history" should be addressed in the future.

Conclusions

According to the previous analysis and discussion, the following conclusions can be stated:

1. *Nine ethical issues in technological development and five ethical issues in design and making of products can be the focal point for ethics in technology education in Taiwan.*
2. *There are no significant differences concerning the inclusion of ethical issues in technology education between Taiwan and the United States.*

According to the results of this study, technology teachers do recognize that ethical issues are important in technological development and the design and making of products. The result of this study can be a beginning point for developing effective approaches for the teaching and learning of ethical issues in technology education. Success in this venture will result in students being much more savvy about the ethical dimensions of modern technology; they will also be able to operate more effectively as both workers and citizens in the future.

Dr. Kuen-Yi Lin is a researcher in the Center for Teaching Development at the National United University in Taiwan. He has been working as a research scholar in the Department of Design and Industry at San Francisco State University.

References

Department of Elementary Education (n. d.). *Nine-year joint curriculum*. Retrieved on December 1, 2004, from http://www.edu.tw/EDU_WEB/Web/EJE/index.htm/

Department of Secondary Education (n. d.). *The formulation of the common core curricula of senior high schools, comprehensive high schools and vocational-technical schools*. Retrieved on December 1, 2004, from http://www.edu.tw/EDU_WEB/Web/HIGH-SCHOOL/index.htm/

DeVore, P. W. (1980). *Technology: An introduction*. Worcester, MA: Davis Publications, Inc.

DeVore, P. W. (1991). Technological literacy: The evolving paradigm. In M. J. Dyrenfurth & M. R. Kozak (Eds.), *Technological literacy* (pp. 251-279). Peoria, IL: Glencoe/McGraw-Hill.

Hendricks, J. L. (1996). Technology-social and interpersonal interaction. In R. L. Custer & A. E. Wiens (Eds.), *Technology and the quality of life* (pp. 321-344). Peoria, IL: Glencoe/McGraw-Hill.

Hill, R. B., & Dewey, G. (2001). Moral and ethical issues related to appropriate technology. In R. C. Wicklein (Ed.), *Appropriate technology for sustainable living* (pp. 78-91). Peoria, IL: Glencoe/McGraw-Hill.

Hill, R. B., & Womble, M. N. (1997). Teaching work ethic: Evaluation of a 10-day unit of instruction on work ethic, work attitudes, and employability skills. *The Journal of Education Opportunity, 16*(1), 57-79.

Reed, P. A., Hughes, A., Susan, P., & Stephens, D. I. (2004). The status of ethics in technology education. In R. B. Hill (Eds.), *Ethics for citizenship in a technological world* (pp. 163-186). Peoria, IL: Glencoe/McGraw-Hill.

Operating a Successful PowerTech Creativity Contest

Jon-Chao Hong, Chan-li Lin, and Ya-ling Lin

Abstract

To help cultivate future talent for creating technology, the PowerTech Youth Creativity Contest was first held in 2000 by the Taiwan Creativity Development Association (TCDA) and the National Taiwan Normal University (NTNU). It has since been organized regularly on a yearly basis, with the number of contending teams growing from 78 in the first year to 414 in 2006 (3-4 members each team). The categories have been extended from the elementary school level to include junior high school categories. The activity design adopts the project-based learning approach and aims to develop important technological creation abilities for students, particularly with respect to knowledge application, psychomotor skills, and creative thinking in which the planning ability, imagination, analytical skill, and implementation ability will be developed, and some affective domains such as persistence, high regard for efficiency, quality improvement ability, and teamwork spirit will be cultivated through project competition and realization.

The purpose of this article is to describe the operation principles behind the PowerTech contest from four different dimensions: (1) contest design and its rationale, (2) contest promotion which includes the application of information technology (IT), and the social resource identification and application. It is hoped that the discussion of this article will be valuable as a referential basis to organizers of similar activities.

Introduction

Education reform is a necessary means to the enhancement of national competitiveness, including intra-institutional or extra-institutional educational reform measures aimed at equipping learners with creative abilities or problem – discovering and solving skills. The ability to create technology, in particular, helps lay the foundation for national competitiveness. This is why the cultivation of technological - creating abilities in the younger generations has always been among the top priorities of domestic educational reform measures. In light of this, technology educators too should strive to broaden and deepen their effort to create technological ability in young students.

According to the investment theory of creativity by Sternberg (1995), creativity requires a confluence of six distinctive resources: intellectual abilities, knowledge, thinking styles, personality, motivation, and environmental context. In other words, in order to create effectively, individual creators must possess sufficient domain knowledge and realize their full intellectual potential. To help technology take root, educators need to devise a group activity and a mechanism to involve students and encourage them to explore technological inventions. This paper therefore focuses its discussion on the operations of the PowerTech Youth Creativity Contest (henceforth PowerTech Contest) from the group activity-mechanism perspective.

The Rationale of PowerTech Contest

Sternberg (1985) developed a triarchic theory of intelligence, highlighting the individual differences in intelligence and dividing human intelligence into analytical, creative, and practical intelligences. These are described as follows: (1) analytical intelligence includes the ability to analyze, compare and contrast, evaluate, explain, judge, and criticize, (2) creative intelligence includes the ability to create, design, invent, imagine, and suppose, and (3) practical intelligence includes the ability to use, apply, implement, employ, and contextualize.

In other words, technological creation should be a comprehensive embodiment of a pool of integrated abilities, including knowledge application, practical intelligence, thinking ability, and action taking (Magee, 2005). Taiwanese students in general perform very well in knowledge memorization and reasoning, but they are rather weak in knowledge application and innovation. Regarding practical intelligence, the majority of the students in Taiwan are lacking in hands-on experiences. Many school assignments that require hands-on practice are often done by parents. In terms of thinking ability, the current constructivist teaching approaches in Taiwan have led to a general lack of plurality and flexibility among students, particularly with respect to their problem-discovering and problem-solving abilities. The situation is worse with elementary school pupils because the younger the age, the more easily bored the students become. This shows that domestic students in general lack the abilities to implement and complete a task.

Given this background, many nationwide contests to create technologies have based their contest design on the successful development of such abilities as knowledge application, pluralistic and flexible thinking, practical intelligence, and a careful attitude in students. According to the spirit of the Nine-Year Integrated Curriculum for Mandatory Education in Taiwan, a domestic technological creation contest should strive to cultivate the following 10 abilities for students:

1. Self-understanding and potential development.
2. Appreciation, performance, and innovation.
3. Career planning and life-long learning.
4. Expression, communication, and sharing.
5. Respect, caring, and teamwork.
6. Cultural learning and international understanding.
7. Planning, organization, and implementation.
8. Technology and information application.
9. Active exploration and research.
10. Independent thinking and problem solving.

Furthermore, technological creation contests for youths have the following personal, societal, and economic benefits:

1. Individually

a. Pre-production design drawing improves planning ability.

b. Flexible thinking and knowledge synthesis enhances imagination.

c. Project production encourages independent thinking and promotes originality.

d. Comparison of their own and rivals' work helps them to learn analytical skills.

e. Utilization of equipment and hand tools for material processing, production, and formative design improves practical skills.

f. Competition stimulates persistence and cultivates sportsmanship.

g. Team cooperation embodies the concept of symbiosis and makes students a better team player.

2. Socially

a. The organization of a nationwide contest for technological creation helps involve people at all levels of the society and boosts their interest in technological creation.

b. The organization of a nationwide technological creation contest increases opportunities for inter-school exchange.

c. The activity itself helps the concept of *technological creation* to take root into the daily lives of the citizens.

3. Economically

a. The cultivation of product R&D capabilities helps increase the added-value of technological products.

b. The cultivation of manufacturing R&D capabilities helps boost production efficiency and quality.

Theme Selection and Its Meaning

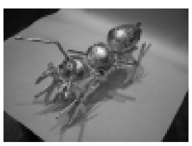
From the corporate management point-of-view, the PowerTech Contest itself can be seen as the product, and the participating students are its customers. In order to capture precisely what the market demands are we need to develop and put in place a system of effective management. Cooper (1993) pointed out in his review of three high-tech product cases following the common characteristics of successful technological inventions: (1) close collaboration between the inventor and the customer, (2) well-defined market demands, and (3) the existence of a technical champion. Based on the rationale discussed in the previous section and the past experience of TCDA and NTNU organizing the youth creativity camp activity, the PowerTech organizers selected “The Queen of Ants” and “King of Beasts” as the theme for elementary school students to compete and “The Totoro of Buses” and “The Giant of Bugs” for junior high school student to compete, with an aim to develop the participants' ability to construct and improve their technological knowledge. The contest requires rival teams to apply relevant theories of physics for the internal structure of their invention, including the electrical motor and the gear set in the power system, and the linkage mechanism in the transmission system. Since no specifications and dimension requirements are given for the final product, teams are allowed to fully stretch their creativity and are required to search for the needed knowledge and to put their theories into practice. In addition, students also need to learn to utilize unprocessed materials provided by the contest organizers and apply their creative thinking skills to produce a project. Below is a brief summary of the characteristics of the end product, and the categories and method of the competition.

Contest Theme Selection

The elementary school competition has two themes. The first theme “The Queen of Ants” requires a final structure that contains a body comprised of three separate parts linked with a linkage device and a cross-shaped foot stand. The final product is expected to perform the mechanical functions of spinning and crossing a hurdle. The second theme “The King of the Beasts” requires a final structure that has the ability to walk with four legs by using crank and linkage devices. An animal appearance is also an important part of the competition, and the competing teams are free to add any aesthetic element or any defensive/offensive function to their creation.

In junior high school competition, the first theme is “The Totoro of Buses,” a four-wheel-drive vehicle with an arch-shaped roof that can maintain a continuous and smooth movement of rolling over when it hits against a vertical wall through its wheel-body coordination and center-of-gravity design. “The Giant of Bugs” requires the use of a linkage structure together with the crank movement and the front-end chassis-to-ground friction design to enable the Bug to crawl forward with alternating stretching and recoiling movements like a caterpillar. The competition is divided into different categories according to the level of difficulty in project production and mechanical requirements, and it is conducted in two stages (preliminary and final).

Table 1. Four Projects of Technological Creativity Contest

Item	Description
The Queen of Ants 	The Queen of Ants is a robot with a structure with three interconnected body parts and a crossed-leg design for hurdle crossing. Pupils can learn about the various fundamental technological concepts through the design of a power system, including the gear drive system (the principle of leverage), DC electricity application features (difference between parallel and serial circuits) and component linking methods, all of which are useful for creation of technological products of different mechanical structures and functionalities.
The King of Beasts 	The King of Beasts is a four-legged, animal-looking walking robot for use in a wrestling contest. In addition to the relevant principles of physics mentioned above, pupils can also learn about the basics and the design of a linkage structure, and about how to transform the rotary movement of a motor into linear movement, and how to increase friction (by increasing product weight or changing the material texture, etc.) in the contest.
The Totoro of Buses 	The Totoro of Buses is a four-wheel-drive motor vehicle with an arch-shaped roofline design to capacitate continuous rolling movement. Through motor-driven vehicle design and production, pupils can learn about gravity (vehicle body’s center of gravity) of vehicle body, centrifugal force (generated during rolling), streamline design, etc.
The Giant of Bugs 	The Giant of Bugs is a robot emulating the stretching and contracting movement of a real worm for use in a straight-line speed race and a tug-of-war contest. In addition to providing pupils an opportunity to synthesize various concepts of physics and to develop a basic understanding of biology, the product requires the use of environment-friendly materials and processing methods for appearance design. This helps incorporate the concept of biological chain into product design, and this challenge demands a good balance between the mechanical and functional structure of the product and its appearance design.

Content Method Analysis

The PowerTech Contest requires the creative project to be produced and completed on site within the one-day competition. During the production process, all teams work on their projects in an isolated area to protect them against external disturbances and unwanted interferences, including instructions (oral or otherwise) from teacher advisors and parents, who are only allowed to observe the contest from outside the isolation line. This particular arrangement has been used to ensure that the entire competition process and setting are fair, just, and open.

The PowerTech Contest contains three subcategories: power contest (e.g., speed racing and push), form design contest, and innovation process records contest. In power contest, the contesting teams are required to make designs for each required contest item according to the mechanical features under the given theme. At the same time they must take into consideration the respective constraints of each required item, and then seek to optimize the mechanical design. Table 1 summarizes the different contest items for respective themes.

In the innovation process records contest, an expert review meeting was convened one week before the final competition to evaluate the innovation process records of the rival teams, which should include their problem-discovering and problem-solving methods, idea-searching and idea-generation methods, and technological innovation processes that were recorded during their meetings with their teacher advisor. The form design contest was held on the day of competition, and the evaluation is based on the contesting teams' overall structure design, color applications, environment-friendly material employment, and processing skills. The final score is determined by the total score of all the subcontests. In other words, the contesting teams are required to put in a carefully measured amount of effort into the respective preliminary contests in order to win the game. Through participating in the entire process from planning and design to pre-contest practice and the final competition, students should be able to develop a basic design concept that emphasizes not only the mechanical function but also the formative design, instead of overemphasizing one aspect at the expense of the other.

Operating a Successful PowerTech Contest

The goal of the contest is to help students to learn to utilize limited resources to achieve project objectives through planning, implementation, and evaluation. Therefore, the operation of the PowerTech Contest should cover all aspects of resources including people, processes, materials, and finances. As a regular activity of a nonprofit organization, a PowerTech Contest indeed faces serious obstacles in all aspects in its pursuit for sustainability. Hence, an effective management mechanism is required in order to help the contest overcome the various challenges it may face in the course of development.

As already mentioned in the previews section on PowerTech Contest rationale, in order to create a technological project, students must have abundant knowledge and possess various skills and capabilities (including knowledge application, plurality and flexibility in thinking, and implementation and persistence). The Ministry of Education has also pointed out that technology should be an integral part of the learning of Natural Science and Life Technology in its Nine-Year Integrated Curriculum for Mandatory Education. Currently, however, students' understanding and skills for technological creation remain largely insufficient for a successful implementation of the new curriculum. Therefore, in preparing for the contest, the organizers foresaw several problems. First, who should be the target audience of the contest? Because students largely lack technological creation capabilities, the end "product" may not be one that could be sold on the market, and the goal of helping to cultivate students' technological creation abilities may not be fully realized. The second challenge was about how to get the word out to the target audience. What could be done to improve the visibility of the activity among possible contestants? This second question would entail marketing.

The organizers mistakenly decided to address the second question first during the first-year of the contest due to a lack of experience. The organizers adopted a media propagation strategy, but much of the effort was to no avail. That experience taught the organizers to deal with the first challenge first in order to process a successful event. In addition, for the contest to continue yearly, the organizers also need to address the issue of sustainability. And this third problem has to do with the sustaining of participants' motivation and interest. Below is a brief discussion of how these three difficulties can be resolved.

The problem of "Who is Capable?"

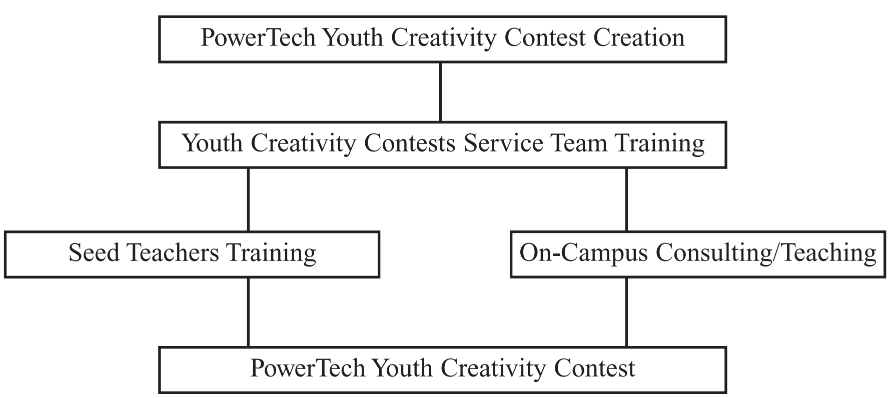
Since most of the students had no previous experience making technological creations in school, they probably had little self-confidence for such a contest. It is therefore important to provide a learning opportunity for those who were willing to give it a try. Also, considering the fact that the contest is at "national level," such a learning opportunity has to be provided nationwide, not limited to certain cities or counties. According to "The Tipping Point: How Little Things Can Make a Big Difference" (Gladwell, 2000), a contest must have relevant connectors in order to become popularized. In other words, teacher's interest has to be cultivated first, instead of students, and they had to be provided with technological creation experiences. The organizers therefore recruited students from college-level teacher-education programs to form the Youth Technological Creation Service Teams and to provide necessary training to them. The purpose of setting up these teams is twofold: (1) to provide an educational internship opportunity for these college students, and (2) to reduce the budget requirement for organizing teacher-training programs as part of the PowerTech Contest promotional campaign.

During the second-year PowerTech training, the service teams used the National Museum of Natural Science and the National Science and Technology Museum as their bases to train seed teachers by stages and to utilize various collaborative learning mechanisms through knowledge collection, diffusion, transmission, and innovation in order to help the trainees to help their students. In addition, to increase participation rate, the service teams toured elementary and junior high school campuses to provide guidance and to help increase the ability and confidence of prospective participants. The flowchart of the PowerTech Contest is shown in Figure 1.

The problem of "Who should promote to?"

Compared to the National Science Fair that already has a history of over 20 years, the PowerTech Contest is relatively new and unknown to most of the parents and teachers. To acquaint and familiarize parents and teachers with the contest, multiple media channels were used and a consulting center was established to help promote the activity and provide all necessary assistance. The media promotional campaign was divided into two stages. In the first stage, reports plus advertisement were published in Mandarin Daily News whose main readers are elementary school teachers and students, and other print media such as promotional leaflets and direct marketing materials, were placed in technological-innovation-related social and educational institutions, including the National Museum of Natural Science, the National Science and Technology Museum, and the Science Education Center. All promotional materials included a brief introduction about the organization and implementation of the activity as well as the contact information. During the second stage, organizers started promotional activities, provided guidance on school campuses and established a PowerTech Contest Consulting Center to coordinate the handling of inquiries. In addition, the TCDA created a new column on its organizational Website to disseminate relevant information about the contest, including technological innovation teaching, FAQs, and online registration, in order to increase the visibility of the contest and the registration rate. Through these efforts, the number of participating teams grew exponentially from 78 in the first year to 414 in 2006.

Figure 1. Power Tech contest flowchart



The problem of "Who has the willingness?"

According to the theories of incentives (Rice, 2006; Baer, Oldham & Cumming, 2003), one would offer a "carrot" in front of a horse for it to move forward. Therefore, the PowerTech Contest organizers provided a free trip to Japan to see a robot contest (sponsored by domestic business enterprises) as the final prize. Also, officials from the Ministry of Education and National Science Council were invited to be award presenters at the award ceremony, which was also a great encouragement for the participants. In addition to student awards, teacher advisors were also given awards for their leadership and dedication. This was to encourage them to continue their efforts and to lead another team in future contests.

According to the equity theory, fair games promise chances to win, and the chances to win sustain the willingness to participate. In order to ensure the principles of fairness, justice, and openness, the PowerTech Contest required the participants to produce their product on site on the day of competition to avoid similar criticism on science fairs about the possible master-hand hidden behind the scene. For score calculation, the contest included the creating competition contest (60%), the modeling design contest which aims to encourage students to utilize their artistic talents and improve their command over aesthetic expression (20%), and the teacher advisor's innovation process record journal (20%), to ensure that teachers indeed participated in the process. As long as teachers are involved in the process, they are sure to gain something; and as long as they feel rewarded, they will be motivated to lead their students to participate in the contest.

Finally, according to game theory, an interesting game must also be competitive. The competition may be against time, against a rival, or against both at the same time. The PowerTech Contest not only upholds the principles of fairness and openness, the contest design, including the speed race, wrestling, and tug-of-war competition between participants' creative inventions, also imitates real, live human competition so that students can become highly involved and motivated to make improvements to their invention and to enter the competition again in the future to prove that their improvements indeed work better. Based on the three guiding principles discussed previously, it is believed that the PowerTech Contest will continue in the years to come.

Conclusion

For a nonprofit organization to hold a sustainable activity in this rapidly changing society, and thereby fulfilling the missions and ideals of the organization, a process of strategic planning and managerial thinking as stringent as that followed by the corporate world is necessary. The core of the PowerTech Contest also lies in its ability to fulfill its educational functions and purposes. Next follow the conclusions of this study.

Building a professional operation mindset to boost competitiveness

The organizers of this nationwide contest successfully formulated and designed a creative activity that not only appeals to today's youngsters but also meets their demands for science education. In addition, the organizers have incorporated novelty features in the contest designed to attract students, and they have reviewed the effectiveness of its activity implementation throughout the whole process of design, development, and assessment.

Shaping a professional image to lure new "customers"

The PowerTech Contest has focused its public and media promotion efforts on building a professional image in order to increase its name recognition. Also, various new marketing approaches (regional integration, total marketing) were incorporated in order to create positive and effective word-of-mouth marketing via participating students, so that all the limited resources can be fully exploited.

Extending the reach and scope by involving relevant institutions

In addition to internal management strategies, the organizers also strengthened its partnership with external resources. For instance, the first three contests all collaborated with the National Museum of Natural Science and the National Science and Technology Museum and used them as bases for service team training and contest venues. Such cross-institutional partnership and collaboration further ensured an effective use of the limited operating resources of the contest.

Since there is still room for improvement in terms of general considerations and specific measures of the contest, the organizers will strive to make continuous improvements to ensure that technological creation can truly become a part of everyday life and that their countries' economic competitiveness will be further lifted as a result.

Acknowledgement

The PowerTech contest is mainly sponsored by National Science Council and Ministry of Education of Taiwan.

Dr. Jon-Chao Hong is a professor in the Industrial Education Department at the National Taiwan Normal University.

Chan-Li Lin is an Assistant Professor in the Department of Visual Communication Design, China University of Technology, Taiwan.

Ya-Ling Lin is a full-time teacher at Taipei country Jhangshu Junior High School, wand is currenlty prusuing her PhD at National Taiwan Normal University

References

Baer, M., Oldham, G. R., & Cumming, A. (2003). Rewarding creativity: when does it really matter? *The Leadership Quarterly, 14* (4-5), 569-586.

Cooper, R. G. (1993). *Winning at new products(2nd ed.)*. Mass: Addison-Wesley.

Gladwell, M. (2000). *The tipping point: How little things can be made a big difference*. NY: Little, Brown & Company.

Magee, G. B. (2005). Rethinking invention: Cognition and the economics of technological creativity. *Journal of Economic Behavior & Organization, 57* (1), 29-48.

Rice, G. (2006). Individual values, Organizational Context, and self-perceptions of employee creativity: Evidence from Egyptian organizations. *Journal of Business Research, 59* (2), 233-241.

Sternberg, R. J. & Lubart, T. I. (1996). Investing in creativity. *American Psychologist, 51*(7), 667-668.

Sternberg, R. J. (1985). *Beyond IQ: A triarchic theory of human intelligence.* New York: Cambridge University Press.

Wolf, T. (1999). *Managing a nonprofit organization in the twenty-first century*. New York: Simon & Schuster.

Exploring the Influence of New Technology Planning and Implementation on the Perceptions of New Technology Effectiveness

Al Bellamy

Abstract

This study explored influences that perceptions of new technology implementation and planning processes, and dimensions of organizational climate have on perceptions of new technology deployment effectiveness. It also examined the extent to which dimensions of organizational climate moderates the relationships among new technology implementation, planning, and new technology deployment effectiveness.

Data for this study was collected from 100 employees within 6 different types of organizations that had recently installed new technology. The results of the study indicate that these factors do indeed influence new technology deployment effectiveness. Organizational climate was not shown to have a moderator affect.

Introduction

The rapid speed of technological development and its effect on organizational strategy, structure, and processes has created a critical need for a systematic approach to managing technology. Technology Management "…links engineering, science, and management disciplines to address the planning, development, and implementations of technological capabilities to shape and accomplish the strategic and operational objectives of an organization" (Manufacturing Studies Board 1986). Technology management has its roots in strategic management, engineering management, innovation management and R & D management, all dating back to the 1970's (Ulhoi, 1996). Technology management during the past two decades has emerged as a viable framework within corporate strategy making (Burgelman, Madique, & Wheelwright, 1995; Collier, 1985; Porter, 1985) and is considered to be an independent sub-discipline of organizational management. Its interdisciplinary framework focuses upon understanding the peculiar integration between information history and radically new modes of production that is rarely understood within the industrial technology paradigm of current management thought (Bellamy, Becker, Kuwik, 2001). For the conceptual purposes of this paper, technology is defined as the ideas, tools, and knowledge that are utilized for developing, transforming, or modifying a product, service, and skills. This definition acknowledges the nonmaterial aspects of technology as well as tools and equipment. Technology management refers to the management strategies and processes that are utilized in the effective deployment and maintenance of technology. Strategies and processes consist of such things as the assessment and requisite changes of the organizational structures, work processes, modes of integration, communication networks, and human resources that are needed to effectively bring about an isomorphic relationship between technology and the accomplishment of organizational objectives.

This exploratory study examined the extent to which perceptions concerning technology planning, implementation, and organizational climate influence perceptions of the effectiveness of new technology. The study is further concerned with exploring the extent to which organizational climate moderates the relationships among technology planning, technology implementation, and technology effectiveness. Previous and existing literature has tended to focus more on the macro level aspects of technology management and strategy (such as environmental monitoring of technology, product development and innovation,) and technology leadership (Barclay, 2002; Barclay, 1990; Cooper and Kleinschmidt, 1995; Clarke and Thomas, 1990). The emphasis placed upon these broader aspects of technology management is understandable given the implications that technology has for improving an organization's competitive position. However, specific organizational processes such as the way in which organizations go about planning and implementing technology are equally salient to the management of technology. The influence that these processes have on technology management, has for the most part, been ignored within the empirical literature. What does exist within the literature are theoretical statements regarding the importance of implementation and planning processes. However, there is a critical need to empirically investigate the impact that these processes have on technology outcomes.

Technology is believed to have more effective outcomes when it is integrated systematically within an organization's strategy process (Steele 1989: Uhoi, 1996). The micro processes of planning and implementation relate to an organization's strategic behavior toward technology management. Conducting empirical research on how these factors influence the deployment of technology will provide deeper insights into the processes needed for developing an effective technology management strategy.

Factors Examined in Study

Planning and Implementation Factors

The way in which internal planning and implementation processes are managed could greatly influence the fecundity of new technology. Analyses of how these processes are managed could be seen as an indicator of the extent to which organizations strategically approach the deployment of new technologies (Hong & Kyung-Kwon, 2002). Technology implementation and planning refers to the extent in which the organization has strategically approached the deployment of new technologies and the manner in which it has prepared for the execution of the technologies prior to their implementation. The processes incorporated within this design have been cited to influence the overall effectiveness of both the deployment and utilization of technology (Bancroft, 1992; Haddad, 2002).

The implementation factors examined within this study consisted of perceptions relevant to the structure of the implementation process (cross-functional teams), and the extent to which pre-assessment of such things as training needs, required organizational changes, and the capabilities of the new technology was conducted prior to the deployment of new technology.

The study approached the planning process by examining the extent to which the organization devoted time to technology planning, the level of clarity within the planning process, and the extent to which a strategic plan was utilized.

Although the implementation and planning factors incorporated within this study do not exhaust all of the possible factors related to the deployment of technology, it does include a representative cadre of constructs that has been identified within the conceptual literature as being relevant and significant to the implementation of technology (Cleland & Bursic, 1992; Haddad, 2002; Preece, 1995; Steele, 1989).

Criterion Factors

Three types of factors were examined to determine the impact that the technology implementation and planning factors and organizational climate have on new technology outcomes. They are perceived unanticipated outcomes, perceptions of whether the technology accomplished what it was intended to achieve (Overall Perceptions), and perceptions related to its impact on production issues (Production Outcomes).

Organizational Climate

When exploring the ways in which management practices are related to technology implementation outcomes, it is important to realize that these relationships occur within the context of organizational characteristics, such as its climate (Barley, 1990).

Organizational climate refers to:

> "a relatively enduring quality of the internal environment of an organization that is (a) experienced by its members, (b) influences their behavior, and (c) can be described in terms of a particular set of characteristics or attributes of the organization" (Tagiuri, 1968, p 35).

This definition conceptualizes climate as a construct that is linked to perceived qualities of the organization such as leadership, organization design, decision-making processes, and organizational policies and procedures (Guion, 1973). Perceptions of these organizational traits can influence individual behavior in relation to organizational effectiveness (deWitte and de Cock, 1988). More specifically, organizational climate appears to influence the manner in which an organization conducts its planning for new technology. For example, an organization that is characterized by its members as being rigid and unwilling to change would probably approach new technology planning and implementation differently than an organization described as open and that does not resist change. There may also be parallel differences in the effectiveness in which new technology is deployed (Sparrow & Gaston, 1996). The perceived climate of the organization may mediate the relationship among technology, the planning processes, and the perceived effectiveness of the deployment of technology.

There is a lexicon of studies and writings that point to the usefulness of the climate variable in conducting organizational analyses (Sparrow & Gaston, 1996). It has been linked to motivation and job satisfaction (Reichers & Schnieder, 1990). It has also been shown to mediate the relationship between job satisfaction and performance (deWitte and de Cock, 1988). Although recent attention has been focused on examining the influence that climate has on innovation and organizational learning (Agrell & Gustafson, 1994; Anderson & West, 1994) very little empirical attention has been directed to describing its role in technology management issues.

This study examined the following four dimensions of culture extrapolated from the Business Organization Climate Index (BOCI) (Payne & Mansfield, 1978): (a) questioning authority, (b) administrative efficiency, (c) open-mindedness, and (d) innovation. These four factors were chosen from among 17 factors within BOCI because they appeared to be the most relevant toward the subject of implementing and planning for new technology.

Research Questions

This study explored the following research questions:

1. What is the nature and strength of the relationship among technology assessment, technology planning factors, and perceived technology effectiveness outcomes?

2. What is the impact of organizational climate on technology assessment, technology planning, and perceived technology effectiveness outcomes?

3. In what way does organizational climate moderate the relationships among technology assessment, technology planning, and perceived technology effectiveness?

Methodology

Sample

Data for this study was collected from 101 employees who had direct experience with selecting and implementing new technologies within their work units. These respondents were selected from six departments within six different organizations located in Southwestern Michigan. Access to each of these departments was attained through 6 graduate students who were enrolled in a technology management class during the Winter 2 semester of 2002. These students were employed in these departments. Figure 1 presents an overview of the sampling demographics of these departments. Participants within each organization specified within the chart, represent the number of people within a particular work unit who were directly involved with the planning and implementation processes of their new technologies.

Measurement.

All of the departments with the exception of one were involved in the implementation of new information technology (non-mechanical). Examples of the technologies include CAD/CAM software, group decision-making software, and accounting management software.

Figure 1. Demographics of sample

Type of Organization	Size of Work Department	Occupation of Respondents	Number of Respondents
Health Care Insurer	150	Managers and Supervisors	20
Military Logistics	90	Information Systems Admin.	16
Police Agency	108	Managers	10
Manufacturing	30	Managers and Supervisors	9
Engineering* Design	77	Engineers	12
Engineering* Design	52	Engineers	17
University	71	Academic Administration	17

*Indicates two departments from same organization.

One department (manufacturing) had recently installed new numerically controlled machinery. Each respondent completed a questionnaire and was informed to respond to technology implementation, planning, and outcome items as these pertained to the most recent new technology within their departments. For each of the items within the questionnaire, respondents were asked to circle the response value that most indicated their opinion concerning the statement within the item.

Planning

A technology planning scale was developed by combining each of the first five items listed within Figure 2. A five point scale and five anchor response format was utilized for each item in which respondents were asked to describe the extent to which each item was used during the technology planning process. Anchors ranged from "Strongly Agree" to "Strongly Disagree" with corresponding scores of 1 through 5. A value of five was assigned to a "Strongly Agree" response whereas a value of 1 was assigned to a "Strongly Disagree" response. Scores for this scale ranged from 8 to 25, with a median of 17. The alpha reliability for this five-item scale is .86. These items are representative of the domain of ideas pertaining to technology planning delineated within the technology management literature. As such, the items appear to have high content validity. The high alpha reliability for the scale lends further support to the scale having good content validity.

Item 6, the use of a strategic plan for the new technology, was used as a separate one item scale. Factor analyses revealed that it is a separate factor from the created implementation scale. Higher scores on each of the scales indicate a higher orientation toward new technology planning.

Implementation factors

Eight items pertaining to technology implementation were included within the questionnaire (Figure 3). Each item utilized a seven point scale and three anchor response format in which respondents were instructed to rate the extent to which each item was utilized during the most recent technology implementation within their department. Anchors ranged from "Strongly Agree" to "Strongly Disagree" with corresponding scores of 1 through 7. A value of seven was assigned to a "Strongly Agree" response while a value of 1 was assigned to a "Strongly Disagree" response.

Items 1 through 6 were combined to form one implementation scale. Scores ranged from 9 to 41, with a median of 27. The alpha reliability for this scale is .87. Figure 3 illustrates each of the implementation items. These items are representative of the domain of ideas pertaining to technology implementation delineated within the management of technology literature. As such, the items appear to have high content validity. The high alpha reliability for the scale lends further support to the scale having good content validity.

Figure 2. Planning Factors

1. The extent that management had a clear understanding of the objectives of the new technology.
2. The amount of time devoted to planning for the new technology
3. The extent to which there was a clear plan for implementing the new technology.
4. The extent to which there was appropriate planning for costs associated with upgrades for the new technology.
5. The extent to which workers were informed of the new technology before it was implemented
6. The use of a strategic plan for the new technology.

Figure 3. Implementation Factors

1. The extent to which training needs related to the new technology were assessed.
2. Assessment of the new technology's impact on existing personnel functions.
3. Assessment of the organizational changes needed to fully support the new technology.
4. Assessment of the capabilities of the new technology.
5. Assessment of the financial feasibility of the new technology.
6. Assessment of how the new technology would affect job responsibilities.
7. The extent to which there was top management involvement during the implementation process.
8. The use of cross-functional planning and implementation teams.

Items 7 and 8, top-management involvement and the use of cross-functional teams were used as separate one-item scales. A factor analysis revealed that they are separate factors from the created implementation scale. Higher scores on each of the scales indicate a higher orientation toward new technology assessment.

Organizational Climate

This variable was measured by utilizing four dimensions of the Business Organization Climate Index (Payne & Mansfield, 1978), which contains 17 climate dimensions. These four dimensions were selected because they appear to be relevant to the technology implementation concepts of this particular study. Participants were asked to describe the extent to which each of the climate items were indicative of their work department. A four-point scale and four-anchor scale format was utilized with responses ranging from "Definitely True" to a "Definitely False". A score of 4 was attached to a "Definitely True" response and 1 to a "Definitely False" answer. Each dimension consists of eight items. The four dimensions along with their alpha reliabilities, range of scores, and median values are as follows:

Questioning Authority: alpha = .77; range of scores = 10-26; median = 21.00

Administrative Efficiency: alpha = .81; range of scores= 7-26; median = 19.00

Open-mindedness: alpha = .89; range of scores=15-30; median = 21.00

Innovation: alpha = .82; range of scores=15-27; median= 20.50

Higher scores on each of the dimensions indicate a higher orientation towards that aspect of organizational climate. A copy of the items contained within each of these climate dimensions is provided within Appendix A.

Technology Outcomes

Eight items were used to measure perceptions of new technology outcomes. These eight items were used to create three separate technology outcome variables: perceptions of unanticipated new technology outcomes, (3 items) perceptions of improved performance and morale (4 items), and overall perception of whether the new technology accomplished its intended objectives (one item). The scale and response format for the first and third outcome variables are the same for the planning factors. The items along with the alpha reliabilities for the unanticipated technology outcome and accomplish intended objectives variables are as follows:

Unanticipated Technology Outcomes Scale.

Scores for this scale ranged from 3 to 15, with a median of 9. The alpha reliability for this scale is. 83. The high alpha reliability gives evidence to this scale having high content validity.

1. The new technology had an unanticipated impact on employee's job responsibilities.
2. The new technology had an unanticipated impact on employee work stress.
3. The new technology had an unanticipated impact on work processes.

Perceived Performance and Morale Scale (Overall Perceptions).

The performance and morale variable used an eight point scale response structure ranging from 0 to 7 with four anchors. A zero response indicates a very low level of the item, whereas a response of 7 indicates a high level for a specific item. Scores for this scale ranged from 0 to 27, with a median of 14. The alpha reliability for this scale is .88. The high alpha reliability gives evidence to this scale having high content validity. Performance and morale scale consisted

Table 1. The Effect of Perceptions of Technology Assessment and Planning Factors, Organizational Climate Dimensions, on Perceptions of Technology Outcomes

N = 100

	Assessment	Planning	Questioning Authority	Innovation	Open Mindedness	Admin Efficiency	Top Mgt Involvement	Strategic Plan	Cross Functional Teams
Unanticipated Outcomes	-.170*	-.204*	-.210*	.151*	-.251**	-.173*	-.195*	-.142*	.022
Productivity Outcomes	.523**	.480**	.113	.039	.045	-.029	.237**	.402**	.417**
Overall Perception	.347*	.316**	.013	-.115	.044	—.091	.125	.167*	.100

*P ≤ .05 **p ≤. 00*

of the extent that the following things occurred as a result of the most recent new technology.

1. Improved productivity
2. Improved product or service quality
3. Enhanced the competitiveness of the organization
4. Improved employee morale

Results

Research Question One:

"What is the nature and strength of the relationship among technology assessment, technology planning factors, and perceived technology effectiveness outcomes?" As revealed in Table 1, the new technology assessment and planning factors are significantly correlated with each of the technology outcome variables. The negative correlations between these factors and unanticipated outcomes indicate that increases in planning and assessment activities decreases the instances of unintentional outcomes that could negatively affect the effectiveness of the new technology. The positive correlations between the implementation and planning factors and the productivity and overall perception variables, shows that engaging in technology planning and assessment processes improves perceptions of its effectiveness.

The study also reveals statistically significant correlations between top-management involvement during the implementation and planning processes and the unanticipated outcomes and productivity criterion factors. This factor, however, is not correlated with employee's overall perceptions of the new technology accomplishing what it was intended to accomplish.

Table 1 shows that the use of cross-functional teams during the planning and implementation processes is significantly correlated only with the productivity outcome variable. An interesting finding shown in Table 1 is that the four climate dimensions are only significantly correlated with the unanticipated outcome variable. No statistically significant correlations are shown with the other two outcome factors.

Table 2. Effect of Organizational Climate Factors on Perceptions of Technology Assessment and Planning Factors, Management Involvement, The Use of Cross Functional Team, and The Use of a Technology Strategic Plan

N = 100

	Questioning Authority	Innovation	Open Mindedness	Admin Efficiency
Assessment	-.001	.160*	.089.	.001
Planning	-.001	-.026	.017	-.133
Top Mgt Involvement	.235**	-.037	.111	.037
Cross Functional Teams	-.033	.151*	.097	.040
Strategic Plan	.165*	-.179*	.108	.698**

* p < .05 **p < .00

Table 3. Correlations Between Technology Assessment and Planning Factors, Controlling for Dimensions of Organizational Climate

N = 100

	Control Factors							
	Questioning Authority		**Innovation**		**Open Mindedness**		**Admin. Efficiency**	
	Assessment	**Planning**	**Assessment**	**Planning**	**Assessment**	**Planning**	**Assessment**	**Planning**
Unanticipated Consequences	-.17	-.20*	-.19*	-.20*	-.17	-.21*	-.17	-.23*
Productivity Outcomes	. 53**	.48**	.52**	.45**	.52**	.47**	.52**	.48**

* p < .05 **p < .00

Research Question Two

"What is the impact of organizational climate on technology assessment, technology planning, and perceived technology effectiveness outcomes?

Table 2 reveals that relatively few statistically significant correlations between the organizational climate dimensions and the assessment and planning factors are found within this study. However, the data does indicate that each dimension has a different influence on these factors. The questioning authority and administrative efficiency dimensions reveal two relatively strong and statistically significant correlations. The questioning authority dimension is positively related with the amount of top-management involvement. This finding seems to imply that top-management involvement with the implementation and planning processes influences a climate where employees are encouraged to challenge issues surrounding new technology. The strongest correlation is shown between the administrative efficiency and the strategic plan variables. This finding alludes to the idea that departments that are highly structured in terms of having such things as well organized work processes, that sufficiently disseminates information to employees, and that are concerned about work quality, are more oriented toward developing strategies for technology deployment. A related finding is that all but one (open-mindedness) of the organizational climate dimensions correlates with the strategic plan variable.

Table 2 reveals statistically significant correlations between the innovation climate dimension and the technology assessment, the use of cross-functional teams, and strategic plan factors. In short, based upon having the greatest number of statistically significant correlations, one can partially assume that an innovative climate is the most significant factor of the organizational climate dimensions examined within this study. In comparison, a climate of open-mindedness appears to be the least significant.

Research Question Three

"In what ways do organizational climate moderate the relationships among technology assessment, technology planning, and perceived technology effectiveness?"

The results presented within Table 3 indicate that none of the organizational climate factors moderate the relationships between the technology implementation and planning factors and the technology outcome variables.

Discussion

Practical Implications of Study for The Management of Technology

The results of this exploratory study provide confirmation to the somewhat ubiquitous conceptual proposition that the structure of the implementation process and the nature of the planning process influence the effectiveness of the deployment of new technology. Both the assessment and planning factors were shown to be correlated with each of the criterion factors. The practical implication of this finding is that it informs managers that engaging in specific assessment and planning processes of new technology *prior* to its deployment may lead to better technological outcomes. Managers oftentimes approach performance issues within their company through the use of technology. The data from this study strongly alludes to the idea that the "manner" in which new technologies are deployed have a high if not equal degree of saliency than the new technology itself. Particular attention should be focused on the relationship between employee's perceptions of the assessment/planning process and the unanticipated outcomes variable. Unanticipated technological outcomes are very commonplace in most organizations. They also carry a heavy financial and performance cost. To the extent that these perceptions of employees can be translated into valid unanticipated outcomes, the results of this study suggest the following things to management regarding how unanticipated outcomes of new technologies can be reduced:

1. Develop an assessment plan that analyzes such things as the technology's impact on employee training, work processes, and job responsibilities.

2. Develop a technology management strategy that includes not only the technical and financial aspects of the new technology, but also a robust planning process that examines such things as the clarity of the implementation plan, and the extent to which management has a clear understanding of the objectives of the new technology.

3. Make use of cross-functional teams in developing and implementing the technology strategy.

4. Conduct a comprehensive study of the climate of the organization.

These suggested steps should be conducted prior to the deployment of new technologies.

Dr. Al Bellamy is a Professor of Technology Management within the College of Technology at Eastern Michigan University.

References

Agrell, A. & Gustfson, R. (1994). The team climate inventory (TCI) and group innovation: a psychometric test on a Swedish sample of work groups. *Journal of Occupational and Organizational Psychology, 67, (2)*. 143-152.

Anderson, N. & West, M. (1994). *Team climate: measuring and predicting innovation in groups at work.* Paper presented at the BFS Occupational Psychology Conference, Birmingham.

Bancroft, N. (1992). *New partnerships for managing technological change.* New York: John Wiley & Sons.

Barclay, L. (2002). *Organisational factors for success in new product development. IEEE Proceedings. Science, Measurement and Technology, 149, (2).* 105-120.

Barclay, L. (1990). Managing new product development effectively. *Leadership and Organizational Development. Journal.* [Special Issue.]

Barley S. (1990). The alignment of technology and structure through roles. *Administrative Science Quarterly, 35, (1)*, 61-104.

Bellamy, A., Becker, P., & Kuwik, P. (2001). *The development of strategic intent within technology management programs.* Paper presented at the Annual Meeting of the National Association of Industrial Technology, Michigan.

Burgelman. R., Madique, M., & Wheelwright, S. (1995). *Strategic management of technology and innovation.* Chicago: Irwin.

Clarke, K., & Thomas, H. (1990). Technology change and strategy formulation. In: Loveridge, R. and Pitt. M. (Eds), *Strategic management of technological innovation.*(251-260) New York: John Wiley & Sons.

Cleland, D., Bursic, K. (1992) *Strategic technology management: Systems for products and processes.* New York: AMACOM.

Collier, D. (1985). Linking business and technology to market. *Harvard Business Review. 59, (2).* 111-123.

Cooper, R., & Kleinschmidt, E. (1995). Benchmarking the firm's critical success factors in new product development. *Journal of Product Innovation and Management, 12*, 372-391.

Guion, R. (1973). A note on organizational climate. *Organizational Behavior and Human Performance, 9,* 120-125.

Haddad, C. (2002). *Managing technological change: A strategic partnership approach.* Thousand Oaks: Sage Publications.

Hong, J., & Kyung-Kwon, K., (2002) The critical success factors for erp implementation: an organizational fit perspective. *Information & Management, 40, (1),* 25-40.

Manufacturing Studies Board. (1986). *Management of technology: The hidden competitive advantage.* Washington, D.C: National Academy Press.

Payne, R., & Mansfield, R. (1978). Correlates of individuals' perceptions of organization climates. *Journal of Occupational Psychology, 51,* 209-218.

Porter, M. (1985). Technology and competitive advantage. *Journal of Business Strategy, 5,* 60-77.

Preece, D. (1995). *Organizations and technical change: Strategy, objectives and involvement.* London: Routledge.

Reichers, A., Schneider, B. (1990). Climate and culture: an evolution of constructs. In B. Schneider. (Ed.) *Organizational climate and culture.* Oxford: Jossey-Bass. (74-93).

Sparrow, P., Gaston, K. (1996). Generic climate maps: A strategic application of climate survey data. *Journal of Organizational Behavior, 17,* 679-698.

Steele, L. (1989). *Managing technology: The strategic view.* New York: McGraw-Hill.

Tagiuri, R. (1968). The concept of organizational climate. In Tagiuri, R. and G Litwin, (Eds.) *Organizational climate.* Boston: Harvard University Press. (15-22).

Ulhoi, J. (1996). Towards a theoretical and methodological corporate technology management framework: The strategic perspective. *International Journal of Technology Management*, 12, (2), 44-59.

deWitte, K & de Cock, G. (1988). *Strategic human resources management andorganizational culture*. Working Paper. Centrum voor Organisetie—en op Personeel pschologie. Leuven: Katholieke Universiteit.

Appendix A

Questioning Authority

1.____Criticism of policies and practices are encouraged.
2.____When people disagree with a decision, they work to get it changed.
3.____People here are not likely to accept managerial ineptitude without complaint or protest.
4.____When people dislike policy they let it be known in no uncertain terms.
5.____People avoid direct clashes with senior personnel at all costs. (R)
6.____Many people will not hesitate to give strong support to a project that senior management is opposed to.
7.____People who get pushed around here are expected to fight back.
8.____People delight in challenging official polices.

Open Mindedness

1.____Errors and failures are talked about freely so that others may learn from them.
2.____No one needs to be afraid of expressing extreme or unpopular viewpoints here.
3.____The expression of strong personal belief is pretty rare here. (R)
4.____One of the values most stressed here is open-mindedness.
5.____People here tend to be cautious and restrained. (R)
6.____People here speak out openly.
7.____Criticism is taken as a personal affront in this organization. (R)
8.____People here feel free to express themselves impulsively

Innovation

1.____Policy changes occur slowly here and only after considerable deliberation.
2.____Quick decisions and actions are not characteristic of this place. (R)
3.____Thinking of alternative ways in which problems might be solved or things done differently is encouraged here.
4.____New ideas are always being tried out here.
5.____The latest scientific discoveries make a few changes in the way this place is run.
6.____Unusual or exciting plans are encouraged here.
7.____There are conventional ways of doing things here which are rarely changed. (R)
8.____Programmes here are quickly changed to meet new conditions.

Administrative Efficiency

1.____Work is well organized and progresses systematically from week to week.
2.____Most activities here are planned carefully.
3.____People get sufficient notice of policy decisions to able to plan their own work accordingly.
4.____Work is checked to see if it is done properly and on time.
5.____The flow of information downward is smooth and efficient.
6.____There is no wasted time here; everything has been planned right to the minute.
7.____There is a specific place for everything and everyone here.
8.____The quality of work is rated or evaluated frequently.
(R) Denotes that score was reversed.

Cell Phones in American High Schools: A National Survey

S. John Obringer and Kent Coffey

Abstract

A survey instrument to determine school policy and practice regarding cell phone use by teachers and students was developed using a literature review, a panel of experts, and then a pilot study with typical respondents. The survey was mailed out randomly to 200 high school principals representing all 50 states. The return rate was 56 percent with responses coming from all regions of the country. The findings include: (1) A majority of high schools (districts) had policies in place, (2) parents generally supported the school's cell phone use policy, (3) classroom teachers used cell phones at school for non-school-related business, (4) disciplinary action for inappropriate cell phone use by students ranged from a mild reprimand to confiscation of the cell phone, and (5) the potential misuses of camera phones in high schools has not been fully addressed by many schools. Because cell phone use has become a part of American culture, and this technology is constantly being upgraded, school or district policies should be revamped periodically to stay abreast of this phenomenon. Specific recommendations are put forward.

Technology and Policy

The expansion of cell phones during the past decade has made it commonplace for students and teachers to have cell phones in the school setting. Data from 2004 indicated that 58 percent of 6th –12th graders have a cell phone and 68 percent of students regularly bring cell phones to school ("NetDay's 2004," 2005). The number of cell phones in the United States rose from 1.2 million in 1987 to 145 million in 2002 (Danforth, 2003). No reliable estimate has been found for teachers, but anecdotal data indicate that a majority of classroom teachers have access to a cell phone.

Educators, administrators, and school boards are concerned about many issues related to the use of cell phones at school: distractions to the learning environment (Gilroy, 2003), cheating on tests and quizzes through text messaging (Meer, 2004), cyber bullying students by sending nasty messages ("Bullying shoots," 2005), phoning in bomb threats (Danforth, 2003), using calculator functions to cheat on math tests (Hurst, 2004), and jamming phone lines in the event of an actual emergency ("Calling cell," 2002). Many parents believe that cell phones would be especially useful in an emergency situation. However, 68 percent of police officers assigned to schools believe that cell phone use would actually hamper school safety in a crisis (National School Safety and Security Services, 2005).

In addition, 21 percent of students who bring cell phones to school have video/photo capabilities on their phones (Carroll, 2004). These video/photo capabilities present additional concerns. One issue is that camera phones can be used to take photographs of quizzes or exams and transmit them to classmates (Hurst, 2004). An especially egregious problem is the use of camera phones to take embarrassing photographs of classmates in private areas (e.g., restrooms or locker rooms) and share them with others electronically. This technology raises legal issues of privacy, sexual harassment, and theft of proprietary information (Carroll, 2004). This rapidly evolving problem has led the Montana High School Association to strongly recommend that schools develop policies to prohibit the use of camera phones, especially in locker rooms (Carroll, 2004).

Cell phones also do offer advantages. Parents want their children to have cell phones due to their involvement in activities (e.g., athletics) or to assuage safety concerns (Dianis, 2004). They can be important for school supervisors who are at crossings or playgrounds who may need to call for help quickly in case of an emergency (Galley, 2000), and a cell phone may facilitate students in planning after-school work and other activities ("The right to ring," 2004). Additionally, the camera phone can have a number of educational benefits. The camera capability can be used to record field trips or school events, to enhance reports with visuals, and to develop photo essays (Dyrli, 2004).

The purpose of this study was to measure, through a national survey, administrators' perceptions of cell phone issues and related policies for students and teachers. Many administrators and school board members are familiar with the cell phone policies of their own districts as well as surrounding districts. This study also allows them to compare their policies with national trends.

Methodology

A literature review was conducted to determine the issues and controversies associated with the use of cell phones in school settings, resulting in a large number of potential items identified for possible inclusion. The investigators then developed a draft of the survey. A panel of experts (building principals) was assembled to review the draft survey. The panel consisted of 11 principals who were selected to represent both rural and suburban settings along with small and large schools. The panel of experts provided feedback on the clarity, purpose, and comprehensiveness of the survey. Using their feedback, the survey was modified and a relatively small pilot study was conducted using an intact group of 15 educators associated with the university. The pilot study revealed no problems with the survey instrument. The survey was then finalized with 19 items, divided into three types of responses: yes/no, agree/disagree, and short answer.

The survey was mailed to high school administrators in all 50 states. Schools and administrators were randomly selected from *Patterson's American Education* which lists every U.S. school and its current address, grouped by state. Using a random number generator, four high schools from each state were chosen, and a survey was mailed to the principal of each chosen school. A follow-up survey was mailed to schools that didn't respond to the first mailing.

The statistic used for this study was a chi-square with a .01 level of significance. For questions 1-8, the chi-square tested goodness of fit using the yes/no responses. For questions 9-15, two items (strongly agree/agree) were grouped together, and the other two items (strongly disagree/disagree) were grouped together. In this case, the chi-square tested goodness of fit using the agree/disagree responses. For questions 16-19, the open-ended responses, these were tallied to determine any common themes or patterns.

Results

The initial mailing yielded 77 valid responses. The follow-up mailing yielded 35 additional responses for a total of 112 responses. This represents a response rate of 56 percent. The returned surveys represented 46 states (12 southern states, 11 northern states, 11 midwestern states, 10 western states, and 2 noncontiguous states).

Questions 1-8

As shown in Table 1, four of the eight yes/no questions met the .01 level of statistical significance and are examined below:

Question 1: Does your school/district have a written policy regarding cell phones?

Table 1. Responses of High School Principals to Information Questions

	Yes	No	Sig.
1. Does your school/district have a written policy regarding cell phones?	84 percent	16 percent	**
2. Does your school permit cell phone use by teachers?	78 percent	22 percent	**
3. Does your school permit cell phone use by students?	24 percent	76 percent	**
4. Does your school allow students to leave cell phones on silent mode?	47 percent	53 percent	
5. Do teachers have access to a hard-wired phone in their classrooms?	56 percent	44 percent	
6. Do you believe that teachers who utilize cell phones use them only for school-related business?	6 percent	94 percent	**
7. Does your school district supply cell phones for administrators?	54 percent	46 percent	
8. Do bus drivers have cell phones supplied by the school/district for safety?	47 percent	53 percent	

**$p < .01$

Eighty-four percent of the responding principals indicated that their schools did have a written policy on the use of cell phones.

Question 2: Does your school permit cell phone use by teachers? Seventy-eight percent of the responding principals indicated that their schools allow teachers to use cell phones.

Question 3: Does your school permit cell phone use by students? Only 24 percent of the responding principals indicated that their schools allowed students to use cell phones.

Question 6: Do you believe that teachers who use cell phones use them only for school-related business? Only 6 percent of the responding principals indicated that cell phones were used by teachers primarily for school-related business.

Questions 9-15

As shown in Table 2, all seven of the agree/disagree questions met the .01 level of statistical significance. The questions are examined below:

Question 9: Direct instructional time is lost due to cell phone use by teachers. Twenty-two percent of responding principals agreed with this statement, whereas 78 percent disagreed with the statement.

Question 10: Teachers having cell phones improves school safety. Seventy-three percent of responding principals agreed with this statement, whereas 27 percent disagreed with the statement.

Question 11: Teachers having cell phones facilitates prompt teacher-parent communication. Thirty-three percent of responding principals agreed with this statement whereas, 67 percent disagreed with the statement.

Question 12: Major incidents of violence (e.g., Columbine High School) influenced this school's/district's policy on cell phones. Twenty-one percent of responding principals agreed with this statement while 79 percent disagreed with the statement.

Question 13: Parents are supportive of the school's overall cell phone policy. Eighty-two percent of responding principals agreed with this statement, whereas 18 percent disagreed with the statement.

Question 14: Cell phone use by teachers adversely affects the sustained focus of teachers on the classroom/students. Thirty-one percent of responding principals agreed with this statement while 69 percent disagreed with the statement.

Question 15: Text-messaging features are a problem/potential problem during tests and examinations. Eighty percent of responding principals agreed with this statement while 20 percent disagreed with the statement.

Table 2. Responses of High School Principals to Judgement Questions

	Agree	Disagree	Sig.
9. Direct instructional time is lost due to cell phone use by teachers.	22 percent	78 percent	**
10. Teachers having cell phones improves school safety.	73 percent	27 percent	**
11. Teachers having cell phones facilitates prompt teacher-parent communication.	33 percent	67 percent	**
12. Major incidents of violence (e.g. Columbine High School) influenced my school's/district's policy on cell phones.	21 percent	79 percent	**
13. Parents are supportive of the school's overall cell phone policy.	82 percent	18 percent	**
14. Cell phone use by teachers adversely affects the sustained focus of teachers on the classroom/students.	31 percent	69 percent	**
15. Text-messaging features are a problem/potential problem during tests and examinations	80 percent	20 percent	**

**$p < .01$

Questions 16-19

The patterns and themes of the four open-ended questions are presented below:

Question 16: Principals were asked, "What is the exact policy if a student's cell phone rings during class?" By far, the most common response was immediate confiscation of the cell phone. The penalties were quite broad ranging from confiscation for the remainder of the class period to confiscation for the entire semester. Other reported consequences included: Saturday detention, 3-day suspension, and cell phones returned only to parents.

Question 17: Principals were asked, "What is the exact policy if a teacher's cell phone rings during class?" For most respondents, the school's cell phone policy did not address this issue. The second most frequent response was some type of administrative warning.

Question 18: Principals were asked, "Approximately what percent of your school's teachers, if any, misuse cell phones for personal business?" The percentages of teacher misusing cell phones during instructional time ranged from 0 percent to 100 percent. However, the vast majority of principals rated the problem at 5 percent of teachers or less.

Question 19: Principals were asked, "How has your school addressed the issue of camera phones affecting students' privacy (e.g., in a school locker room, at a nurse's office, or for uploading videos to the web) or being used by students to take photos of a test for friends?" The most common response was that students should not have a phone out during school hours. The second most common response was that many schools have not yet addressed the potential misuse of camera phones.

Discussion

Cell phones have become an integral part of our society, and like most technologies, they have both positive and negative aspects. With technology expanding so rapidly, it can outpace American schools' ability to make appropriate policies.

An examination of the responses to the information questions found in Table 1 revealed the following factors. Almost all schools/districts have a written policy regarding cell phones; however, these policies primarily address students' use of cell phones. As cell phone features increase (e.g., storing documents on them), the policy will likely need to be revisited. Almost all schools permit cell phone use by teachers. This is potentially problematic in that many companies (e.g., Microsoft) are either banning or putting significant restrictions on employee's use of a cell phone during working hours. Perhaps the most common feature of school cell phone policies is that students are prohibited from using the devices at school, and in some cases even bringing cell phones to schools is strictly disallowed. Responding principals believed that teachers used cell phones for purposes other than school-related business. This would be acceptable provided the calls are made during their planning/free periods, at lunch, or after the school day ended. Optimally, however, personal business should be performed after official school hours.

The judgment questions in Table 2 revealed the following factors. Responding principals believed that instructional time is not lost because of teachers' use of cell phones. Teachers who possess cell phones can improve school safety. This issue would be especially true when teachers perform outside-of-the-classroom duties. They could rapidly contact school and public safety officials in the event of an accident or emergency. Teachers having cell phones does not facilitate parent-teacher communication. This is not surprising since teachers have had regular access to telephones for many years when it became necessary to contact a parent. The addition of cell phones probably does not change this dynamic. Major incidents of violence (e.g., Columbine High School) did not influence a school district's policies on cell phones. It is likely that many school districts developed cell phone policies as the use of cell phones became pervasive in the culture and began to have an impact on students' work and the classroom. School safety was probably only one factor, among many, that led to the development of cell phone policies. Parents are generally supportive of the school's cell phone policy. Most district policies restrict cell phone use by students during the school day, and parents seem to believe this is appropriate. Parents seem to agree that cell phone use could be a significant distraction during instructional time. Sustained focus of teachers on students is not affected by the teacher's own use of a cell phone. This correlates with the findings on the previous question concerning the potential affect that a teacher's cell phone use can have on instructional time. Text messaging features are problematic during tests. Text messaging can take place without teachers being aware of it because phones are becoming smaller and more easily obscured. In addition, many students are extremely rapid and proficient at text messaging and could share answers on both multiple choice and essay type items.

The open-ended questions revealed an interesting range of responses. Some conclusions that may be drawn include the following: in general, many district administrators have codified their response when a student's cell phone rings during class, but they have not addressed this same issue for teachers; principals possibly may be hesitant to address the staff's use of cell phones because of their own personal use of this technology; and in many districts, the issue of camera phones have simply not been addressed.

Although not statistically significant, it was somewhat surprising on the basis of Question 8 that the number of districts that do supply cell phones to bus drivers ($n = 48$) was smaller than the number of districts that do not supply cell phones to bus drivers ($n = 55$). Time on a school bus is clearly a time when the students are less supervised and away from established methods of communication. If a school district were extremely conscious about safety issues, bus transportation would likely be a key area where cell phones could potentially affect students' safety.

Cell phones are now an accepted part of the school culture for teachers and students. Most schools or districts *do* have policies in place, and principals believe that parents are generally supportive of the approved policies. The findings in this study run contrary to a number of national incidents in which parents opposed the school's restrictive policy on cell phone use (e.g., Broward County, FL; Salinas, CA; Crosby, TX). Parents seem to believe that cell phones improve the safety of their children, but this may be more an issue of culture and convenience.

The dichotomy between a principal's perceptions that cell phones are used by teachers for issues other than school-related business and their perception that this has no impact on instructional time is difficult to reconcile. It seems unlikely that teachers' use of cell phones for personal business would not to some extent compromise a sustained focus on instruction. In addition, anecdotal evidence suggests that many teachers make and receive phone calls during class time.

The fact that almost all principals listed a specific consequence for a student's cell phone ringing during class indicates that this is an ongoing problem. A student's cell phone ringing during class time would almost certainly have a negative impact on instruction.

Industry trends indicate that within the next year a majority of cell phones will have photo capability as a standard feature. Because the survey revealed that a number of schools have not addressed the issue of camera phones in their current policy, this is an area that will have to be dealt with in the near future.

The capabilities of cell phones have been evolving quite quickly. During the past few years, cell phones have gone from a simple communication tool to include a calculator, a clock with alarm, games, a video function, a calendar, an FM radio, a music player, a picture ID, streaming multimedia, a speaker phone, a hard drive, and a camera with flash. If cell phones mimic other technologies, these features will only increase. Schools will be pressed to stay ahead of this fast-moving technology. A policy on cell phone use made only a few years ago may be outdated by today's technology. As new technology emerges, policies must grow and change as well. This presents an ongoing challenge for school leaders.

Dr. S. John Obringer is a Professor in the Department of Counseling, Educational Psychology, and Special Education at Mississippi State University in Starkville, MS

Dr. Kent Coffey is a Professor in the Department of Counseling, Educational Psychology, and Special Education at Mississippi State University in Starkville, MS

References

Bullying shoots into cyber space. (2005). *District Administration, 41*(6), 18.

Calling cell phones bans in to question. (2002). *Current Events, 101*(19), 3.

Carroll, C. A. (2004). Camera phones raise whole new set of privacy issues. *Education Week, 23*(23), 8.

Danforth, E. L. (2003). Mixed signals. *American School Board Journal, 190*(7), 30–32.

Dianis, C. (2004). Local schools happy with cell phone policies. Retrieved September 20, 200,5 from http://www.stamfordadvocate.com/news/local/scn-sa-cells3aug24,0,303581.story?coll=stam-news-local-headlines

Dyrli. O. E. (September, 2004). Odvard Egil Dyrli on cell phone camera policies. www.DistrictAdminnistration.com

Galley, M. (2000). Districts inclined to hang up on students' cellular phones. *Education Week, 19*(28), 13.

Gilroy, M. (2003). Invasion of the classroom cell phones. *Hispanic Outlook in Higher Education, 14*, 38–39.

Hurst, M. D. (2004). Nevada report reveals spike in test irregularities. *Education Week, 24*(6), 19, 22.

Meer, K. F. (2004). Should we ban cell phones in school? *NEA Today, 22*(5), 42.

National School Safety and Security Services. (2005). Cell phone and pager use. Retrieved September 29, 2005 from http://www.schoolsecurity.org/trends/cell_phones.html

NetDay's 2004 survey results show 58 percent of students have cell phones, 60 percent email or IM adults on a weekly basis (March 8, 2005). Retrieved September 29, 2005, from http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=104&STOR.

The right to ring. (2004). *Scholastic Action, 28*(1), 6.

Appendix 1

For questions 1-8 circle Yes or No:

Yes	No	1.	Does your school/district have a written policy regarding cell phones?
Yes	No	2.	Does your school permit cell phone use by teachers?
Yes	No	3.	Does your school permit cell phone use by students?
Yes	No	4.	Does your school allow students to leave cell phones on silent mode?
Yes	No	5.	Do teachers have access to a hard-wired phone in their classrooms?
Yes	No	6.	Do you believe that teachers who utilize cell phones use them only for school-related business?
Yes	No	7.	Does your school district supply cell phones for administrators?
Yes	No	8.	Do bus drivers have cell phones supplied by the school/district for safety?

For questions 9-15 circle SA for strongly agree, A for agree, D for disagree and SD for strongly disagree:

SA A D SD	9.	Direct instructional time is lost due to cell phone use by teachers.
SA A D SD	10.	Teachers having cell phones improves school safety.
SA A D SD	11.	Teachers having cell phones facilitates prompt teacher-parent communication.
SA A D SD	12.	Major incidents of violence (e.g. Columbine High School) influenced my school's/district's policy on cell phones.
SA A D SD	13.	Parents are supportive of the school's overall cell phone policy.
SA A D SD	14.	Cell phone use by teachers adversely affects the sustained focus of teachers on the classroom/students.
SA A D SD	15.	Text-messaging features are a problem/potential problem during tests and examinations.

For questions 16-19 please answer briefly:

16. What is the exact policy if a student's cell phone rings during class?
17. What is the exact policy if a teacher's cell phone rings during class?
18. Approximately what percentage of your school's teachers, if any, misuse cell phones for personal business?
19. How has your school addressed the issue of camera phones impacting student privacy (e.g. in school locker room, nurse's office, uploading videos to the web, etc..) or students taking photos of a test for friends?

Training Transfer between CD-ROM Based Instruction and Traditional Classroom Instruction

Gregory C. Petty, Doo H. Lim, and Jeff Zulauf

Abstract

Many research studies on the effect of organizational factors on training transfer have been conducted, but few studies have considered the effect that different training delivery methods have on training transfer. This study sought to identify if there is any difference in the perceived transfer of training between traditional classroom instruction learners and computer-based instruction learners. Other demographic variables (e.g., years of work experience, age, level of education, years of experience as a supervisor, online course experience, and gender) also were investigated to assess their influence of the transfer of training. The study results revealed that training delivery methods did not make any significant difference in the transfer of training while several demographic variables were associated with significant differences in some of the five subcategories of training transfer construct (organizational support, supervisory support, peer support, motivation, and self-efficacy).

As globalization increasingly affects the workplace, today's organizations are facing severe competition from around the world. Among many performance solutions to equip organizations and their employees with competitive organizational and individual competencies to lead the global business environment, learning has been considered one of the most promising solutions that strategically addresses performance issues at the individual, group, and organizational level (Poell & Krogt, 2003). For private sector organizations, the return on training investment has been a critical issue to verify the impact that training has on improved organizational performance (Phillips, 1997). As advancements in learning and performance technologies have created a strong impetus to use technology-driven learning solutions, more organizations utilize cost-saving learning technologies to improve performance in all domains of the organization (Clark, 1999). As a technology-driven learning solution, computer-based instruction (CBI) has been one of the most frequently used methods proven to be a cost effective and yet instructionally sound delivery method for learning (Blotzer, 2000; Wilson, 2000).

Millions of dollars are spent each year to deliver training programs in the workplace (Greengard, 1999). In a recent benchmarking survey, it has been estimated that the corporate expenditure for training in the United States was $3.5 billion during 2002 (Levis, 2002). It is still unclear, however, what types of training methods have produced tangible results for organizations. Traditionally, instructor-led classroom training has been the dominant style of training delivery (Evuleocha, 1997; Lawson, 1999). Other studies indicate that technology-driven training programs continue to expand in public as well as private organizations (Filipczak, 1996). With more investment being made on technology-driven training programs, this would seem an appropriate time to measure whether it would be a better alternative to traditional classroom training.

Problem Statement

Computer-based Instruction (CBI) has been at the forefront of discussion among many researchers because of its cost effectiveness for learning and performance improvement (Mottl, 2000; Wilson, 2000; Lawson, 1999; Rand, 1996). Mottl (2000) asserted that traditional classroom instruction costs approximately $75 an hour, where as CBI costs about half the traditional classroom instruction costs. Due to this cost ratio, the use of traditional classroom instruction declined, and technology-driven courses are predicted to rise. According to a recent survey, the volume of traditional classroom training decreased from 77 percent to 72 percent between 2001 and 2002 and training delivery via learning technologies increased from 10.5 percent to 15.4 percent between 2001 and 2002 (Thompson & Wellins, 2003). This kind of trend raises critical questions about the effectiveness and ability to transfer CBI compared to traditional classroom instruction (Filipczak, 1996; Mottl, 2000; Maul & Spotts, 1993; & Greengard, 1999).

There is an evident gap in the knowledge base when comparing CBI to traditional classroom instruction as it pertains to transfer of training. Since the advent of CBI, abundant amounts of research studies on technology-based training programs and their effectiveness have surfaced (Wilson, 2000; Greengard, 1999;

Fister, 1998; Filipczak, 1996; Rand, 1996). These studies document that the use of CBI in education results in higher learning retention rates (Kerr, 1998), higher return on investment (Allen, 1996), reduced learning time (Maul & Spotts, 1993), and reduced costs for training delivery (Lawson, 1999) compared to the use of traditional classroom instruction. Because traditional classroom training is still the dominant means of instruction in the corporate environment, little research has been done to compare the two types of training (CBI versus traditional classroom instruction) and measure the perceived barriers for effective transfer of training (Evuleocha, 1997; Lawson, 1999; Filipczak, 1996). Most of the research on CBI and traditional classroom instruction concentrated on the mere advantages and disadvantages of both training methods. Little evidence has been shown as to the transferability of CBI compared to the traditional classroom instruction. A comparison between CBI and traditional classroom instruction is necessary to differentiate which type of training would produce more appropriate results for the transfer of training that results in performance improvement.

Research Questions

1. The purpose of this study is to determine the motivational factors, support factors, self-efficacy, and demographic factors that affect the employees at a paper-production company in the United States and their intentions to transfer training as measured by the Training Performance Transfer Instrument (TPT). Several research questions were developed to address the research purpose.

2. Is there a significant difference in the transfer of training between the CD-ROM-based learners and traditional classroom-based learners based on the five training transfer variables of organizational support, supervisory support, peer support, motivation, and self-efficacy?

3. What demographic variables (e.g., age, job title, years of full-time experience, level of education, years of experience as a supervisor, and gender) affect learners' perceived training transfer?

Theoretical Framework

Training Transfer Models and Variables

Training transfer studies have focused on several meaningful constructs including individual and organizational variables that are believed to promote or hinder the transfer of learning in organizational settings. Baldwin and Ford (1988) proposed a training transfer construct in three domains of transfer: training inputs, training outputs, and conditions of transfer. Parry (1990) described three factors for improving training transfer: personal factors, instructional factors, and organizational factors. Foxon (1997) believed that transfer of training was a process rather than an outcome or product of training. Foxon's transfer model is expressed in terms of initiation of transfer, frequency of transfer, and overall transfer. This model contains several transfer factors: organizational climate, motivation to transfer, manager support, peer support, and action planning. Holton (1996) developed the Learning Transfer Systems Inventory (LTSI) expressing training transfer as a function of ability, motivation, and environmental factors at three outcome levels: learning, individual performance, and organizational performance. Geilen (1996) presented another training transfer construct containing transfer variables of training design characteristics, trainee characteristics, and work environment characteristics.

Apart from these integrated models of training transfer, other research studies were conducted to verify independent variables in work system factors and people factors (Rainey, 1993), organizational culture (Tracey, Tannenbaum, & Kavanagh, 1995), opportunity to use training (Ford, Quinones, Sego, & Sorra, 1992; Lim, 2001; Clarke, 2002), match between training and organizational goals (Montesino, 2002), availability of mentor (Richey, 1990), goal setting (Gist, Bavetta, & Stevens, 1991), identical elements between training and work setting (Garavaglia, 1993), and support from peers and supervisors (Ford et al., 1992; Tracey, Hinkin, Tannenbaum, & Mathieu, 2001). From the review of many transfer studies, the concept of transfer of training seems to contain some meaningful themes to expand the research study. First, the concept of transfer of training can be viewed either as process or outcome. Second, various transfer variables either promote or hinder the transfer process. The transfer variables can be categorized into personal factors (learning readiness, self-efficacy, goal setting, motivation, etc.), instructional factors (transfer design, identical content, transfer strategies, action learning, etc.), work factors (opportunity to use training, availability of tools, availability of mentor, etc.), and organizational factors (peer support, supervisor support, reward system, organizational culture, etc.). Third, these transfer variables interact with each other to form situation-specific force of training transfer either with negative or positive influences.

Computer-based Instruction and Learner Variables

A CBI program generally includes tutorials, practice exercises, and case studies with more sophisticated interactions incorporating game-based activities and business simulations (Rand, 1996). Compared to traditional classroom instruction, several advantages of CBI include consistent learning content, anytime and anywhere learning, interactive learning to promote learners' interest, automated record keeping and tracking, multimedia content, self-paced learning, and reduced training time and costs (Kerr, 1998; Lawson, 1999). Some shortcomings of CBI, however, also exist. These include the lack of human aspects in interaction (Sullivan, 1998), ineffective hands-on practices and lack of instructor feedback requiring self-motivation for learning (Rodriguez, 1999), difficulty to update content change (Fister, 1998), lack of peer interaction (Rand, 1996), and computer literacy issues (Lawson, 1999). Despite these weaknesses of CBI, Goldstein (1998) advocates that CBI systems are learner-centered-environments that provide self-paced learning and interactive training sessions satisfying a user's learning style. Several features of CBI, such as video, audio, and interactive testing, are believed to maintain an individual learner's attention and can improve learning compared to traditional classroom instruction.

Among several learner variables that affect the transfer of training, motivation to transfer and self-efficacy were identified as ones that play a major role in learning transfer (Machin & Fogarty, 1997; Foxon, 1997; Facteau, Dobbins, Russell, Ladd, & Kudish, 1995). First, self-efficacy refers to one's beliefs and feelings of self-worth regarding how well he/she can perform and be responsible in a learning task (Bandura, 1994; Foster, 2001). Bandura posited that confidence in one's ability for success will affect the learner's initial willingness to try, individual persistence, and the level of personal investment. For concepts of motivation, Pinder (1998) described work motivation as a set of internal and external forces that initiate work-related behavior and determine its form, directions, intensity, and duration. Ambrose and Kulik (1999) claimed that there were two types of motivational forces: environmental forces (organizational reward systems, the nature of work being performed) and personal forces (individual needs and motives) on work-related behavior. Herzberg's two-factor theory of motivation distinguishes between intrinsic (motivators) and extrinsic (hygiene) factors (Herzberg, 1982). Other job-related motivation factors include opportunities for promotion and job challenges (Kaplan, Jayaratne, & Chess, 1994). Motivation is also influenced by such factors as trainees' confidence in their ability to use the new skills, by their perception of the relevance of the training to their work, by their ability to identify work situations where using the skills would be appropriate, and by their belief that using the new skill will improve their job performance (Baldwin, Magjuka, & Loher, 1991; Holton, 1996; Noe, 1986; Tannenbaum, Mathieu, Salas, & Cannon-Bowers, 1991). A study conducted by Machin and Fogarty (1997) examined several individual characteristics (self-efficacy, motivation to transfer, training reactions, goals for transfer, and commitment to transfer goals) and concluded that self-efficacy and motivation to transfer training were significantly related to positive transfer intentions.

Methodology

This study utilized a quantitative approach to compare differences in perceived transfer of training between CD-ROM-based learners and traditional classroom learners. The sample for this study was the full-time employees of a branch mill of a paper-production company located in a southeastern state. The entire population of employees at the mill was surveyed. This sample was chosen based on its accessibility to the researchers. Approximately 370 questionnaires were distributed, and 278 responses were returned, which equaled a 75 percent return rate. The survey instruments were distributed in person at the morning and evening shift change meetings. Mail delivery was also used to reach employees who could not be contacted during team meetings. After two weeks, a follow-up e-mail was sent out to participants who had not finished the survey. Traditional learners were differentiated from CD-ROM-based learners based on the amount of CD-ROM-based experience the person declared on his or her survey.

From a review of literature to find the most suitable instrument for the purpose of this study, three instruments were selected and compared: the Trainer's Assessment Proficiency (TAP), the Wechsler Memory Scale III, and the Training Performance Transfer (TPT). After further investigation of the three instruments, the researchers concluded that the TPT was a better fit for the purpose of this study. This instrument is subdivided into two sections. The first part consists of five sub-scales that included 42 performance statements to determine the identified factors or barriers in the transfer process. These five subscales are: (a) supervisor support, (b) organizational support, (c) peer support, (d) self-efficacy, and (e) motivation to transfer. The instrument uses a Likert-type scale ranging from one to five (1 = Never, 2 = Seldom, 3 = Sometimes, 4 = Usually, and 5 = Always). The second part of the survey consists of eight demographic questions regarding age, gender, years of full-time work experience, job title, years of experiences as a supervisor, CD-ROM course experience, online course experience, and level of education. The TPT instrument was used with consent and permission. Data analysis revealed the Cronbach's alpha for the five sub-scales were all higher than .74.

The data analysis utilized descriptive statistics to interpret employees' demographic information and calculate the mean scores of the TPT's sub-scales. The independent variables in this study were the employees' demographic information. The dependent variables consisted of the five sub-scales that either inhibited or promoted the transfer of training as measured by the TPT instrument. A univariate analysis of variance (UNIANOVA) test was conducted to analyze the employees' perceptions of the transfer of training process according to the five descriptors (self-efficacy, peer support, organizational support, supervisor support, and motivation). The Tukey Honestly Significant Difference (HSD) post hoc test was used to analyze any differences that persisted among the eight demographic variables (age, gender, years of full-time work experience, job title, years of experiences as a supervisor, CD-ROM course experience, online course experience, and level of education).

Background Information about the Company

The paper mill, which was used for this study, is one of many paper mills located in the United States and abroad by this particular paper-production company. The mill was designed using high-performance work teams (HPWT). This type of work design allows teams and individuals to be more actively involved in the day-to-day decision-making process. The mill is operated with 12-hour rotating shifts in order for the mill to run 24 hours a day, 365 days per year. The employees of the mill have received traditional classroom training in the areas of team building, new hire orientation, leadership, and many other topics. All employees of the mill received competency-based training that combines traditional classroom instruction with on-the-job instruction. Some employees have received instruction on OSHA safety training via CD-ROMs and web-based instruction to teach the purchasing system at the mill.

Findings

Two research objectives were set for this study. The first objective was to identify differences that might exist between traditional classroom learners and CD-ROM-based learners based on the five descriptive factors and their perceptions of transfer of related training. The second objective was to determine any differences that might exist between traditional classroom learners and CD-ROM-based learners based on the eight demographic factors.

Demographic Characteristics

The demographic information collected for this study includes age, gender, years of full-time work experience, job title, years of experiences as a supervisor, CD-ROM course experience, and level of education. Data analysis revealed that 137 (49.3%) participants did not have any CD-ROM course experience, 80 (28.8%) participants had less than 20 hours of experience, and 61 (21.9%) participants had more than 20 hours of course experience. For the purpose of this study, the 141 respondents who had less than 20 hours and more than 20 hours were defined as CD-ROM-based learners (50.7% of all respondents). Regarding job title, 181 (65.1%) were machine operators, 41 (14.7%) were maintenance personnel, and 56 (20.1%) were resource personnel respectively. For the number of years of full-time work experience at the company, 43 (17.3%) respondents had less than one year of experience, 78 (28.1%) had one to five years of experience, and 152 (54.7%) had five or more years of experience. In terms of level of education, there was only one respondent (0.4%) who had less than a high school diploma, 184 (66.2%) attained a high school degree or GED, 55 (19.8%) had two years of college or associate's degree, 27 (9.7%) had a bachelor's degree, and 11 (4.0%) had completed at least some graduate work. For the years of experience as a supervisor, 149 (53.6%) of the respondents reported no experience, 42 (15.1%) had less than two years of experience, 69 (24.8%) respondents had between two and eight years, and 18 (6.5%) had more than eight years of supervisory experience. Responses to gender revealed that there were 62 (22.3%) female and 216 (77.7%) male participants. The age of the respondents was also examined. Among all respondents, 22 (7.9%) were 20 to 26 years of age, 84 (30.2%) were between the ages of 27 and 35, 167 (60.1%) were between the ages of 36 and 55, and 5 (1.8%) were over 55 years old.

Difference in the Transfer of Training Between the Two Delivery Formats

In order to examine if there is any significant difference in the perceptions of transfer of related training between CD-ROM-based instruction and traditional classroom instruction based on the five subcategories of supervisor support, peer support, self-efficacy, organizational support, and motivation, a Univariate Analysis of Variance (UNIANOVA) was calculated. The analysis revealed there were no significant differences between CD-ROM-based learners and traditional classroom learners for the five subcategories. Table 1 shows the Cronbach's Alpha scores for the five subcategories.

Effect of Demographic Variables on Training Transfer

In order to investigate if there is any significant difference in perceptions of the transfer of training as measured by the TPT survey based on the eight demographic variables used in this study, a UNIANOVA was conducted. From the data analysis, the demographic variable of job title and years of work experience registered a significant difference for the organizational support. For supervisory support, job title, years of work experience, and level of education indicated significant differences for the transfer of training. For peer support, only years in work experience showed a significant p-value. For motivation, job title, years of work experience, years of experience as a supervisor, and age indicated a significant difference. Lastly, for self-efficacy, job title, years of work experience, level of education, and age were found to have significant p-values. These findings are summarized in Table 2.

The Tukey HSD test was used to explore any further differences within some the subcategories of the demographic variables (age, years of full-time work experience, job title, and educational level). When the subcategories of the years of full-time work experience were compared with organizational support, respondents with less than one year perceived a significantly higher organizational support than either those with one to five years or those with more than 5 years of work experience. Respondents with one to five years of work experience also indicated a significant higher mean score for organizational support than those with over 5 years of work experience. For supervisor support, those with more than five years of experience were significantly different in their perceptions of supervisor support than respondents with less than one year and one to five years of experience. With respect to peer support, respondents with more than five years of experience reported significantly different perceptions of peer support compared to those with less than one year of experience and those with one to five years of experience. The Tukey HSD compared years of full-time work experience to motivation looking for significant differences. The analysis found that respondents with more than five years of experience were significantly different in their perceptions of motivation from those with less than one year of experience and those with one to five years of experience. Regarding

Table 1. Cronbach's Alpha for the Five Subcategories

	Organizational Support	Supervisor Support	Peer Support	Motivation	Self-Efficacy
Questions	1, 5, 6, 8, 11, 12, 16, 22, 29, 31, 35, 37	4, 9, 15, 20, 24, 27, 32, 33, 40, 41	10, 21, 34, 42	2, 13, 19, 26, 28, 30, 36, 38, 39	3, 7, 14, 17, 18, 23, 25
Cronbach's Alpha	.7427	.9214	.8561	.7146	.8590

Subcategories		Job Title	Yrs. Wrk. Exp.	Edu. Level	Yrs. Exp. Sup.	Age
Organizational Support	Sig.	.004*	.000*	.056	.575	.493
	F value	5.528	10.900	2.340	.664	.803
Supervisory Support	Sig.	.006*	.000*	.013*	.354	.442
	F value	5.248	12.782	3.235	1.090	.900
Peer Support	Sig.	.676	.004*	.332	.371	.069
	F value	.392	5.563	1.154	1.051	2.392
Motivation	Sig.	.000*	.000*	.139	.046*	.026*
	F value	14.168	13.170	1.754	2.708	3.152
Self-efficacy	Sig.	.026*	.025*	.047*	.067	.004*
	F value	3.718	3.736	2.446	2.412	4.546

*Significance at .05 level.
Note. Yrs. Wrk. Exp. = Years of full-time work experience, Yrs. Exp. Sup. = Years of experience as a supervisor.

Table 2. UNIANOVA for the Demographic Variables and the Transfer Subcategories

age, responses of those between the ages of 20–26 were significantly different than those ages 27–35 and those 36–55. Those ages 27–35 had significantly different responses from those ages 20–26. Respondents ages 36–55 were significantly different in their perceptions of motivation than respondents ages 20–26.

With regards to self-efficacy, respondents ages 20–26 were significantly different in their perceptions of self-efficacy as compared to those ages 27–37 and those 36–55. Those who were 37–55 were significantly different than those ages 20–26. Respondents with 36–55 reported significant differences in perception than those ages 20–26. Respondents with years of full-time work experience reported significant differences in their perceptions of self-efficacy. Respondents with less than one year of experience felt significantly different than respondents with more than five years of experience. Those with more than five years of experience felt significantly different than those with less than one year of experience. In job title, there were significant differences reported in the respondents' perceptions of self-efficacy between machine operators and resource personnel. Table 3 presents the findings from the Tukey HSD tests.

Conclusion and Discussion

This study has sought to identify differences that might exist between traditional classroom learners and CD-ROM-based learners based on their perceptions of transfer of training for the five descriptive factors. It also tried to determine the effect of the eight demographic variables on the five training transfer factors. Several conclusions could be drawn from the study's findings. First, the study revealed there is no significant difference in the perception of the transfer of training between the employees who

Table 3. Tukey HSD Tests for the Subcategories of the Demographic Variables

Demographic Variables	Comparison Groups		Training Transfer Variables: OR Support	Supervisor Support	Peer Support	Motivation	Self-efficacy
Job Title	Machine	Resource	.230	.099	.123	<.001*	.006*
	Resource	Maintenance	.324	.193	.087	.031*	.336
Yrs. Wk. Exp.	> 1 year	1-5 years	.015*	.071	.215	.068	.420
	> 1 year	< 5 years	.001*	<.001*	<.001*	<.001*	.021*
	1-5 years	< 5 years	.030*	.004*	.042*	.008*	.278
Age	20–26	27–35	.082	.557	.343	.007*	.028*
	20–26	36–55	.239	.463	.175	.006*	.012*

* Significance at .05 level.

had traditional classroom training and those with CD-ROM-based training. This implies that delivery methods may not influence the transfer of training of a specific training program. Rather, other variables (e.g., years in full-time work experience, job title, and age) were found to significantly influence the transfer process of a training program. Second, among the different variable categories, personal variables, such as motivation and self-efficacy, indicated more associations with the demographic variables than the organizational variables of organizational support, supervisory support, and peer support. Third, the fewer years of full-time work experience, the greater the chance to transfer training.

The study results reveal that there are no differences in the perceptions of transfer of related training between traditional classroom instruction and CD-ROM-based instruction within a manufacturing company. Therefore, this finding may justify using more CBI for training delivery in these types of organizations. The benefit of CBI would lower training costs for program development, delivery, and evaluation while keeping the same level of training transfer. One consideration, however, is that instructional designers of the CBI programs may need to tailor their training programs more closely to the demographic differences in their workplaces. According to the study's findings, aging workers with higher levels of work experience in the machine trades need more support from the organization, supervisors, and peers to transfer their training to jobs and tasks. Issues of motivation and self-efficacy for these aging workers should also be addressed to promote higher transfer of training. This implies that human resource development efforts and resources within a corporate environment should be balanced to address workplace performance issues between the existing human resources and the new hires. The existing workers also become a critical target population who need to learn and transfer their skills, otherwise they may become stagnant, and this can hinder the transfer of training.

Limitations of the Study

This study produced several meaningful findings regarding the transfer of training research. The major findings, however, may contain some limitations for generalization. The subjects of the study were limited to a specific industry-paper production, and data collection was undertaken at a paper mill. The study utilized subjects' perceptions about the transfer of training instead of actual transfer performance data. Due to these limitations, the generalization of the research findings may not be appropriate.

These data might serve as a baseline for future research in the area of transfer of related training pertaining to CD-ROM-based instruction and transfer of training studies. In order to broaden the scope of this study, future research studies should utilize larger populations from other manufacturing companies and other industry sectors. Also, gathering actual performance data to document the transfer of training is another extension of this study. More research should be conducted to explore CD-ROM-based instruction and other technology-based instruction (e.g., online instruction, simulation, and virtual reality). Research concerning technology-based instruction and its ability to transfer to the job should be conducted both qualitatively and quantitatively to further explore in-depth information about the training transfer process.

Dr. Gregory C. Petty is a Professor of Instructional Technology, Health, and Cultural Studies at the University of Tennessee, Knoxville. He is a Member-at-large of Epsilon Pi Tau.

Dr. Doo H. Lim is Assistant Professor of Management at the University of Tennessee, Knoxville.

Jeff Zulauf is a graduate of the Human Resource Development program at the University of Tennessee, Knoxville and works for Kimberly Clark Corporation, Loudon, Tennessee.

References

Allen, R. J. (1996). The ROI (return on investment) of CBT (computer-based training). *CD-ROM Professional, 9* (10), 34-45.

Ambrose, M. L., & Kulik, C. T. (1999). Old friends, new faces: Motivation research in the 1990's. *Journal of Management, 25* (3), 231-292.

Baldwin, T. T., & Ford, J. K. (1988). Transfer of training: A review and directions for future research. *Personnel Psychology, 41,* 63-105.

Baldwin, T. T., Magjuka, R. J., & Loher, B. T. (1991). The perils of participation: Effects of choice of training on trainee motivation and learning. *Personnel Psychology, 44,* 51-67.

Bandura, A. (1994). *Self-efficacy: The exercise of control*. New York: Freeman.

Blotzer, M. J. (2000). Web-based training. *Occupational Hazards, 62,* 35-38.

Clark, K. F. (1999). Virtual evolution. *Human Resource Executive, 13*(4), 32-33.

Clarke, N. (2002). Job/work environment factors influencing training transfer within a human service agency: Some indicative support for Baldwin and Ford's transfer climate construct, *International Journal of Training and Development, 6*(3), 146-162.

Evuleocha, S. (1997). The effect of interactive multimedia on learning styles. *Business Communication Quarterly, 60*(2), 127-129.

Facteau, J., Dobbins, G., Russell, J., Ladd, R., & Kudish, J. (1995). The influences of general perceptions of the training environment on pre-training motivation and perceived training transfer. *Journal of Management, 21* (1), 1-25.

Filipczak, B. (1996). Engaged! The nature of computer interactivity. *Training, 33,* 52-58.

Fister, S. (1998). The hybrid solution: Combining the Web with CD-ROM. *Training, 35,* 24-26.

Ford, J., Quinones, M. A., Sego, D. J., Sorra, J. S. (1992). Factors affecting the opportunity to perform trained tasks on the job. *Personnel Psychology, 45,* 511-527.

Foster, J. J. (2001). Why technology is being integrated into the classroom at such a slow rate: A discussion of self-efficacy, motivation, and utility. *Proceedings of the 2001 Society for Information Technology and Teacher Education* (pp. 2178-2179), AACE, Orlando.

Foxon, M. (1997). The influence of motivation to transfer, action planning, and manager support on the transfer process. *Performance Improvement Quarterly, 10* (2), 42-63.

Garavaglia, P. L. (1993). How to ensure transfer of learning. *Training of Development, 47 (10),* 63-69.

Geilen, E. W. (1996). Transfer of training in a corporate setting: Testing a model. In E. Fr. Holton (Ed.), *Proceedings of Academy of Human Resource Development* (pp. 434-441). Baton Rouge, LA: AHRD.

Gist, M., Bavetta, C., & Stevens, C. (1991). Effects of self-efficacy and post training intervention on the acquisition and maintenance of complex interpersonal skills. *Personnel Psychology, 44*, 837-861.

Goldstein, J. (1998). The case for learning styles. *Training & Development, 52*(9)*,* 36.

Greengard, S. (1999). Web-based training yields maximum returns. *Workforce, 78,* 95-96.

Herzberg, F. (1982). *The managerial choice: To be efficient and to be human*. Salt Lake City, UT: Olympus.

Holton, E. (1996). The flawed four level evaluation model. *Human Resource Development Quarterly, 7,* (1)*,* 5-21.

Kaplan, V. D., Jayaratne, S., & Chess, W. A. (1994). Job satisfaction and retention of social workers in public agencies, non-profit agencies, and private practice: The impact of workplace conditions and motivator. *Administration in Social Work, 18*(3), 93-121.

Kerr, D. C. (1998). *The education dean: Perspectives on the human dimension of restructuring*. Unpublished doctoral dissertation, Widener University, Chester, PA.

Lawson, S. R. (1999). Is it the next wave? *Professional Safety, 44,* 30-33.

Levis, K. (2002). *The business of E-learning: A revolution in training and education markets*. Retrieved May 15, 2003 from http://www.hrmguide.net/usa/hrd/e-learning_survey.htm.

Lim, D. H. & Johnson, S. D. (2002). Trainee perceptions of factors that influence learning transfer. *International Journal of Training and Development, 6*(1), 36-48.

Machin, M., & Fogarty, G. (1997). The effects of self-efficacy, motivation to transfer, and situational constraints on transfer intentions and transfer of training. *Performance Improvement Quarterly, 10* (2), 98-115

Maul, G. P., & Spotts, D. S. (1993). A comparison of computer-based training and classroom instruction. *Industrial Engineering, 25*(2), 25-27.

Montesino, M. U. (2002). Strategic alignment of training, transfer-enhancing behaviors, and training usage: A posttraining study. *Human Resource Development Quarterly, 13*(1), 89-108.

Mottl, J. N. (2000). Learn at a distance. *Informationweek, 767,* 75-78.

Noe, R. A. (1986). Trainee's attributes and attitudes: Neglected influences on training effectiveness. *Academy of Management Review, 11*(4), 736-749.

Parry, S. (1990). Ideas for improving transfer of training. *Adult Learning, 1*(7), 19-23.

Phillips, J. J. (1997). *Return on investment in training and performance improvement programs*, Houston, TX: Gulf Publishing.

Pinder, C. (1998). *Work motivation in organizational behavior*. Upper Saddle River, NJ: Prentice-Hall.

Poell, R. F., & Van der Krogt, F. J. (2003). Learning strategies of workers in the knowledge-creating company. *Human Resource Development International, 6*(3), 387-403.

Rainey, E. (1983). *How to communicate with your professional staff: Build the proper climate.* Paper presented at the National School Boards Association Convention, San Francisco, CA.

Rand, A. (1996). Technology transforms training. *HR Focus, 73,* 11-13.

Richey, R. C. (1990). *The effects of organizational climate factors on industrial training outcomes*. Paper presented at the Convention of the Association for Educational Communications and Technology, Ames, Iowa.

Rodriguez, L. (1999). Turn any room into a classroom. *Sales and Marketing Management, 151*(1), 75-76.

Sullivan, E. (1998). The web isn't always the best teacher. *PC Week, 15,* 36.

Tannenbaum, S., Mathieu, J., Salas, E., & Cannon-Bowers, J. (1991). Meeting trainee's expectations: The influence of training fulfillment on the development of commitment, self-efficacy, and motivation. *Journal of Applied Psychology, 76,* 759-769.

Thompson, C., & Wellins, R. (2003). *Training projections for 2003: Results of an ASTD/DDI poll.* Alexandria, VA: ASTD.

Tracey, B. J., Hinkin, T. R., Tannenbaum, S., & Mathieu, J. E. (2001). The influence of individual characteristics and the work environment on varying levels of training outcomes. *Human Resource Development Quarterly, 12*(1), 5-23.

Tracey, J., Tannenbaum, S. I., & Kavanagh, M. J. (1995). Applying trained skills on the job: The impact of the work environment. *Journal of Applied Psychology, 80,* 239-252.

Wilson, M. (2000). Some companies aren't ready for CBT. *Workforce, 79,* 123-124.

Adoption of Aquaculture Technology by Fish Farmers in Imo State of Nigeria

Nwachukwu Ike and Onuegbu Roseline

Abstract

This paper evaluated the level of adoption of aquaculture technology extended to farmers in Imo State, Nigeria. To improve aquaculture practice in Nigeria, a technology package was developed and disseminated to farmers in the state. This package included ten practices that the farmers were supposed to adopt. Eighty–two respondents were randomly selected from the three zones of the state. Data were collected through structured interview schedule. The results showed that the level of adoption of the technology was low. Less than half of the respondents adopted the technology. After the construction of the ponds, which were usually not to specification, the farmers found it difficult to adopt the other recommendations, (e.g., pond maintenance, feeding, harvesting, and fish preservation). It was discovered that the farmers did not have adequate funds to maintain their small ponds and to purchase the necessary feed and other necessities for aquaculture. To increase the level of adoption of aquaculture technologies in Nigeria, it is necessary to change its perception from subsistence to commercial and sustainable farming practice; to assist the farmers with credit facilities and to provide closer monitoring of the process by extension agents.

Introduction

In Nigeria, fish production is not only important as a source of rich protein, but it also can be used to bring about institutional changes. These changes can offer access to production assets and resources, which can help to empower the poor and directly promote their livelihood (Obikezie, 1999). Unfortunately, Nigeria is not producing enough fish for consumption; also, the fish industry is not providing the much needed financial empowerment that the fish farmers need. According to the Food and Agriculture Organisation of the United Nations (FAO, 2006a) there is a huge supply demand gap for fish and fishery products in Nigeria. According to the report, there is about 400,000 tons of supply in comparison to the 800,000 tons of demand. This makes Nigeria one of the largest importers of fish in the developing world, importing 600,000 metric tons annually (Moehl, 2003). It is therefore necessary to ensure that improved fish production technologies that have been developed and disseminated are adopted, in order to increase fish production.

The fishery industry is crucial to the World economy. The livelihood of millions of people worldwide are dependent on fish farming (Greenfacts, 2004). Fish provides a rich source of protein for human consumption. The flesh of fish is also readily digestible and immediately utilizable by the human body, which makes it suitable and complementary for regions of the world with high carbohydrate diet, like Africa (FAO, 2005a). Research results have linked seafood consumption to reduced risk of disease. The U.S. Government has recommended that all Americans eat two seafood meals per week (Healthnews Digest, 2006). In 2002, the world's total fishery production was reported to be 133 million tons (Vannuccini, 2004).The production from world capture fisheries amounted to 93.2 million tons. This represents a slight increase of 0.4 percent compared with 2001, but a 2.4 percent decline from the peak of 95.5 million tons reached in 2002. About 74 percent of fish produced were used for direct human consumption (Vannuccini, 2004).

Globally, however evidence indicates that in many areas fishery management is failing (Cichrame, 2000). Though it has been geared toward full employment and social peace, the management of the fishery industry has not achieved this goal. According to FAO reports (2005b) the system is not operating in a sustainable and efficient manner. Over the years, however, efforts have been made to develop new technologies, which have been introduced to the industry. This has led to more fish being caught, but this has also resulted in the overexploitation of fisheries (MacLennan, 1995).

The global fisheries production data is not a true reflection of the development in some of the regions of the world. The Less Developing Countries (LDCs) have been experiencing serious decline in production in recent years. Per capita fish supply in the LDCs is still relatively low at an estimated 8.5kg in 2001 (industrialized countries = 13.2 kg) (Greenfacts, 2004). In Africa, the fish sector provides income for over 10 million people engaged in fish production, processing and trade (New Partnership for African Development, 2005). Fish has also become a leading export commodity for Africa with an annual export value of $2.7 billion (U.S.). Yet these benefits are at risk as the exploitation of natural fish stocks is reaching its limits (Mutume, 2002). Although there is a paucity of information on the status of the fisheries industry, and the role it plays, it is estimated that Africa produced 7.3 million tons in 2003, and 4.8 million tons was from marine fisheries (FAO, 2003).

Aquaculture is the breeding and rearing of fish, shellfish, or plants in ponds, or any enclosure for direct harvest of the product. It has come to greatly augment the dwindling marine fish production worldwide, and this field is growing rapidly (Muir & Nugent, 1995; FAO, 2004). Data from Greenfacts (2004) has shown that aquaculture is the fastest-growing animal-based food production sector, particularly in the developing countries – mainly from China and other Asian countries. In Africa, the governments of the continent under the aegis of the African Union, have identified the great potential of aquaculture and are determined to encourage private sector investment (NEPAD, 2005). The potential exists for aquaculture to make a difference as shown by pilot projects, although these pilot projects fail when they are scaled up (Newagriculturists, 2005). While capture fisheries production has stagnated throughout the African continent at about 8 kg per person, aquaculture-based consumption has continually increased from 50 gm per person in 1984 to 100 gm per person in 1992. However, this is still 1.3 percent of total fish intake (Bardach, 1997).

Nigeria has over 14 million hectares of inland water surface, out of which about 1.75 million are available and suitable for aquaculture (FAO, 2006b). In Nigeria, aquaculture is predominantly an extensive land based system, practiced at subsistence levels in fresh waters (Anyawu-Akeredolu, 2005). Commercial farming has yet to become widespread (Fagbenro, 2005). At present, most fish farmers operate small-scale farms ranging from homestead concrete ponds (25-40 metres) to small earthen ponds (0.02-0.2 hectares). The industry produced over 30,000 tons of fish in 2000 (FAO, 2005c).

The development of aquaculture can only be enhanced by the introduction of modern technologies. While there have been instances of successful introduction of technologies to boost production in Bangladesh (Thompson, Sultana, and Khan, 2005) and Ghana (World Fish Centre 2005), the major problem has been the lack of appropriate technology (Gupta, Bartley, & Acosta, 2004; Toure & Noor, 2001; UNDP, 2004a). Aquaculture technologies have been developed and disseminated to farmers. While some scholars have stated that what is needed is to develop the technologies and make them available (Joshua & Omidiji, 2002), others insist that the transfer of technology would be more effective when there is a greater interaction among the developers, transfer agencies, and the farmers (Dlamini 2003; Yap-Gnaore, Ehui, & Shapiro, 1995). However, the crucial point is for the farmers to be able to afford any technology extended to them. A UNDP Report (2004b) indicated that it was the inability of farmers to afford the technologies extended to them that made farmers abandon the ponds. Rogers (2003) has added another dimension by stating that the adoption of technology can be affected by the way it is named and positioned.

This paper evaluated the adoption of an aquaculture technology package extended to farmers in Imo State, Nigeria. The objective was to identify the level of adoption. This is necessary because public sector extension is seldom properly evaluated (Farrington, Christopolos, Kidd, & Bechman, 2002) and so often the level of performance of a particular technology introduced is usually unknown.

Methodology

Study Area.

Imo is one of the 36 states in Nigeria located in the southeastern part of the country. The land area is estimated at 5100.1 square km. The state lies within Latitude 5˚ - 6˚ North of the Equator and Longitude 6.5˚ and 7.5º East of the Greenwich meridian. Apart from Imo River and Oguta Lake, the state is blessed with many inland waters such as the Igwu, Otamiri, Nworie and Ogachi rivers (Iloeje, 1999). The population of the state stands at 2,485,499 according to the National Census of 1992. Generally, about 80 percent of the people engage in agriculture.

Extension services are fully funded by the State under the Agricultural Development

Project (ADP). The State is divided into three agricultural zones, namely Owerri, Orlu and Okigwe zones.The zones are further broken down into blocks. A block is an agricultural area covering a specified number of villages and supervised by extension agents. Again, each block is further divided into circles or cells. Each block contains eight circles. A circle is an agricultural area containing a number of farm families. Thus, the Owerri zone has 18 blocks and 144 circles; Orlu and Okigwe have 10 blocks and 80 circles each. In all, the State is made up of three zones, 38 blocks and 304 circles.

Data Collection

A total of eight blocks were randomly selected, four from Owerri and two each from Orlu and Okigwe zones, and two circles were also selected from each block. A comprehensive list of 520 fish farmers was obtained from the ADP and the village heads. Seven farmers were picked from each circle, resulting in a total of 112 respondents. However, only 82 of them were available for an interview, which was conducted using a structured interview schedule. Due to some educational and cultural considerations, trained enumerators were hired to interview the farmers and record their responses during the interview.

Aquaculture Technology

The technology that was disseminated to farmers was a 10-item package (see Table 1). It included information on pond-site selection, pond construction, pond installation, pond preparation, stocking of pond, transportation of fingerlings, feeding, pond maintenance, harvesting of fish, and fish preservation. For each item an action had to be taken, and each respondent was asked whether that action was taken. Every positive answer meant that the item was adopted. The cumulative positive responses of each respondent indicated the level of adoption. The total level of adoption was determined by calculating the percentage of the total positive responses. The personal and socio-cultural factors associated with the farmers were also studied.

Results and Discussion

Factors Associated with the Adoption of the Technology

It has been noted that people do not just adopt a technology because it is available to them. Even when the technology is available and appropriate, some personal and socio-cultural factors bear on the decision to adopt or not (Berdegue & Escobar, 2001; Daniel, Wilson, & Myers, 2005; Garforth, Angell, Archer, & Green, 2003; Perkin & Rehmand, 1994). In this study some of these socio-cultural factors were identified and studied (see Table 2).

Table1. Questions on the Adoption of Aquaculture Technology

Practice	Yes	No
Site selection Did you do any soil testing before selecting your site?		
Pond construction Is your pond constructed to the dimensions recommended by the ADP?		
Pond installation Did you install water inlet and outlet devices in your pond?		
Pond preparations Did you lime the pond before flooding with water?		
Pond stocking Do you stock the pond based only on the specifications by the ADP?		
Fingerling transportation Do you transport your fingerlings in plastic bags alone?		
Fish feeding Do you feed the fish according to ADP recommendations alone?		
Pond maintenance Do you check the walls of the pond quarterly?		
Harvesting Do you restrict the harvesting to the time recommended by ADP only?		
Preservation Do you use the chilled holding recommended by the ADP?		

From Table 2, 73 percent of the respondents were male. In most cases, fishing activities were done by men, though women are more engaged in the processing and marketing areas. Given the cultural life of most rural African communities, women are still largely kept in the background. So when studies are being conducted, men (usually husbands) are most likely to answer for women (wives). This becomes prevalent because in most communities almost every adult female is likely to be married. This is verified from the result in this study. Almost all the respondents (93%) were married.

Table 2. Selected Personal and Socio-cultural Factors Associated with the Adoption of Aquaculture.

Factors Frequency (# = 82)		Percentage
Male respondents	60	73
Age (30-49)	46	56
Basic education	52	56
Married	76	93
Fulltime farming	27	33
Access to demonstration	62	76
Utilized demonstration	24	29
Popularity of practice	5	6
Community restriction	42	51
Cultural inhibition	79	96

The mean age of the sampled group was 34 years. More than half of the respondents (56%) were between the ages of 30 and 49. This indicated that the respondents were relatively young. The mean age of farmers in Nigeria is usually between 45-48 years (Ezedinma & Otti, 2001; Ogunwale, 2000). The reason for this age composition is easily explainable since aquaculture is relatively new in the country, and there was the deliberate intention by the ADP to target younger farmers who are likely to be interested in homestead fish farming. The results also showed that the respondents were well educated. About two-thirds of them had received a basic education, (i.e., attending twelve years of formal education). Only 3 percent of them did not attend any formal school. This level of education should encourage the adoption of the technology.

Only 33 percent of the respondents were full-time farmers. The rest were artisans, civil servants, business people, and others. Again, this reiterates the fact that the technology was targeted at younger and more educated members of the community. The objective was to introduce aquaculture as a hobby that one can add on to one's other vocation. Hence, the technology was introduced as a simple and subsistence farming rather than a commercial farming venture. Some scientists blame this faulty approach for the failure of aquaculture practice (Fagbenro, 2005).

In introducing aquaculture to the farmers, the extension agency established demonstration farms to teach them. This study found that a vast majority of the respondents (76%) had access to the demonstration farms. However, only about a quarter of the respondents (29%) utilized them by attending the demonstrations (Table 2). The result of this study also showed that aquaculture was not yet a popular vocation. However, there was no cultural inhibition or restriction on land use against the practice.

What can be deduced from these results is that the personal and socio-cultural characteristics of the respondents were favourably disposed to the adoption of the innovation. It was introduced at the homestead, simply, as an activity that would bring additional income to the household.

Adoption of Aquaculture Technology

Results from Table 3 show that the total level of adoption of the technology was 41 percent. Out of the ten components of the technology, about half of the respondents adopted pond construction practice (54%) and pond installation (51%) respectively. Also, 50 percent of them adopted the recommended transportation practice of fingerlings, but only 27 percent of them adopted the proper site selection. However, less than 50 percent of the farmers adopted other practices like pond preparation (44%) feeding (47%) pond maintenance (44%) and stocking practice (34%). In contrast, although 39 percent adopted harvesting practice, only 19 percent of them adopted the preservation practices.

Table 3. Distribution of Respondents According to Percentage Adoption of Technology.

Practice Frequency (# = 82)		Percentage
Site selection	22	27
Pond construction	44	54
Pond installation	42	51
Pond preparation	36	44
Stocking	28	34
Transportation	41	50
Feeding	39	47
Maintenance	36	44
Harvesting	32	39
Preservation	16	19

Level of adoption # = 41 percent

The recommended practices could be categorized into three groups (i.e., pond construction, raising the fish to maturity, and the processing of the harvest). From the result, it could be seen that the adoption level descended from the first to the last group. From the data, half of the respondents adopted the pond construction, which also included installation, preparation, and stocking. Here the adoption of the site selection recommendation was low, and that is understandable. The technology materials recommended that a proper site should be selected in terms of choosing appropriate topography with perennial source of water, and ensuring good quality of soil through soil analysis. However Imo State is very densely populated, so there is more pressure on land availability. Farmers are forced to choose any available land, and they do not even have the financial resources to carry out the tests required for water and soil analyses. It will be assumed that the construction of the pond received the highest adoption score for obvious reasons. Construction of a pond is the necessary first thing to do. At this point, the extension agents, eager to get people to adopt the innovation, provided the highest level of supervision. With the promise of more incentives, farmers were likely to construct the ponds.

After the construction of the ponds, however all other practices to raise the fish were not fully adopted. The exception here was the transportation of the fingerlings where 50 percent of them adopted it. Again, this was not surprising because transportation of fingerlings is the most delicate aspect of aquaculture (Gertjan & Janssen, 1996) and sometimes only 5 percent of the fingerlings survive due to inappropriate handling (Brown & Laland, 2001). Feeding and maintenance of the pond were adopted by less than half of the respondents. It could be assumed that at this point, farmers receive less supervision from the extension agents. After they helped with the construction and stocking of the pond, the agents would assume that the farmers would practice the other recommendations. Feeding was always a problem because farmers were not always able to afford the cost of the feed and to devote themselves to required feeding regime. This could be due to sudden change in the price of feed as a result of inflation. Sometimes, the feed would not even be available in the market. Due to the low quality of locally produced fish feed, farmers often depended on imported feed. However, these are more expensive and may be scarce because of import policies.

Harvesting and processing practice received the lowest level of adoption. About 39 percent of the respondents adopted the harvesting practice. It was discovered that since the technology was introduced as subsistence farming, the farmers found it convenient to harvest the fish at will rather than waiting for the appropriate time. Less than a quarter of the farmers adopted the preservation practice. Since this practice entailed procuring other equipment, not many resource-poor farmers could afford the extra cost of equipment. Since the harvest was very poor, due to the small farm size, there was hardly any need to preserve the fish since they were usually consumed at harvest.

Conclusion

Results from this study showed that the level of adoption of aquaculture technology in the Imo State of Nigeria was low. Many of the farmers who were supposed to be engaged in aquaculture had abandoned it. Important components of the technology that had to do with raising and processing the fish at harvest were adopted by few of the respondents.

The major reason for the low adoption of the technology was the poor economy, which raised the rate of inflation. The farmers continued to experience dwindling disposable income that could be ploughed into the farm. A corollary to this was the inconsistency of some of the Government's policies. There were usually policy changes regarding the importation of feed. When the feed was not available, the fish would die, and the farmers would abandon the ponds.

It can also be inferred that the initial policy of the extension agents to introduce aquaculture as subsistence farming was wrong. When people do not see a technology as generating income immediately, the motivation to commit resources to the venture will not be there. Of course, this was the reason why the technology was targeted at those who already had other sources of income. It therefore means that the poor economy is affecting every sector in the country. For aquaculture in Imo State, therefore, it became a vicious circle. The farm size was too small to generate enough income to sustain the farm.

To improve aquaculture in the State and in Nigeria, the practice should be reintroduced as a commercial venture that could generate income and become sustainable. It also means that the Government must identify genuine investors in the business who are ready to go into the venture full time, and provide adequate financial credit for them.

Dr. Ike Nwachukwu is an Associate Professor of Agricultural Extension and Director of the Extension Centre, Michael Okpara University of Agriculture, Umudike, Nigeria.

Roseline Onuegbu is a Ph.D Candidate at Michael Okpara University of Agriculture, Umudike, Nigeria

References

Anyawu-Akeredolu, B. (2005). *Urban aquaculture in Nigeria. World Aquaculture Society. Annual Report*. www.was.org/meetings/abstractdata. Retrieved on October 2, 2006.

Bardach, J. E. (1997*). Sustainable aquaculture*. John Wiley, New York. p. 35

Berdegue, J.A., & Escobar, G. (2001). Rural diversity, agricultural innovation policies and poverty reduction. *Agren* Network papers. No. 122. ODI.

Brown, C., & Laland, K. (2001). Social learning and life skills training and hatchery reared fish. *Journal of Fish Biology* 59, 471-493

Cichrame K. C (2000) Reconciling sustainability, economic efficiency and quality in fisheries: the one that got away. *Fish 1* pp. 3-21

Daniel, E., Wilson, H. & Myers, A. (2005). Innovation in small and medium sized enterprises: the case of e-commerce adoption in the UK. *Innovation . management policy and practice*. www.innovation-enterprise.com/4.1/4.1.12.htm. retrieved on January 1, 2006.

Dlamini, B. M. (2003). Effective linkages among national agricultural research institute, universities and extension systems; challenges and opportunities. In P. Anandajayasekeram & R. J. Sebola (Eds.). *Science and technology strategy for improved agricultural productivity and food security.* (proc) South Africa/ Inter Academy council. Megaliesberg, South Africa.

Ezedinma, C. I. & Oti, N. N. (2001) Socio-economic issues in the development of cassava processing technology in Nigeria. *Journal of Sustainable Agriculture and the Environment. 3*,(1)., pp.120-126.

Fagbenro, O. A. (2005). *Aquaculture in Nigeria: history, status and prospects.* A report of FAO World Fish Centre Workshop. Cameroon.

FAO (2003) *Review of the state of world fishery resources*. Rome: FAO Fisheries.

FAO(2004) *The state of world fisheries and aquaculture*. Rome: FAO Fisheries.

FAO (2005a) Nutritional benefits of fish. www.fao.org/docrep/168, retrieved on November 11, 2006.

FAO (2005b) *Ethical issues in fisheries*. Rome: FAO Fisheries.

FAO (2005c) Small scale aquaculture in sub Sahara Africa: Revisiting the aquaculture target group paradigm. Rome: FAO Fisheries.

FAO (2006a) Nigeria's fisheries profile. www.fao.org/fi/fcp/en/NGA, retrieved on February 2, 2006.

FAO (2006b) Fisheries management in the Federal Republic of Nigeria. www.fao.org/fi/fcp/en/NGA/body, retrieved on January 13, 2006.

Farrington, J., Christopolos, I., Kidd, A., & Bechman, O. (2002). Creating a policy environment for pro-poor agricultural extension. The who, what, and how. *Natural Resource Perspectives*. No. 80. ODI, London.

Garforth, C., Angell, B., Archer, J., & Green, K. (2003). Improving farmers access to advice on land management. *Agren* Network papers. No. 125. ODI

Gertjan, G., & Janssen, H. (Eds). (1996). *Artificial reproduction and pond rearing of the African catfish.* Rome: FAO Fisheries.

Greenfacts (2004) World fisheries production. www.greenfacts.org/fisheries/o4-utilization.htm, retrieved on January 15, 2006.

Gupta M.V, Bartley D.M and Acosta B.O (2004). Use of genetically improved and alien species for aquaculture biodiversity in Africa. World Food Centre. p.107.

Healthnews Digest (undated). www.healthnewsdigest.com, retrieved on January 16, 2006.

Iloeje, N.P. (1999). *A new geography for Nigeria.* London: Longman.

Imo State Agricultural Development Project (IMADP) (2001). *Annual report.* Owerri.

Joshua, A. & Omidiji, M.O. (2002). *Rural development strategy in Nigeria, West and Central Africa.* Paper presented at the international workshop on rural development in West and Central Africa. IITA, Ibadan. June 3-5.

MacLennan, D. N. (1995). Technology in the capture fisheries. Paper presented at the international conference on sustainable contribution of fisheries to food security. Kyoto, Japan.

Moehl, J. (2003). Gender and aquaculture development in Africa. FAO *Aquaculture Newsletter*, July, No 29. Rome

Muir, J. F. & Nuget, C. G. (1995). *Aquaculture production trends: Perspectives for food security*. Paper presented at the international conference on food security. Kyoto, Japan.

Mutume, G. (2002). Africa seeks to safeguard its fisheries. *Africa Recovery*, 16 (1), 12.

Newagriculturists (2005.) *Fish farming in Africa: Dead or alive?* www.new-agriculturists.co.uk, retrieved on January 1, 2006.

New Partnership for African Development (NEPAD) (2005). *Action plan for the development of African fisheries and aquaculture.* Report of NEPAD Fish For All Summit, Abuja.

Obiekezie, A. I. (1999). Poverty alleviation through fisheries production. The way forward. Paper presented at the Annual Zonal workshop of the Research-Extension-Farmer-Input-Linkage-Systems. Umudike, Nigeria.

Ogunwale, B. (2000). *Communication channels for information dissemination on poverty alleviation among small scale farmers in Oyo State.* Paper presented at AESON Conference, UI Ibadan, Nigeria.

Perkin, K. & Rehman, A. (1994). *Farmers' objectives and their interaction with business and lifestyle: Evidence from Berkshire, England.* In J. B., Dent & McGregor W. J. (Eds). (1994). Rural and farming systems analysis: European perspectives. Wallingford. CAB International.

Rogers, E. M. (2003). *Diffusion of innovations* (5^{th} edition) Free Press: New York.

Thomson, P. M., Sultana, P, & Khan, A. K. M. (2003). *Aquaculture extension impact in Bangladesh*. World Fish Centre .

Toure, M. K., & Noor, M. (2001). The role of agricultural technology in food and nutritional security on Africa. *Journal of Food and Nutritional Security*. *1* (1).

UNDP (2004a). *Equator Initiative* www.tve.org/ho/doc, retrieved on February 2, 2006.

UNDP (2004b). *Sharing innovative experiences. Agricultural and rural development in the South.* http/tcdc.undp.org/experiences/vol5/improved, retrieved on December 2, 2006.

Vannuccini, S. (2004). *Overview of fish production, utilization, consumption and trade*. Rome: FAO.

World Fish Centre (2005). *Successful application of GIFT technology in Ghana and Malawi.* www.worldfishcentre.org/pubs/corporate, retrieved on January 2, 2006.

Yap-Gnaore, V. C., Ehui, S. K., & Shapiro, B. (1995). Peri-urban livestock production and development in sub Sahara Africa: A review of opportunities and constraints. *Tropical Veterinary Medicine*, 1, 151-163

Books Briefly Noted