

Factors Contributing to the Successful Implementation of Technology Innovations

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ABSTRACT

This paper reports the results of a study into the conditions that facilitate the implementation of instructional innovations. One hundred seventy-nine participants completed an online instrument designed to determine the relative importance of eight conditions shown to facilitate implementation. This paper describes the construction and testing of the instrument and the value of its role in measuring implementation profiles. Means and standard deviations of profile scores are reported for the overall sample, by gender and by occupational groups. A factor analysis was conducted to determine if the eight conditions had any underlying relationship. The results from this analysis produced four factors. The discussion describes the four factors as well as additional research questions that result from the findings.

Keywords

Innovation, Implementation, Technology, Change

Factors Contributing to the Successful Implementation of Technology Innovations

In recent years, instructional designers have taken a more active role in the change and implementation of innovation. This trend places designers in the role of change agents and implementers of innovations, as well as, requires that they become more familiar with variables that can influence the implementation of both instructional and non-instructional innovations.

The instructional design process is often thought of having five phases: Analysis, Design, Development, Implementation, and Evaluation. This process, often called the "ADDIE Model," is familiar to most instructional designers. The activities or practices associated with each phase provide guidance for the development of an instructional product. However, the ADDIE model provides little guidance on implementing a completed product or innovation. As a result, innovations designed to solve instructional or performance problems often fail during product implementation resulting in the loss of time, effort and money. To compensate for the lack of implementation guidance of the ADDIE model, others have suggested strategies for increasing successful implementation. Farquhar and Surry (1994) propose conducting an adoption analysis as part of the instructional design process. They recommend that designers and developers of instructional products consider the social context in which the product will be used. They identify two main factor groups, organizational factors and individual factors that must be assessed before and during product design and development. Tessmer (1991 & 1990) emphasized the need to study the learning environment as a means of increasing utilization. He identified two main environmental factors to analyze before design and development of a product - the instructional environment and the support environment. The environmental analysis assesses who will use the product, how the product will be used, where it will be used and how it will be maintained. These two methods attempt to address the issues surrounding the change process in particular the factors that will influence the utilization of the instructional product.

Change Theories, Models, and Strategies

Instructional designers need to have an understanding of change theory in order to facilitate the successful implementation of their products. Change theory isn't one unified, universally accepted theory, but rather a broad family of theories. One of the most widely accepted researchers and theorists in this field is Everett

Rogers. Three commonly referenced ideas of Rogers' include his innovation–decision process, the attributes of the innovation, and the adopter categories.

Rogers' innovation–decision process provides a basic model for change. It consists of five steps that typically occur in sequential order. This process involves gaining awareness of the innovation, forming either a positive or a negative opinion about the innovation, choosing to adopt or reject the innovation, using the innovation, and seeking evidence that supports the decision to adopt or reject the innovation (Rogers, 1995).

Along with a process for adoption, Rogers provides a theory of how the innovation itself can affect this process. He identified five attributes of innovations that influence the decision to adopt an innovation. These attributes are relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995).

In addition to the attributes of the innovation, the traits of an individual or group can also influence the rate of the adoption. Rogers identified five adopter categories (i.e. innovators, early adopter, early majority, late majority, and laggards) that have different social and psychological characteristics. Research indicates that the adopter categories approximate a bell shape curve within a social system (Rogers 1995).

Havelock and Zlotolow's (1995) CREATER model gives change agents a guide for developing implementation plans or change strategies by providing them with a series of steps and strategies that allow them to develop relationships, identify resources and define problems and solutions, as well as assist in the implementation of the solution.

Hall and Hord's Concerns-Based Adoption Model (CBAM) incorporates eight levels of use that can be assessed to determine the progress of the implementation. The model also has seven levels of concern that an innovation moves through sequentially. These levels of concern address affective issues related to the process of adopting and implementing an innovation. Each level of use is associated with one of the stages of concern. (Ellsworth, 2000).

Stockdill and Moreshouse (1992) identified five factors (i.e. "educational need," "user characteristics," "content characteristics," "technological considerations," and "organizational capacity" p. 57). The factor, "organizational capacity," refers to the variables within the organization that influence the adoption of an innovation. These include "staff," "linkages," "equipment," "expertise," "rewards," and the "attitudes and values of the individuals" (p.57).

The User Oriented Instructional Development (UOID) process contains five steps that focus on identifying the intended users, assessing the needs of the user, incorporating user feedback suggestion into the product, and assisting in product adoption and implementation. In the final step the designer works to support the implementation by establishing "moral support," "tactical support," "training support," and "material support" (Burkman 1987, p.450.).

The field of business also has models and strategies intended to assist in the implementation of innovation and change within an organization. Many of these models and strategies have processes similar to those in education.

Kotter (1996) presents an eight-step process. The first four steps deal with creating a change environment and breaking down the status quo. Steps five through seven focus on establishing new methods for producing the desired change. Step eight centers on institutionalizing the change.

Klien and Sorra (1996) describe factors that influence implementation of innovations or change. Among these is the "climate for implementation" which involves variables such as the existing skills and knowledge of employees, positive reinforcement for the use of the innovation, and the removal of obstacles that would reduce the use of the innovation.

Variables Related to Implementation

While the focus of change research has traditionally been on adoption (the initial decision to begin using an innovation), much of the recent research in this area has been related to implementation (Surry & Ely, 2001). Implementation is the process of introducing an innovation into an organization and fostering its use.

Along with specific strategies and models for change, researchers have looked at the variables that influence the success or failure of implementing an innovation within an organization. Bishop-Clark and Grant (1991) recommend “top-down” implementation when introducing computer technology in education. Top-down refers to the involvement of powerbrokers who provide a plan that includes needed resources, support, as well as follow up to ensure the technology is being used correctly (p. 321). Dhanarajan (2001) found the lack of existing infrastructure (i.e., resources), lack of commitment from powerbrokers, low level of skills, and the need to train intended users influenced implementation. Dalton (1989) emphasized the importance of training for the adoption and diffusion of computers in schools. Herson, et al. (2000) listed knowledge and skills of users, involvement of the intended users in the development of the product, and a perceived need to change old methods as factors that influenced implementation. Jost and Schneberger (1994) used information system models as a basis for implementing educational technology. Using this strategy they determined that support from upper level management in the form of “funding”, “job redesign”, “rewards and incentives,” “operational support” and “training” was essential, along with gaining information from intended users when designing the innovation (p. 221).

Others have considered the barriers to implementing technology in education. Rose (1998) identified four groups of barriers that impact implementation of educational technologies. Ebersole and Vornddam (2003) list numerous variables affecting implementation including insufficient time, insufficient resources, lack of leadership, and lack of skills and knowledge. Rogers (2000) identified issues related to user involvement in design, insufficient time for learning or developing instruction and inadequate resources. Pajo and Wallace (2001) reduced barriers to web based technology in higher education into three factors. The first factor, labeled “personal variables,” includes variables related to inadequate time, inadequate skills, and access to training (p. 79). The second factor, “attitudinal barriers,” includes variables related to the general perception and feelings about the innovation (p.79) The final factor, “organizational barriers,” includes variables related to hardware, software, and technical support. (p. 80)

The same variables that affect implementation in education also influence implementation of innovations in business. In a study of key factors related to process innovation in industry Meyers, Sivakumar, and Nakata (1999) reported four factors related to implementation – “seller characteristics,” “buyer seller interface,” “environment,” and “buyer characteristics” (p. 303).

Sims and Sims (2002) emphasize the importance of empowering the frontline employee in the process as the means for creating successful change. Dirks, Cummings, and Pierce (1996) describe the need for developing psychological ownership by employees in order to successfully implement a change within an organization. Conger (2000) focuses on top-level management as the key group in the change process. Smith and Mouier (2000) suggest that organizations set up or adapt existing rewards and incentive programs to favor those who actively support the change, as well as involve the employees in the development of the innovation or change process.

Donald P. Ely is perhaps the most widely cited author in the area of implementation of instructional innovations. Ely’s main contribution to the literature has been the development of eight conditions that facilitate implementation. These conditions apply to both technological and process/administrative innovations. Additionally, Ely’s research indicates that the eight conditions transcend the cultural and organizational lines (Ely, 1999, 1990).

The eight conditions developed by Ely are:

1. Dissatisfaction with the status quo: refers to an emotional discomfort resulting from the use of current processes or technologies that are perceived as inefficient, ineffective or not competitive. This affective state is either self-induced or results from organizational awareness or leadership campaigning for the need to change (Ely, 1999, 1990; Surry & Ely, 2001). This condition is similar to relative advantage (Rogers 1995), establishing a sense of urgency (Kotter 1996), innovation values fit (Klien & Sorra, 1996), and matching product to users needs and values (Burkman 1987). Others citing concepts similar to dissatisfaction with the status quo include Pajo & Wallce (2001), Herson et al. (2000), and Vrakking (1995).
2. Adequate Time: refers to the willingness for organizations to provide paid time for users to learn the new skills or procedure in order to use the innovation, as well as the user’s willingness to devote time to develop these new skills (Ely, 1999, 1990). This also represents the individual’s belief that with time they can successfully adapt to the change. Klein and Sorra (1996), Ebersole and Vornddam (2003), and Pajo and Wallace (2001) also discuss time as a an important implementation condition.
3. Resources: refers to availability and accessibility to resources needed to implement the innovation. Resources include finances, hardware, software, materials, personnel, and technological support (Ely,

- 1999,1990). This condition relates to the general infrastructure of the organization and how well that infrastructure can support the innovation. Burkman (1987) discusses the development of the necessary equipment, materials, and facilities in order to support the implementation of a new instructional product. During the management stage of the CBAM, concern is focused on developing the necessary infrastructure to support the innovation (Ellsworth, 2000). During the acquire stage of the CREATER model, the change agent identifies existing resources and that can be used during the implementation process (Havelock & Zlotolow, 1995). Equipment is considered an important variable in the “organizational capacity” factor (Stockdill & Morehouse, 1992, p. 57.) Other researchers who have identified resources as an important part of implementation include Ebersole and Vornddam (2003), Dhanarajan (2001), Okumus (2001), Pajo and Wallace (2001), and Klein and Sorra (1996).
4. Knowledge and Skills: refers to users possessing and or acquiring the needed skills and knowledge to employ the innovation. This condition also reflects users’ feelings of self-efficacy about using the innovation. Training may be a necessary part of the implementation plan (Ely 1999,1990). It is important to note that knowledge and skills not only reflect the intended users’ current level but also their belief in being able to develop the necessary skills to successfully use the innovation. The “complexity” of the innovation will affect implementation in that it will require more training or skill development by the users (Rogers, 1995). Kotter (1996) emphasizes the development of competencies in order to facilitate the change process. Varkking (1995) identifies training as part of the implementation phase. Burkman (1987) discusses “Training Support” during implementation (p. 450). Expertise is cited as one of the important factors within “organizational capacity” (Stockdill & Morehouse, 1992, p. 57). Other researchers linking knowledge and skills or training to successful implementation include: Ebersole and Vornddam (2003), Dhanarajan (2001), Okumus (2001), Pajo and Wallce (2001) Herson et al. (2000), Klein and Sorra (1996) and Dalton (1989).
 5. Rewards and Incentives: refers to either intrinsic or extrinsic rewards that result from using the innovation; these rewards vary from user to user (Ely 1999,1990). External rewards are provided to intended users as means to motivate them to employ the innovation. Rogers (1995) lists several types of incentives and discusses the role social observation and vicarious reinforcement plays in the implementation process. Burkman (1987) discusses the use of rewards as part of “moral support” during implementation (p. 450). Stockdill and Morehouse (1992) identify rewards as a significant factor in “organizational capacity” (p.57). Others citing this condition as part of implementation include: Okumus (2001), Smith and Mouier (2000), Klein and Sorra (1996), and Jost and Schneberger (1994).
 6. Participation: refers to the level of involvement stakeholders have in the decision making process to adopt and implement an innovation. Participation may take the form of user group representatives if it is difficult to get feedback from all potential users (Ely 1999, 1990). This condition helps intended users develop a sense of ownership of the innovation. “Participation in the design phase is in fact the first step of implementation” (Varkking, 1995, p. 35). Step two of the UIOD model seeks information from the product user in order to direct product development (Burkman, 1987). Participation by intended users or employees during innovation design is stressed by others as well (Sims & Sims, 2002; Hernson et al., 2001; Smith & Mouier, 2000; Myers, Sivakumar, & Nakata, 1999; Dirks, Cummings, & Pierce, 1996).
 7. Commitment: refers to “visible” support by the upper level leaders or powerbrokers. The key to this condition is how the users perceive the powerbrokers’ commitment to the implementation of the innovation. Simple verbal endorsement of the innovation by leaders and powerbrokers does not constitute commitment (Ely, 1999, 1990). Visible forms of commitment include such things as personal communication, development of strategic implementation plans, dedication of resources, and active involvement in the implementation of the innovation. Kotter (1996) discusses building a guiding coalition of powerbrokers that share the common change goal. These members must have key characteristics such as power, expertise, credibility, and leadership. Vrakking (1995) includes this as part of the implementation phase. Changes to policies and procedures can send the signal that the powerbrokers support the new product (Burkman,1987). Bishop-Clark and Grant (1991) describe “top down” implementation as powerbrokers developing plans and committing resources. Dhanarajan (2001) lists lack of commitment from university administrators as a barrier to implementation. Others emphasizing the importance of powerbrokers in the change process include: Conger (2000), Meyer, Sivakumar, and Nakata (1999), and Jost and Scherberger (1994).
 8. Leadership: refers to the level of ownership and support given by the leaders who will manage the daily activities of those using the innovation (Ely, 1999, 1990). The enthusiasm of these leaders directly affects the motivation of the users of the innovation. Immediate supervisors must provide support and encouragement, answer questions, address concerns, and serve as role models. Kotter (1996) emphasizes the need for supervisors to take an active role in supporting and communicating the change to front end workers. Varkking (1995) stresses the importance of front line managers endorsing the change or innovation. Support or championing of the innovation by supervisors is a critical variable (Ebersole & Vornddam, 2003; Meyer, Sivakumar, & Nakata, 1999; Kelin & Sorra, 1996).

Several dissertations (e.g., Bauder, 1993; Jeffery, 1993; Read, 1994; Stein, 1997; Ravitz, 1999) have investigated the importance of Ely's conditions in implementing innovations. These studies have explored the role these conditions play in implementing technological innovations, program innovations and processes innovations. These dissertations indicate that Ely's conditions do facilitate implementation. Questionnaires developed for these studies were specific to the innovation being studied and were not designed to measure profiles of intended users. To facilitate implementation, designers, as well as others responsible for change or adoption of innovations, must acquire information about the factors that affect implementation. More precisely, they need to know which factors the intended users perceive as important. This requires a method of assessing those factors and then generating individual as well as organizational profiles to gain an understanding of which factors are perceived as most important in regards to the implementation of specific innovations.

A study by Surry and Ensminger (2002, 2003) measured the perceived importance of these eight conditions using scenario-based questions. This study was the first attempt to determine the relative importance of the eight conditions prior to the implementation of an innovation. This study served as the catalyst for the development of an instrument to measure implementation profiles, and also provided the foundation for the theoretical view that by assessing the eight conditions before implementation, organizations could develop tailored implementation plans to facilitate the change.

The primary purpose of the study described in this paper was to determine if there are underlying relationships between Ely's eight conditions. We hypothesized that several of the conditions were related and that patterns in those relationships could be identified. In order to measure the underlying relationships between these conditions it was necessary to develop an instrument that measured an individual's perceived importance of each condition in relation to the others.

Method

In this section, we will describe the development of the implementation profile inventory and the process used to verify the content validity and reliability of the instrument. Additionally, we will describe the data collection process and the analysis methods used to analyze the data.

Instrument Development

The primary data collection instrument used in this study was a 56-item questionnaire. Because the main purpose of the study was to determine which of the eight conditions individuals considered more important compared to the other conditions, a forced choice format was selected. Each item would pair two of the eight conditions and participants would be forced to choose which condition they considered to be more important. In order to have a more reliable measure of an individual's perception, we decided that all conditions would be paired together twice. This would result in 56 comparisons and would require two statements that represented each condition. We also determined that two forms of the instrument would be designed: one to measure process innovations and one to measure technology innovations. In order to create two separate forms and have each condition paired twice, 32 statements would need to be written to complete both forms. We independently developed several technology-based and process-based statements for each condition. These statements were then reviewed jointly and the best statements for each condition were selected.

Content Validity

The content validity study for the 32 statements was conducted using experts who have either conducted research or worked in the area of adoption, change, or implementation. This group of experts was provided with a definition for each Ely's conditions and the four statements that represented that condition. They were asked to rate each statement on a scale from 1 (low) to 5 (high) based on how well the statement represented the defined condition. Space was also provided to allow the experts to provide individual feedback about the statements.

Seven of the ten experts who agreed to participate in the content validity study returned completed forms. Prior to reviewing the forms, we determined that an average score of 3.5 or higher on any statement would be used to immediately accept the statement as valid. The averages for individual statements ranged from 2.6 to 4.1. Ten of the 32 statements had averages above 3.5. Of the 22 remaining statements, 15 had average-rating scores of 3.0 to

3.4, and seven had average ratings from 2.6 to 2.9. Six statements with average rating of either 3.3 or 3.4 were accepted as valid because only one or two of the experts had given them a rating score of below three. The rest of the questions were reworded using the comments provided by the experts.

Once the statements were finalized, a paper-based version of the instrument was constructed and provided to several colleagues with experience in questionnaire development. These colleagues were asked to provide feedback on the format and face validity of the inventory. Changes were made based on their feedback.

Next, an online version of the instrument was created. The online version is self-scoring and provides profile scores on the eight conditions to the user. The online version of the questionnaire underwent prototype debugging and testing before going online.

Test / Retest Reliability

In order to test the reliability of the technology form of the instrument, a test / retest study was conducted. Thirty-nine participants completed the instrument on two occasions that were approximately 14 days apart. The reliability scores for each condition ranged from .586 to .864 with the average of all eight scores being .730. The results of the reliability study indicated that the technology form was consistent in measuring an individual's implementation profile. See Table 1 for retest reliability coefficients.

Condition	Coefficient
Status Quo	.586
Skills	.646
Resources	.687
Time	.761
Participation	.773
Rewards	.864
Commitment	.782
Leadership	.778

Table 1. Test/Retest Coefficients

Participants

We solicited participants for this study by sending messages to several electronic mailing lists related to the field of instructional design. Of the 179 participants who participated in the study, 20 worked in K-12 settings, 89 worked in higher education settings, 22 in business or industry, 9 were in the military, 11 worked for the Government, 12 were self employed, and 16 did not respond to the question. The sample consisted of 54 males and 86 females; 39 participants did not report their gender. The educational level of the group was diverse: 32 had a high school education, 41 had a bachelor's degree, 71 had master's degrees, 5 had Education Specialist degrees, 26 had either a doctorate or professional degree, and 3 did not report their educational level. Caucasians were the largest represented ethnic group (n=138), followed by Asian/pacific Islanders (n=11), then African Americans (n=10). The remaining ethnic groups were: Hispanics (n=5), Native Americans (n=1), and Other (n=9). Five participants did not report their ethnicity.

Data Collection and Analysis

Data were collected over a three-month period using the online instrument. Based on responses to the inventory, we calculated an "implementation profile" for each participant. The implementation profile shows how many times the participant selected each condition on the questionnaire. An implementation profile is, in effect, a score from 0 to 14 on each of the eight conditions. Profile scores were entered into SPSS file for analysis.

We used two data analysis methods in this study. The first was descriptive analysis to show the mean score and standard deviation for each condition for the various demographic groups. The second data analysis method was a factor analysis to determine if there were any underlying relationships between the conditions. The results of the data analyses are presented in the following section.

Results

Descriptive Statistics

The mean score and standard deviation of each condition were calculated for the overall sample and for each of the primary demographic groups. The descriptive data show the rank order of importance of each condition for the various groups. Descriptive statistics indicate that for the total sample leadership and commitment were the least important conditions (see Table 2), while resources and participation were the most important. Commitment and leadership were the least important conditions for both males and females (see Table 3). Females selected knowledge/skills and resources as the most important variables while men reported participation and resources as the most important.

	N	Mean	Std. Deviation
Status Quo	179	7.24	4.26
Skills	179	7.98	3.70
Resources	179	8.39	2.98
Time	179	7.13	3.29
Participation	179	8.11	4.13
Rewards	179	7.36	3.76
Commitment	179	4.42	3.80
Leadership	179	5.37	3.45

Table 2. Profile Scores for Total Sample

Condition	Gender	N	Mean	Std. Deviation
Status Quo	Female	86	6.81	4.29
	Male	54	7.65	4.21
Skills	Female	86	8.72	3.58
	Male	54	7.59	3.49
Resources	Female	86	8.56	2.99
	Male	54	8.04	3.07
Time	Female	86	7.38	3.06
	Male	54	6.87	3.80
Participation	Female	86	7.87	4.25
	Male	54	8.63	3.89
Rewards	Female	86	6.78	3.78
	Male	54	7.28	3.80
Commitment	Female	86	3.95	3.49
	Male	54	5.07	3.83
Leadership	Female	86	5.92	3.36
	Male	54	4.87	3.39

Table 3. Profile Scores by Gender

Table 4 shows the implementation profiles for various occupational categories. Participants working in K-12 environments viewed resources and time as the most important conditions related to implementation of technology. Participants employed in higher education also perceived resources as most important. They considered skills and rewards as important as well. Those working in business settings placed more importance on participation, with adequate resources, and dissatisfaction with the status quo also being viewed as critical to implementing a new technology. Military employed participants considered skills, dissatisfaction, and resources as the three most important factors. This occupational group also considered time important. Those participants working for the government considered skills, participation, and resources as the top three conditions when implementing a technological innovation. Participants who identified themselves as self employed perceived resources, dissatisfaction, and participation as the most important factors.

	K-12		Higher Ed.		Business		Military		Government		Self Employed	
	N= 20		N= 89		N= 22		N= 9		N= 11		N= 12	
Conditions	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dissatisfaction	6.95	4.57	6.81	4.36	7.41	3.51	9.11	4.70	6.18	4.21	9.17	3.41
Skills	6.90	4.34	8.15	3.56	6.68	3.88	9.22	3.31	9.00	2.32	7.75	4.45
Resources	9.50	2.86	8.16	3.10	7.73	3.45	9.11	1.83	8.27	2.05	10	2.17
Time	9.05	4.12	7.29	3.42	6.18	3.29	8.56	4.10	6.73	2.83	8.25	2.93
Participation	6.70	3.81	8.06	4.10	8.82	4.01	7.00	3.81	8.63	5.30	6.17	3.79
Rewards	4.65	3.89	7.62	3.58	6.68	4.13	7.00	3.71	7.45	4.66	8.08	4.17
Commitment	4.95	3.89	4.46	3.71	5.82	4.44	2.67	2.83	3.82	3.57	3.33	3.68
Leadership	5.70	2.58	5.46	3.56	6.68	3.26	3.33	2.69	6.18	3.68	3.25	3.14

Table 4. Profile Scores by Occupational Category

Factor Analysis

We conducted a factor analysis of the implementation profiles of all 179 participants to determine if there were any underlying factors within the data. The factor analysis was conducted using the principle component method of extraction and varimax rotation. We decided that for a condition to load on a factor, it must have a minimum absolute value of .45 and must not have loaded on another factor at an absolute value of .45 or greater. The eight conditions reduced to four factors, which accounted for 73.3% of the variance. Factor loadings ranged from -.945 to .901. The results of the factor analysis are shown in Table 5. A detailed discussion of each factor is provided in the following section.

Conditions	Factors			
	Managed Change	Performance Efficacy	Rewards	Resources
Status Quo	-.628	-.172	.055	-.496
Skills	-.426	.528	.434	.060
Resources	-.136	-.023	.079	.901
Time	-.082	.774	.028	.066
Participation	-.081	-.782	.133	.046
Rewards	-.201	.089	-.945	-.056
Commitment	.800	-.237	.127	-.217
Leadership	.858	.029	.103	-.048

Table 5. Coefficient Loadings of Conditions for Factors

Discussion

The main finding of this study is that four factors emerged from the data. Two of the factors had multiple loadings, while two had only one condition loading on the factor. The condition dissatisfaction with the status quo loaded above .45 on two factors and therefore was not considered to load significantly on any factor. These results indicate that there is an underlying relationship between conditions. In this section, we will describe each of the factors.

Factor #1: Managed Change

This factor accounted for 25.3% of the explained variance. Individuals who score high on this factor want upper level management and direct supervisors to play an active role in the change process. They want managers in an

organization to provide direction and leadership during implementation. This may include the need to provide direct communication of why the change is occurring and actively campaign for the implementation of the innovation. Conditions that loaded on this factor were Leadership (.858) and Commitment (.800).

Factor #2: Performance Efficacy

This factor explained 19.8 % of the total variance. Individuals who score high on this factor believe that they will be successful in using the innovation because they either currently have the needed skills, or will be able to learn the skills if provided time. They are not concerned about actively participating in the change process because they feel confident that they will be able to perform and use an innovation. Conditions that loaded on this factor were Participation (-.782), Time (.744) and Skills & Knowledge (.528).

Factor #3: External Rewards

This factor contributed 14.2 % to the total variance explained. This factor was interpreted and labeled by reversing the meaning of the factor. Thus, individuals with a low score on this factor are more likely to want some compensation or reward for implementing an innovation. They will be more likely to participate in the implementation process if they receive some recognition or reward for using the innovation. Only one condition loaded on this factor Rewards (-.945).

Factor #4: Resources

This factor explained 14% of the total variance of the combined factors. Individuals scoring high on this factor view resources as the important variable in the implementation process. They want to know if the equipment, finances, personnel and other resources are in place and easily accessible before implementing an innovation. Only one condition met the criteria for loading on this factor, Resources, (.901).

In addition to the new factors, the technology inventory developed for this study appears to give a reliable and accurate measure of a person's "implementation profile." This inventory provides researchers studying technology implementation a method for assessing the eight conditions that influence the implementation of technology innovations. This inventory can be used to help researchers further explore how the importance of these conditions are influenced by the type of technology being implemented. Additionally, researchers can use this inventory to explore how various groups value the importance of each condition given a particular technology innovation.

On a practical level, by assessing individual and organizational profiles, those responsible for implementing an innovation can work to ensure that the key conditions, as reflected in the inventory results, are addressed prior to and during the implementation phase of change process. In essence, the inventory would allow change agents to evaluate the importance of each condition before implementation and use the results to develop implementation plans tailored to the organization. Thus, an organization whose profile indicates that organizational members perceive adequate time and adequate resources as important conditions will have to develop strategies to ensure that necessary resources are easily accessible to all users and that users are provided with on the job time to develop the skills in order to use the technology.

Future Research

Based on the results of this study, we have identified three key questions that will form the basis for our future research in this area. In this section, we will briefly discuss each question and describe our plans to conduct research to address these questions

The first key question that arose from this study is "Are the factors discovered in this study consistent?" To answer this question we propose replicating the current study. We intend to collect data using the online version of the instrument. We will contact other list servers and recruit participants from other disciplines and fields. We will then analyze the new data using the same factor analysis method.

The second key question that arose from this study is “Do these factors hold true for process innovations?” The current study focused on implementing a technological innovation. Research needs to be conducted to determine if the process form of this inventory produces the same factors. Currently we are constructing an on line version of the process form of the implementation inventory using the statements from the content validity study previously mentioned. Once constructed and shown to be reliable, this form will be used to test whether the factors found in this study are consistent when implementing a process innovation.

The third key question is “Do the profiles generated from the implementation inventory, reflect the conditions that people think are important when implementing a new technology?” In order to investigate this question, we will use a mixed methods approach. First we will develop an interview protocol designed to collect qualitative data on participant’s views of technology implementation. The questions will focus on what conditions participants think are important when implementing a new technology. After the interview, participants will be asked to complete a version of the technology form implementation profile instrument. Qualitative analysis will consist of categorizing comments from participants into one of the eight conditions, if it reflects the condition, and comparing participants’ qualitative statements with their implementation profiles.

Conclusion

Implementation can be thought of as the “mystery phase” of the ADDIE Model. However, instructional designers must work to unravel this mystery in order to ensure that their instructional products are implemented successfully. This will require that designers familiarize themselves with change theories, models and strategies, as well as become knowledgeable about what factors and variables facilitate implementation. Finally, the implementation profile inventory used in this study can provide designers with an additional tool for assessing these factors and variables as part of the ADDIE process in order to develop plans that will increase the likelihood that their products are successfully implemented.

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