DOCUMENT RESUME

ED 423 872 IR 019 093

AUTHOR	Mills, Steven C.; Ragan, Tillman R.
TITLE	An Implementation Model for Integrated Learning Systems.
PUB DATE	1998-02-00
NOTE	13p.; In: Proceedings of Selected Research and Development Presentations at the National Convention of the Association for Educational Communications and Technology (AECT) Sponsored by the Research and Theory Division (20th, St. Louis, MO, February 18-22, 1998); see IR 019 040.
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Check Lists; *Computer Assisted Instruction; *Computer Managed Instruction; Courseware; Educational Change; Educational Practices; Elementary Education; Elementary School Teachers; Evaluation Criteria; Instructional Design; Instructional Effectiveness; *Integrated Learning Systems; Interviews; Matrices; *Measurement Techniques; Models; Program Implementation; Student Motivation; Tables (Data)
IDENTIFIERS	*Technology Implementation; Technology Integration

ABSTRACT

This paper describes the development, validation, and research application of the Computer-Delivered Instruction Configuration Matrix (CDICM), an instrument for evaluating the implementation of Integrated Learning Systems (ILS). The CDICM consists of a 15-item checklist, describing the major components of implementation of ILS technology, to be completed by an evaluator based on responses supplied by teachers during an interview. The CDICM was used to examine the operational patterns of teachers (n=30) whose students interacted with an ILS using the "Successmaker" courseware in four elementary schools in a metropolitan school district. Data regarding the operational patterns of teachers using ILS technology were collected from teacher interviews and analyzed. The best ILS implementation practices included integration with classroom instruction, training in the use of an ILS, and the use of motivational strategies. Implications for educational change and reform are discussed. Tables and figures present data on discriminant functions for CDICM components, interview data grouped by implementation pattern, significant CDICM components, and influence variables on degree of ILS implementation. The CDICM and interview guide are included. (Contains 18 references.) (AEF)

An Implementation Model for Integrated Learning Systems

Steven C. Mills, Ph.D. and Tillman R. Ragan, Ph.D.
University of Oklahoma

ABSTRACT

Integrated learning systems (ILSs) provide a multi-year curriculum sequence of computer-based instruction controlled by a sophisticated management system. ILS implementation is better understood when the focus of implementation is shifted from the technology to the people who use the technology. This study examined the operational patterns of teachers implementing an ILS in elementary schools in a metropolitan school district. A measure was developed that described the major components of imple7mentation of ILS technology. Data regarding the operational patterns of teachers using ILS technology were collected from teacher interviews and analyzed. The best ILS implementation practices included integration with classroom instruction, training in the use of an ILS, and the use of motivational strategies. Implementation is better understood when contextual phenomena of the implementation are examined because the question of the instructional effectiveness of an ILS or other forms of computer-delivered instruction may be as much an implementation issue as a matter of instructional design.

Introduction and Background of Study

To suppose that users of computer-delivered instruction implement courseware in the way it is intended to be used is often an ambitious assumption. Smith and Ragan (1993) advised that "in drawing the line of causation from the instruction to the results, it is critical to be able to identify the degree to which the description of the program represents what actually occurred during instruction with the new program" (p. 416). Therefore, the determination of effectiveness of computer-delivered instruction needs to begin with a determination of the degree of implementation of the instruction.

This article describes the development, validation, and research application of an instrument for evaluating the implementation of computer-delivered instruction. This instrument, the Computer-Delivered Instruction Configuration Matrix (CDICM), was designed to examine the implementation of Integrated Learning Systems (ILSs). The instrument was validated in a study by Mills (1997) involving four metropolitan elementary schools. The purpose of this paper is to describe the development and deployment of the CDICM and its implications for educational change and reform.

The CDICM was adapted from the Innovation Configuration Matrix (ICM), a tool developed by Heck, Steigelbauer, Hall, and Loucks (1981) for use in identifying the essential components of an innovation and the variations of implementation for each of the innovation components. The ICM is an effective resource for assessing implementation of instructional technology and other educational innovations (Albers, 1994; George & Hord, 1980; Gleghorn, 1993; Hord, Huling, & Austin, 1986). The ICM provides an understanding of the operational patterns of users of an innovation and therefore allows the evaluators of an innovation to make judgments about appropriate practices and how much variation in practices is acceptable (Hord, Rutherford, Huling-Austin & Hall, 1987).

Hall and Loucks (1977) were disappointed when experimental research and evaluation studies presumed the treatment was present and its effects were accounted for by testing for statistically significant differences between two groups or by pre- and post-testing the same sample. They concluded that information about the actual use and degree of implementation of an innovation might better explain some nonsignificant findings reported in evaluation and experimental studies. According to Hall and Loucks (1978) a particular innovation can have several different operational patterns as a result of variations in the selection and use of innovation components. They labeled these operational patterns as innovation configurations. Different patterns or configurations resulted when different teachers put innovations into operation in their classrooms. Individual teachers used different components of an innovation in different ways and when these components were put together a number of patterns emerged that characterized different uses of the innovation (Hord, Rutherford, Huling-Austin, & Hall, 1987).

Development and Field Testing of Innovation Configuration Matrix

The construction of the CDICM was based on a review of research on computer-delivered instruction, courseware documentation, telephone interviews with courseware developers, and interviews with vendor training facilitators, lab managers, and teachers who used the Computer Curriculum Corporation (CCC) courseware, *Successmaker*. *Successmaker* courseware covers subjects ranging from math and reading to GED preparation.

Using ICM development techniques an ICM was developed to fit with the adoption and use of the *Successmaker* ILS in varying degrees and patterns of implementation. The matrix consisted of a component checklist comprised of five variations for each component with each successive variation indicating a level of use representing a closer approximation of ideal use. Although the CDICM instrument was developed and tested with a particular ILS, its application is relevant for many forms of computer-delivered instruction.

The CDICM was devised as an instrument to be completed by an evaluator based on responses supplied by teachers during an interview. The components of technology use and variations of the components selected for inclusion on the CDICM were presumed to reflect the actual and ideal practices of teachers involved with ILS implementation. Although many forms and variations of technology adoption and use by teachers may exist, the process of instrument development attempted to reflect a true and accurate gradient of technology use from "least acceptable" to "ideal." Since truth and accuracy of instrumentation was not absolute, the intent was to develop an instrument that provided estimates that possessed known and reasonable validity and reliability.

As part of the development process, the CDICM was subjected to a two-phase field test. In the first phase interviews were conducted with a sample of ten teachers who regularly used the courseware for instruction. The purpose of this administration of the CDICM was to make revisions to matrix components and to make revisions to the interview guide. After revisions were made, the second phase of the field test was conducted to establish reliability and validity for the final version of the CDICM. A sample of nineteen teachers who regularly used the courseware completed a CDICM checklist using the revised CDICM and then five of the subjects completing the checklist were selected for interviews.

Descriptive statistics were computed for total instrument reliability. The final 15-item checklist allowed for a range of total scores from 0 to 75. The standard error of measurement for the field test was 3.68 while the interscorer reliability coefficient was .96 for all items. This administration of the CDICM checklist yielded a coefficient alpha of .61 ($p < .01$) for the total scale. The final version of the CDICM checklist and interview guide is provided at the end of this article.

Data Collection and Analysis Procedures

The final version of the CDICM was deployed in a school district that had made a substantial investment in ILS technology. ILS technology was used in all elementary school campuses in the district. The school district initially implemented ILS technology in six elementary schools and during the previous school year expanded the program to include almost all kindergarten through eighth grade students in the school district.

A lab configuration was employed at each school with a number of workstations distributed to some classrooms. Each school had a lab coordinator or media specialist to coordinate the computer lab activities and to assist the classroom teacher in the management and coordination responsibilities of the computer lab and in facilitating ILS instruction. The school principal developed a lab schedule in which all students at each school were provided forty-five minute sessions using the ILS two or three times per week to supplement regular classroom instruction.

The sample selected for this study consisted of elementary school teachers at four schools whose students interacted with an ILS using the *Successmaker* courseware for instruction. A sample of teachers (N=30) was randomly selected for the study from all of the ILS-using teachers in the four schools. The schools selected for this study had employed ILS technology for different periods of time and since the sample size was relatively small, no comparisons were made among the various schools.

To collect data regarding patterns of use occurring among individuals implementing an ILS and differences among these patterns of use, a structured interview was conducted and recorded by the researcher with each of the teachers selected for the random sample. One interview in the original selection was not completed making N=29 for the CDICM.

An expert group consisting of the researcher, an experienced lab manager (not from the school system under study), and a vendor representative was assembled to rate the interviews for the CDICM checklist. The CDICM component scores for each case in the sample were based on the collective ratings of the expert group. The expert group reviewed transcribed audio tapes of teachers' interviews and independently scored each respondent based on the content and structure of the CDICM checklist.

Analysis of use by teachers implementing the ILS was conducted through pattern analysis of the interview data to determine dominant configuration patterns or variations. The general patterns that emerged were analyzed by a cluster analysis that identified relatively homogenous groups of cases based on selected characteristics.

One-way analysis of variance was used to examine differences among the configuration patterns for each of the components measured by the CDICM. A test was performed to validate the results of the ANOVA against discrepancies that existed in the assumptions due to differences in group sizes and normality (Minium, 1978; Norusis, 1995). Post-hoc tests were performed to compare differences between pairs of configuration patterns' means for each CDICM component using the Bonferroni procedure.

An independent variable was constructed for CDICM level of use by assigning a level of use classification for the composite score of the CDICM to each case (using the same scale as was used for the component variations on the CDICM (1, 2, 3, 4 or 5). Next, a linear regression analysis was used to examine the relationship between each significant CDICM component (from the ANOVA) and the degree of ILS implementation. A stepwise multiple regression was performed to determine which components were the best predictors of ILS implementation.

Results of the Data Analysis

Reliability statistics were computed to determine the internal consistency in the ratings determined by each scorer as well as the external consistency in ratings among the scorers. External consistency of the ratings among the three scorers for all items on the scale was $r = .9926$ for AB, $r = .9974$ for AC, and $r = .9935$ for BC. Internal consistency was indicated by a significant coefficient alpha ($p < .01$) for each scorer and for all scorers combined.

Pattern analysis of the interview data was performed to determine dominant configuration patterns or variations. This procedure identified relatively homogenous groups of cases by computing the centroid for each dominant configuration pattern that emerged from the data and then assigning each case to the cluster with the nearest centroid until no cases changed cluster membership. Since the initial cluster centers and the number of dominant patterns were unknown, this procedure consisted of selecting all fifteen components of the CDICM for use in the cluster analysis and incrementing the number of clusters until a reasonable model was obtained. The number of clusters started with two and was incremented by one until convergence of cluster centers reached a distance of zero and the number of cases in each cluster was similar. The cluster analysis was run for two, three, and four clusters before a reasonable model was selected.

At two clusters convergence was achieved with a maximum distance of center change of .3205 while at three and four clusters convergence was achieved with a maximum distance of center change of .0000. At two clusters the distance between final clusters centers was 7.1883 with 18 cases in one cluster and 11 cases in the other. However, at four clusters the distances between final cluster centers ranged from 7.6997 to 17.1270 and the number of cases in each cluster ranged from 1 to 16. The best model occurred with the number of clusters set at three. When the number of clusters was set at three, convergence of cluster centers was achieved after four iterations and the maximum distance by which any cluster center changed was zero. When the number of clusters was set at three, the number of cases in each cluster ranged from 8 to 12.

In order to assess the adequacy of the classification of implementation pattern groups by the cluster analysis a Discriminant Analysis (DA) was performed. The fifteen CDICM components were used to separate the groups into the discriminant functions. As a result of this procedure all grouped cases were correctly classified.

Table 1 lists each CDICM component by $F(2,26)$ and the corresponding discriminant function coefficients and Figure 1 provides a plot of the discriminant functions for each of the CDICM patterns. The discriminant function coefficients reflected the importance attached to each CDICM component in distinguishing the discriminant functions. The multivariate analysis of variance performed by the DA produced significant differences among the Implementation Patterns on CDICM components 1, 2, 3, 4, 5, 11, and 12 ($p < .05$). Based on both functions of the DA, Pattern 2 was indicative of a high degree of implementation characterized by high training and support, integration into classroom and curriculum, and use of reinforcement and motivational strategies.

To examine differences among the CDICM configuration patterns a one-way analysis of variance (ANOVA) was performed. One-way analysis of variance determined significant differences among the implementation patterns groups for each of the CDICM components. A test of homogeneity of variance was performed to validate assumptions required by the ANOVA and to determine whether the variance of the dependent variables was significantly different among the implementation pattern groups. For the most part, the assumption of equality of variances was satisfied. However, the Levene statistic produced by the homogeneity of variance test was

Table 1. Discriminant Function Weights for CDICM Components

CDICM Component	F	Sig.	Fn 1	Fn 2
12. Uses Reinforcement/Motivational Strategies	67.8826	.0000	1.25823	-.30846
2. Received Training in Use of ILS	10.2191	.0005	.13897	.29295
5. Integrates with Classroom Instruction	9.2215	.0009	-.27445	1.74723
3. On-Going Support is Provided	7.6386	.0025	.60909	.18948
11. Facilitates ILS Instruction	6.5705	.0049	.33663	.14500
1. Understands ILS Instructional Design	3.4095	.0484	-.16839	.28902
4. Sets Instructional Goals for ILS	2.8557	.0757	-.23317	.61968
13. Uses ILS Management Reports	2.5546	.0971	-.36072	-.09096
10. Provides Sufficient Time on Task	2.1375	.1382	1.48069	-.53613
9. Sets Clear Rules of ILS Use	1.7029	.2019	-.15515	.10001
6. Integrates with District Curriculum	1.5184	.2379	.35935	-.59012
15. Understands/Uses ILS Routines and Equipment	.9081	.4157	-.07324	.08089
7. Individualizes Enrollment Options on ILS	.6088	.5516	.25277	-.42373
8. Effective Scheduling of ILS	.4905	.6179	-1.07805	-.77891
14. Uses ILS Achievement in Learner Evaluation	.3634	.6988	.14913	-.58905

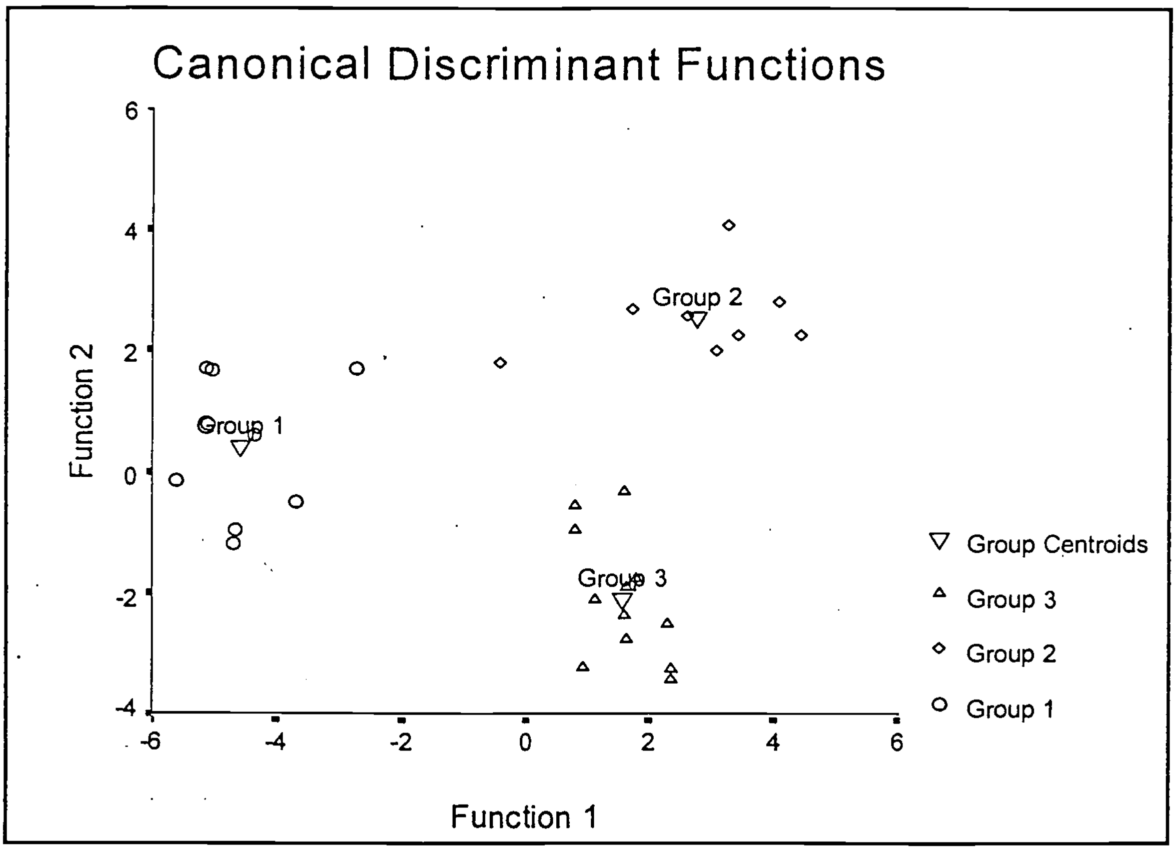

Figure 1. Plot of Discriminant Functions for Each CDICM Implementation Pattern.

significant ($p < .05$) for two CDICM components: Component 7—*Individualizes Enrollment Options on the ILS* and Component 9—*Sets Clear Rules of ILS Use.*

A plot of these two variables revealed that the homogeneity of variance assumption was violated by four outlier cases for Component 7 and three outlier cases on Component 9. Several attempts to transform these variables yielded no success in obtaining a nonsignificant Levene statistic and in satisfying the assumption of equality of variances and so these variables were discarded from further analysis.

An ANOVA examined the differences among the implementation patterns for each of the components measured by the CDICM (see Table 2). The observed power was calculated for the *F* test (p<.05). The results of the ANOVA were consistent with the multivariate analysis of variance performed by the discriminant analysis. The ANOVA indicated significant differences for six of the CDICM components.

To validate the results of the ANOVA in regard to violations of assumptions about differences in group sizes and normality, a Kruskal-Wallis nonparametric analysis of variance was performed. The Kruskal-Wallis test confirmed the results of the ANOVA for five of the six significant CDICM components. Only Component 1—*Understands ILS Instructional Design* yielded a significant difference on the ANOVA but not on the Kruskal-Wallis.

Table 2. ANOVA of CDICM Interview Data Grouped by Implementation Pattern

Dependent Variable		df	F	Sig.	Observed Power
1. Understands ILS Instructional Design	Between Groups	2	3.409	.048	.589
	Within Groups	26			
	Total	28			
2. Received Training in Use of ILS	Between Groups	2	10.219	.001	.975
	Within Groups	26			
	Total	28			
3. On-Going Support Is Provided	Between Groups	2	7.639	.002	.920
	Within Groups	26			
	Total	28			
4. Sets Instructional Goals for ILS	Between Groups	2	2.856	.076	.511
	Within Groups	26			
	Total	28			
5. Integrates with Classroom Instruction	Between Groups	2	9.221	.001	.961
	Within Groups	26			
	Total	28			
6. Integrates with District Curriculum	Between Groups	2	1.518	.238	.293
	Within Groups	26			
	Total	28			
8. Effective Scheduling of ILS	Between Groups	2	.491	.618	.122
	Within Groups	26			
	Total	28			
10. Provides Sufficient Time on Task	Between Groups	2	2.137	.138	.398
	Within Groups	26			
	Total	28			
11. Facilitates ILS Instruction	Between Groups	2	6.570	.005	.874
	Within Groups	26			
	Total	28			
12. Uses Reinforcement/ Motivational Strategies	Between Groups	2	67.883	.000	1.000
	Within Groups	26			
	Total	28			
13. Uses ILS Management Reports	Between Groups	2	2.555	.097	.465
	Within Groups	26			
	Total	28			
14. Uses ILS Achievement in Learner Evaluation	Between Groups	2	.363	.699	.102
	Within Groups	26			
	Total	28			
15. Understands/Uses ILS Routines and Equipment	Between Groups	2	.908	.416	.190
	Within Groups	26			
	Total	28			

Post-hoc Bonferroni tests were used to compare differences between pairs of configuration patterns' means for CDICM components yielding a significant difference on both the ANOVA and the Kruskal-Wallis (see Table 3). The Bonferroni comparisons indicated significant mean differences ($p < .05$) for all five CDICM components for configuration Pattern 2 when compared to Patterns 1 and 3 except for Component 12. These post-hoc findings indicated that differences among the configuration patterns revealed by analysis of variance were primarily based on differences between Pattern 2 and the other two patterns. Post-hoc testing validated that these differences were significant for Components 2, 3, 5, 11, and 12. Thus, teachers who implemented the ILS according to Pattern 2 were statistically better implementers than teachers who implemented the ILS according to Patterns 1 or 3.

Table 3. CDICM Components Significant at 95% Confidence Interval in Post Hoc Comparisons

Dependent Variable	Implementation Pattern	Implementation Pattern	Mean Difference	Std. Error	Sig.
2. Received Training in Use of ILS	1	2	-3.28*	1.089	.017
		3	1.31	.988	.593
	2	1	3.28*	1.089	.017
		3	4.58*	1.022	.000
	3	1	-1.31	.988	.593
		2	-4.58*	1.022	.000
3. On-Going Support Is Provided	1	2	-2.39*	.819	.022
		3	.53	.743	1.000
	2	1	2.39*	.819	.022
		3	2.92*	.769	.002
	3	1	-.53	.743	1.000
		2	-2.92*	.769	.002
5. Integrates with Classroom Instruction	1	2	-4.26*	1.084	.002
		3	-.56	.984	1.000
	2	1	4.26*	1.084	.002
		3	3.71*	1.018	.004
	3	1	.56	.984	1.000
		2	-3.71*	1.018	.004
11. Facilitates ILS Instruction	1	2	-1.76*	.608	.022
		3	.19	.552	1.000
	2	1	1.76*	.608	.022
		3	1.96*	.571	.006
	3	1	-.19	.552	1.000
		2	-1.96*	.571	.006
12. Uses Reinforcement/ Motivational Strategies	1	2	-7.64*	.769	.000
		3	-7.22*	.698	.000
	2	1	7.64*	.769	.000
		3	.42	.722	1.000
	3	1	7.22*	.698	.000
		2	-.42	.722	1.000

*The mean difference is significant at the .05 level.

A stepwise multiple regression was performed to determine significant CDICM components or combinations of components that were the best predictors of the degree of ILS implementation (see Table 4). Stepwise variable selection entered each CDICM component into the regression model by order of importance and removed components with diminished importance as additional predictors were added.

All CDICM components were entered into the regression model as predictor variables and the degree of ILS implementation as measured by CDICM composite score was entered into the regression model as the criterion variable. Significant correlations ($p < .01$) were obtained among all the variables. Component 5—*Integrates with Classroom Instruction* explained 56% of the variability in the degree of ILS implementation for this model and 54%

for other data sets from the same population. Component 5, Component 2—*Received Training in Use of ILS*, and Component 12—*Uses Reinforcement/Motivation Strategies* explained 87% of the variability of the degree of ILS implementation for this model and 95% of the variability of the degree of ILS implementation was explained by Components 5, 2, 12, 4, and 6.

Table 4. Stepwise Multiple Regression of Influence Variables on Degree of ILS Implementation

Variable[a,b]	R	R^2	Adjusted R^2	Std. Error of Estimate
5. Integrates with Classroom Instruction	.748	.560	.544	9.39
2. Received Training in Use of ILS	.855	.732	.711	7.47
12. Uses Reinforcement/Motivational Strategies	.933	.871	.856	5.28
4. Sets Instructional Goals for ILS	.967	.935	.924	3.82
6. Integrates with District Curriculum	.974	.950	.939	3.44
15. Understands/Uses ILS Routines and Equipment	.980	.961	.950	3.11
8. Effective Scheduling of ILS	.984	.969	.959	2.82
14. Uses ILS Achievement in Learner Evaluation	.989	.978	.969	2.44
11. Facilitates ILS Instruction	.993	.986	.980	1.98
9. Sets Clear Rules of ILS Use[c]	.995	.990	.984	1.77

[a]Dependent Variable is Degree of Implementation
[b]Stepwise Method, Probability-of-F-to-Enter <= .050, Probability-of-F-to-Remove >= .100
[c]Probability of F-to-enter = .050 limits reached

Implications for Educational Change

Current debate in the field of educational change has concentrated on contrasting differences in reductionist and holistic orientations to scientific inquiry (see Banathy, 1995). Carr (1996) explained this debate by suggesting that integration and separation represented two fundamentally different aspects of the same reality. Integration was concerned that when a system was separated or reduced to smaller components some of its vital properties were lost while separation was concerned that the whole was too complex to be studied or understood in its entirety.

The problem with the approach of the first decade of computer use in schools was that it was focused on applying the computer to the existing instructional delivery system. Collins (1991) described American schools as a self-sustaining, interlocking system of institutions consisting of age-graded schools, multiple-choice testing, curriculum and materials, teacher education, and lecture and recitation that naturally resisted technology:

> If you try to introduce computers for students to do their work, the change will be sustained only to the degree that it fits the prevailing institutional structure. Since computers undermine the lecture and recitation methods of teaching and promote the student as self-directed learner, they do not fit this institutional structure and will be squeezed out by it. (p. 32)

However, for systemic change to occur the focus of change must become our view of the role of the teacher in implementing technology. Many researchers in the field of educational change are applying the principles of holistic thinking to the creation of new systems of human learning through methodologies that focus less on end goals and outcomes and more on helping individuals change their perceptions of themselves (Carr, 1996). The methodology followed by this study—emphasizing ILS implementation factors and focusing on users of ILS technology—and the subsequent data collection and findings support a systemic change process in education.

The findings of this study provided evidence for the proposition that not all ILS use is the same. Significant differences and variances in both the ILS implementation concerns and behaviors of teachers implementing an ILS were noted. The level of ILS implementation was a function of implementation practices that included integration with classroom instruction, training in the use of an ILS, and the use of motivational strategies.

Furthermore, using an ILS to improve the teaching/learning process was more complex than earlier understood. Just because a teacher was an effective implementer of an ILS was no guarantee that learners realized higher achievement using the ILS. Without the necessary organizational support the expectation for instructional technology to improve the teaching and learning process cannot be sustained.

This examination of the practices of teachers implementing an ILS can be a highly effective guide to actions that change agents and stakeholders might follow as they assume a role in facilitating change and improvement in the implementation of ILS technology. Given the context of ILS implementation, the findings of this study substantiated the research on change and innovation. Several lessons from the change literature were revealed through this study that might assist stakeholders or change agents in promoting a successful and effective implementation of computer-delivered instruction:

1. Implementation of an ILS is a developmental process that must be nurtured and sustained. Implementation of an ILS doesn't happen by itself. When left to their own devices, teachers will implement an ILS to whatever level is consistent with their concerns about the ILS and structurally fits into their existing teaching patterns and practices.
2. Teachers implement an ILS in different ways. The specific operational components of the ILS must be communicated to teachers so they understand what the program looks like when it is fully functioning. Before learner achievement data can accurately be examined to determine the effectiveness of the ILS, it must be determined to what degree the ILS has been implemented. A determination of the relative merit of an ILS should be based on an examination of the degree to which an ILS is actually used in relation to the intended use of the ILS.
3. Integrate ILS instruction with classroom activities and instruction. For systemic change to occur in the teaching/learning process, the existing system has to be fundamentally replaced with an improved system. Teachers that were the most effective implementers of an ILS incorporated ILS instruction into classroom instruction or vice versa.
4. Training should be a continuous process and not a one-time event. On-going training is a key component to sustaining an ILS implementation. On-going training reaffirms fundamental practices that focus the user on the intended use of the ILS and influences the concerns a user will have about the implementation of an ILS.
5. ILS implementation must be teacher-driven. There is a perception that an ILS runs itself (Gleghorn, 1993) and by simply placing learners with computers does not ensure that they will grasp the underlying structure of important ideas and concepts. Resnick and Johnson (1988) noted that learning that occurs in isolation is not sustained in other contexts and Pea (1988) explained the necessity of teachers to assist learners in applying principles in multiple situations. Effective teaching practices accommodate effective ILS implementation
6. An understanding of how the ILS is to be used and the expectations for learning must be clearly articulated. Jones (1990) observed that change is more manageable and occurs more easily when school districts articulate a common perception about what the change process entails. Once an ILS goes into a school building it is beyond the control of the designers and developers and it becomes the responsibility of the stakeholders in the change process to ensure that the ILS is properly implemented and that systemic change occurs

Conclusions

This study focused on describing the concerns and implementation practices of teachers implementing an ILS. Computer-delivered instruction and integrated learning systems represent one stage in a long succession of technologies and innovations embraced by education in the last several decades. Although the problem of implementing ILSs is relatively new, the issue of properly or adequately assimilating technology into the classroom and promoting its effective use has long been a matter of research and debate. Since the implementation of ILSs is a complex process, further studies that describe the implementation process for ILSs should be conducted.

Implementation is better understood when contextual phenomena of the implementation are examined because the question of the instructional effectiveness of an ILS or other forms of computer-delivered instruction may be as much an implementation issue as a matter of instructional design. Ultimately, the potential of ILSs and other forms of computer-delivered instruction may be unfulfilled when the technology is ineffectively or improperly implemented.

Computer-Delivered Instruction Configuration Matrix
Integrated Learning System

Rules for Rating:
(1) Any information in the interview may be used to rate any single component.
(2) Rate to the highest level of use described by the respondent for any single component.

	5 IDEAL USE	4 ACCEPTABLE USE	3	2 MINIMAL USE	1 UNACCEPTABLE USE
Component 1 Instructional System and Design of ILS	Describes individualized prescriptive strategies	Describes instructional presentation and mastery of skills	Describes enrollment levels	Describes different content areas only	Has no understanding of instructional design or no understanding is necessary
Component 2 Training in Use of ILS	Initial training, continued training, and program updates are conducted	Initial training and continued training is conducted	Initial training or orientation is conducted	Training is self-directed and occurs on-the-job	Received no training
Component 3 On-Going Support System and Communication in Use of ILS	Formal grade/ department level meetings to discuss ILS are conducted	Building level meetings with vendor or principal to discuss ILS are conducted	Technology committee meets periodically to discuss ILS instruction	Informal discussions with lab manager or other teachers	No attention is given to on-going support
Component 4 Instructional Goals or Expectations for Use of ILS	Accomplishment of goals is celebrated	Instructional goals for ILS are accomplished	A plan for accomplishing instructional goals is stated	Goals or expectations for ILS are stated	No goals or expectations for ILS instruction are set
Component 5 Integration of ILS Courseware with Classroom Instruction	ILS is used as a tool for regularly accomplishing classroom instructional objectives	Plans lessons that integrate ILS courseware with classroom instruction in multiple subjects (Worksheets may be used)	Plans lessons that integrate ILS courseware with classroom instruction in one subject (Worksheets may be used.)	ILS courseware supplements classroom instruction	ILS courseware is not integrated with classroom instruction
Component 6 Integration of ILS Courseware with Curriculum	Sequence and selection of courses/lessons are adjusted to align with or support district curriculum	ILS courseware supplements district curriculum in multiple subjects	ILS courseware supplements district curriculum in one subject	ILS courseware is correlated to district curriculum when possible	ILS courseware is not integrated with district curriculum
Component 7 Appropriate Selection of Courses, Enrollment Levels, and Options of ILS	Individualized learning sequences are designed and modified based on test scores, monitoring student progress, forecasts of learning gains	Learning sequences are individualized for each student based on test scores or monitoring of student progress	Test scores or prior ILS performance are used to enroll students in same courses at different grade levels	Students are enrolled in same courses at grade level	Students are enrolled at beginning level of course or strand
Component 8 Effective Scheduling of ILS	All students are scheduled for regular use and makeup sessions are provided	All students are scheduled regular use	Some students are scheduled for regular use	Some students are scheduled for occasional, remedial or specialized use	Students are not scheduled for either occasional or regular use

	5 IDEAL USE	4 ACCEPTABLE USE	3	2 MINIMIMAL USE	1 UNACCEPTABLE USE
Component 9 **Clear Rules for Daily Procedures Using ILS**	Orientation to rules and procedures is presented	Rules and procedures are established and handed out to students in printed form	Rules and procedures are established and posted in lab or classroom	Some rules and procedures are established by the teacher	No rules and procedures are established
Component 10 **Sufficient Time on Task for Each Student Using ILS**	Amount of instructional time is determined by targeted gain for students	Students receive more than 30 minutes of ILS instruction per week and makeup sessions are provided	Students receive more than 30 minutes of ILS instruction per week	Students receive at least 30 minutes of ILS instruction per week	Students do not receive regular weekly instruction using ILS
Component 11 **Teacher Facilitation and Intervention Using ILS**	Continuously facilitates instruction; provides intervention strategies including worksheets, selected practice, tutoring, or small group instruction	Continuously facilitates instruction	Occasionally facilitates instruction or facilitate when students request assistance	Facilitation and intervention Is provided primarily by lab manager	Teacher is not present or does not facilitate ILS instruction
Component 12 **Effective Use of Reinforcement and Motivational Strategies Using ILS**	Recognizes individual and group achievement through use of individual and group motivational strategies of motivational strategies involving parents or community sponsors	Recognizes individual achievement through use of individual motivational strategies including certificates, wall charts, or individual competition	Recognizes group achievement through use of group motivational strategies including contests or team activities	Explains reasons for using ILS and encourages students to actively participate in ILS instruction	No motivational strategies or activities are used
Component 13 **Student Feedback and Use of Reports Generated by ILS**	Reports are used to provide information for determining classroom instruction or classroom activities	Reports are used to review student progress and modify student enrollment	Reports are used for progress review by lab manager, teacher, or principal	Reports are used infrequently or on a limited basis	Reports are not run or distributed
Component 14 **Instructional Assessment of ILS Courseware**	Evaluation or assessment of students includes mastery levels, lesson completion, or courseware content for multiple subjects	Students receive a letter or numeric grade for ILS achievement in multiple subjects	Students receive a letter or numeric grade for ILS achievement in one subject	ILS is optional for inclusion in the evaluation or assessment of students	ILS is not included in the evaluation or assessment of students
Component 15 **Teacher Knowledge and Skills Using ILS Routines and Equipment**	Familiar with course content for multiple courses, can modify instructional levels or other student enrollment information, and can use custom reports or forecasting reports to make instructional decisions	Familiar with course content for multiple courses and can modify instructional levels or other student enrollment information	Familiar with course content and student resources for multiple courses	Familiar with course content and student resources for one course	No familiarity with course content, student resources, or management system

Interview Guide for the Computer-Delivered Instruction Configuration Matrix

Is it OK if we use the term ILS to stand for the integrated learning system including courseware, computers, and lab?

1. Describe in your own words the organization of ILS instruction?

2. How much formal training have you had in the use of ILS? What training have you received lately?

3. What formal or informal communication such as meetings or discussions has occurred to support you in the use of ILS? (What do you do and who do you tell if you have a problem?)

4. What goals or expectations do you set for your class for ILS instruction? How do you determine if these goals are accomplished?

5. When planning for classroom instruction, how do you integrate or coordinate ILS instruction into classroom activities?

6. Does ILS integrate with district or grade level curriculum? If so, in what ways and with what courses?

7. How do you determine the courses, level, and sequence of instruction students receive using ILS? Are modifications to student enrollment ever made? If so, how do you determine what modifications are made?

8. What students in your class receive ILS instruction? Are makeup classes provided for when students miss ILS instruction or when your class misses a scheduled lab time?

9. Have rules or procedures been established for students using ILS? If so, how do students know these rules or procedures?

10. How much time do students spend each day or week using ILS? How do you determine the amount of time students spend using ILS?

11. What do you actually do while the students are using ILS?

12. How do you keep students motivated about using ILS? (Are there organized programs in your classroom or school to recognize student achievement using ILS?)

13. How do you use the student reports generated by ILS? Is this information reported to the principal or lab manager? If so, how do they use the reports?

14. Is ILS included in your evaluation and assessment of students? If so, in what ways do you use ILS for evaluation and assessment of students?

15. What courses on the ILS are you most familiar with? What routines on ILS can your perform (student reports, custom reports, enrollment)?

REFERENCES

Albers, R.P. (1994). Effective change strategies: Implementation of computer-assisted instruction in elementary schools. *Dissertation Abstracts Online, 55*(12-A). (University Microfilms No. AAD95-14082).

Banathy, B.H. (1995). Developing a systems view of education. *Educational Technology,35*(3), 53-57.

Carr, A.A. (1996). Distinguishing systemic from systematic. *Tech Trends, 41*(1), 16-19.

Collins, A. (1991). The role of computer technology in restructuring schools. *Phi Delta Kappan, 73*(9), 28-36.

George, A.A. & Hord, S.M. (1980). *Monitoring curriculum implementation: Mapping teacher behaviors on a configuration continuum*. Paper presented at the annual meeting of the American Educational Research Association, Boston, MA. (ERIC Document Reproduction Service No. ED 192 45).

Gleghorn, S.R. (1993). A study of innovation configurations for integrated learning systems. *Dissertation Abstracts International, 54*(07-A). (University Microfilms No. AAD93-32907)

Hall, G.E. & Loucks, S.F. (1977). A developmental model for determining whether the treatment is actually implemented. *American Education Research Journal, 14*(3), 263-276.

Hall, G.E. & Loucks, S.F. (1978). *Innovation configurations: Analyzing theadaptations of innovations*. Austin, TX: Research and Development Center for Teacher Education, University of Texas. (ERIC Document Reproduction Service No. ED 189 074)

Hord, S.M. & Huling-Austin, L. (1986). Effective curriculum implementation: Some promising new insights. *Elementary School Journal, 87*(1), 97-115.

Hord, S.M., Rutherford, W.L., Huling-Austin, L. & Hall, G.E. (1987). *Taking charge of change*, Alexandria, VA: ASCD Publications.

Heck, S, Steigelbauer, S.M., Hall, G.E. & Loucks, S.F. (1981). *Measuring innovation configurations: Procedures and applications.* Austin, TX: Research and Development Center for Teacher Education, University of Texas.

Jones, T.G. (1990, Winter). *School District Personnel's Perceptions of Change,* ERS Spectrum, 33-38.

Mills, S.C. (1997). Implementing integrated learning systems in elementary classrooms. *Dissertation Abstracts International, 58*(02-A). (University Microfilms No. AAD97-21054).

Minium, E.W. (1978). *Statistical Reasoning in Psychology and Education* (2nd ed.) New York: John Wiley & Sons.

Norusis, M.J. (1995). *SPSS Guide to Data Analysis*. Englewood Cliffs, NJ: Prentice Hall.

Pea, R.D. (1988). Putting knowledge to use. In R.S. Nickerson and P.P. Zodhiates (Eds.), *Technology in education: Looking toward 2020* (pp. 139-168). Hillsdale, NJ: Lawrence Erlbaum Associates.

Resnick, L. & Johnson, A. (1988). Intelligent machines for intelligent people: Cognitive theory and the future of computer-assisted learning. In R.S. Nickerson and P.P. Zodhiates (Eds.), *Technology in education: Looking toward 2020* (pp. 139-168). Hillsdale, NJ: Lawrence Erlbaum.

Smith, P.L., & Ragan, T.J. (1993). *Instructional design.* New York: Macmillan Publishing Co.

NOTICE

REPRODUCTION BASIS

☒ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☐ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").