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ABSTRACT

The Berlin-White Action Research Model (BWARM) described here was designed to prepare and support teachers in the development, implementation, and evaluation of innovation within their classroom. The year-long program consists of three interrelated phases over four academic quarters: (1) "Pedagogical Awareness," designed to provide knowledge and experiences to advance teacher learning and to serve as a springboard for the development of educational innovations; (2) "Research, Development, and Evaluation," which prepares teachers in the fundamentals of inquiry in education; and (3) "Classroom Applications," three quarter-long seminars focusing on development of curriculum innovation and data collection procedures, classroom implementation and data collection and analysis, interpretation, and report writing. A culminating 2-day conference brings together teachers and other professional educators to share the curriculum innovation and action research results. The findings of a 5-year longitudinal study involving 92 elementary teacher-researchers suggest that the BWARM program enhanced teacher attitudes toward educational innovations and educational research, facilitated the implementation of educational innovations and improved teaching and learning in individual classrooms, and changed the participating teachers' views of their classroom roles to include reflection and inquiry. A figure and eight tables are attached. (Contains 17 references.) (ND)

TEACHER ACTION RESEARCH:

THE IMPACT OF INQUIRY ON CURRICULUM IMPROVEMENT AND PROFESSIONAL DEVELOPMENT

By

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Introduction

Among the significant challenges identified by recent education documents is the lack of communication between researchers and practitioners. White and Tisher (1986) reflect that while a great deal of science education research has been conducted over the last decade, very little has informed or affected practice. To meet this challenge, they suggest that teachers become full members of research teams. "This development may lead to a different, collaborative style wherein research is done by and with, rather than, on the teacher." (White & Tisher, 1986, p. 897) This type of collaborative approach characterizes action research. Although action research has been defined in many different ways, the term as used in this paper denotes systematic and recursive inquiry and reflection in a collaborative learning community directed toward the understanding and improvement of practice. Readers interested in a review of the action research literature are referred to Hollingsworth (1992), Holly (1991), Kemmis and McTaggart (1988a, 1988b), McCutcheon and Jung (1990), Noffke (1989, 1990), and Watt and Watt (1993).

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Within the current education reform environment, action research is being endorsed as a means to broaden the research base, expand knowledge, and strengthen the impact of research. For example, Shymansky and Kyle, Jr. (1991) in their document, Establishing a Research Agenda: The Critical Issues of Science Curriculum Reform, provide a strong rationale for the use of collaborative action research in science education research.

> Our understanding of science teaching and learning will be enhanced by practitioners and researchers theorizing, planning, conducting, and interpreting research that is pedagogically valid. Enhanced communication and collaboration should inform the process and influence practice. (p.40)

Klapper, Berlin, and White (1994) strongly argue that systemic reform must be linked to a professional environment that

> ...provides teachers the resources to continue extending (through both self-learning and external presentation) their mastery of content and pedagogy...; supports teachers engaging in critical self-reflection and analytic/systematic inquiry; and encourages teachers to pursue innovation within the classroom, school, school district, and the enterprise of teaching. (p. 3)

In a recent conference entitled "An Agenda for Science Education Research" (White & Klapper, 1994) held at The National Center for Science Teaching and Learning, one of the five organizing theme questions was, "What are the appropriate relationships between practice and research in science education?" Both university researchers and practitioners agreed that

> for change in practice to occur, there needs to be collaboration between researchers and practitioners. For practitioners to use and value research, they must be a part of the process itself, actively contributing to the research enterprise. For research to be valuable to practice, real problems emerging from practice should become a part of the science education research agenda. (Berlin & Krajcik, 1994, p.1)

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Action research promises not only to improve practice, but also to contribute to the professional development of teachers and the professionalization of teaching. A national focus on teacher professional development is articulated in the recent *Draft Mission Statement and Principles of Professional Development* (U.S. Department of Education - Professional Development Team, 1994). This document recognizes the essential role of practitioners in educational reform and the need for enabling conditions - an environment that promotes and supports the professionalization of teachers. Among the ten principles put forth, the following four are especially relevant.

> Professional Development:
> ... respects and nurtures the intellectual capacity of teachers and others in the school community;
> ... enhances leadership capacity among teachers, principals, and others;
> ... requires ample time and other resources that enable educators to develop their individual capacity, and to learn and work together;
> ... promotes commitment to continuous inquiry and improvement embedded in the daily life of schools

Other national-impact documents are equally supportive of teachers as researchers. Both the mathematics and science education communities have proposed professional development standards that recommend opportunities for teachers to use inquiry, reflection, and existing research to generate new knowledge about teaching and learning and improve practice (National Council of Teachers of Mathematics [NCTM], 1991; National Research Council [NRC], 1994).

> Teachers must be recognized as and encouraged to be partners with college and university faculty in planning, conducting, and interpreting research that impacts on mathematics teaching and learning. (NCTM, 1991, p. 185)

> Teacher[s] [should] develop habits of conducting formal and informal classroom-based research to improve their practice. They [should] ask questions about how

students learn science, try new approaches to teaching, and evaluate the results in student achievement from these approaches. (NRC, 1994, p. III-21).

Action research is integral to both the improvement of educational practice and the professionalization of teaching. As Watt and Watt (1993) state, "Teacher research as beneficial to the teacher involved, the children learning, the curriculum, and the broader social community no longer needs defense." (p.38) Now is the time to develop and implement action research programs for both preservice and inservice teachers and to establish a teaching environment that provides the enabling conditions that nurture and support teacher-researchers engaged in action research.

Berlin-White Action Research Model (BWARM)

The purpose of this section is to describe a model for action research, the Berlin-White Action Research Model (BWARM). This model was developed and implemented for six years (1987-1993) under the auspices of a State of Ohio Academic Challenge grant. The National Center for Science Teaching and Learning (NCSTL), funded by the U.S. Department of Education Office of Educational Research and Improvement, has enabled subsequent implementations in Grove City, OH (1992-1993, in collaboration with South-Western City Schools); San Francisco, CA (1993-1994, in collaboration with the Far West Laboratory for Educational Research and Development); and Elkhart, Indiana (1994-1995, in collaboration with Goshen College and the Elkhart Community Schools). Subsequent implementations assimilated program modifications consistent with local needs and resources. In addition, NCSTL has supported a five-year, longitudinal study of the BWARM program to determine the attitudes and perceptions toward educational research and educational innovations and to document the professional growth and development of participating teachers.

Goal and Objectives

The primary focus of the year-long BWARM program is action research designed to prepare and support teachers in the development, implementation, and evaluation of innovation within their classrooms. In addition to curriculum improvement, this program seeks to "improve the structures and social conditions of practice" from a "professional critique" standpoint (Hollingsworth, 1992). The specific objectives of the program are to:

- provide teachers with knowledge and experiences related to innovative teaching methods and materials;
- provide teachers with knowledge and experiences in order to conduct action research;
- develop positive attitudes and realistic perceptions related to educational research and innovations in teaching and learning; and
- develop, implement, evaluate, and disseminate innovative teaching methods and materials.

Program Structure

The BWARM Program consists of three interrelated phases over a period of four academic quarters. These phases are: Pedagogical Awareness; Research, Development, and Evaluation; and Classroom Applications. Figure 1 depicts the relationship between components of the BWARM model and the academic year.

Insert Figure 1 about here

Pedagogical Awareness. This phase consists of two special topics courses offered during the Summer Quarter. The special topics courses are designed to provide knowledge and experiences to advance teacher content and pedagogy learning and to serve as a springboard for the development of the educational innovations. Special topics courses have included: Alternative Learning Environments; Integrating Technology into the Classroom; Mathematics Education Reform; Multicultural Education; Science Education Reform; Science, Technology, and Society; Whole Language; and Visualizing the Classroom. Special topics can be selected from issues and initiatives relevant to the local educational community or state and national concerns.

Research, Development, and Evaluation (R D & E). This phase consists of the third course offered in the Summer Quarter. This course, Action Research: Solving Educational Problems in the Classroom, prepares teachers in the fundamentals of inquiry in education. It includes literature search strategies and basic concepts and principles of research design, data collection, data analysis, and data interpretation related to both quantitative and qualitative paradigms. It should be noted that this program, distinct from other action research programs reported in the literature (McCutcheon & Jung, 1990; Richardson, 1994; Watt & Watt, 1993) exposes teachers to a variety of research methods, both quantitative and qualitative. The underlying assumption is that educational research should include "the full range of investigative methods, embracing quantitative research and qualitative/ethnographic/naturalistic research to address either basic or applied questions." (Kyle, Jr., et al., 1991; p. 414)

Classroom Applications. During the academic year, three quarter-long seminars are provided to facilitate and support the transformation of the previous two phases. Bi-weekly seminars are designed to provide ongoing review and support for the teacher-researchers and continuous feedback for program modification. The seminar foci are: Autumn Quarter -

development of curriculum innovations and data collection procedures, Winter Quarter - classroom implementation and data collection, and Spring Quarter - data analysis, interpretation, and report writing.

A culminating two-day conference brings the teachers and other professional educators together to share the curriculum innovations and action research results. These efforts are disseminated as Conference Proceedings consisting of two parts: a description of the innovation and a report of the research results related to the evaluation of the innovation. Some examples of the action research projects are as follows:

- Managing the Environment to Promote Interactive Learning through Play
- The Effect of Alternative Learning Environments on Students' Attitudes/Perceptions and Knowledge of World Cultures
- Exploring the Effect of Business Partners Upon Education
- Using Computer Environmental Simulations to Enhance Student Decision Making
- Using Folk Literature to Improve Reading Comprehension, Vocabulary Development, and Stimulate Positive Attitudes toward Reading
- Using Student-Scientist Interactions to Improve Attitudes Toward Science and Science-Related Careers
- Using Videotapes to Enhance Expressive Language Skills in a Multi-Handicapped Classroom.

Program Participants

Potential BWARM Program participants are chosen through a self-selection, application process. The application form requests the following information: name, home and work address and telephone number, grade(s) taught, current grade(s), subject areas, years of teaching experience, degrees, undergraduate and graduate grade point average, graduate courses, in-service courses/workshops, professional association memberships, professional presentations/publications, grants/honors/awards. In addition, the applicants are asked to write a description of the ways in which their professional goals relate to the goals of the BWARM Program. A copy of undergraduate and graduate transcripts, along with a letter of recommendation from a principal, supervisor, superintendent, department chair, or other administrator is also required. The demographic variables were explored as predictors of attitudes and perceptions related to educational research using multiple linear regression analysis. Interestingly, there were no single or combination of variables that were found to be predictors. This seems to indicate that for this sample of teachers, their past experiences and academic accomplishments were not determinants of changes in perceptions or attitudes related to educational research.

The participants in the program are expected to be involved for 12 months. The quarterly components of the program include: Summer Quarter, two 2-hour courses and one 3-hour course; Autumn Quarter, one 1-hour seminar; Winter Quarter, one 1-hour seminar; and Spring Quarter, one 1-hour seminar and a 2-day conference at a state park.

Program Support

The participants each receive graduate credit hours of tuition-free course work, funds for substitute teacher support, and expenses to cover the two-day retreat in the Spring. Monies are also provided to purchase resources (assessment instruments, books, equipment, and instructional resources) necessary to develop, implement, and evaluate the educational innovations.

Longitudinal Study

The teacher-researchers (N=92) in the five-year longitudinal study were primarily kindergarten through eighth grade teachers from eight counties in the state of Ohio. Semantic differential instruments were created, tested, and revised to measure change in teacher attitudes and perceptions related to educational innovations and educational research. Additional data sources include biographical and demographic information, responses to open-ended questionnaires, and taped teacher presentations/discussions of projects. Follow-up questionnaires, distributed approximately six months after completion of the program, and periodic follow-up communications were also analyzed to determine current attitudes and perceptions toward educational innovations and educational research as well as to gather indicators of professional growth.

Procedures

A 20-item instrument was created, tested, and revised, resulting in a 15-item instrument to measure the attitudes and perceptions of teachers related to specific educational innovation topics and educational research. A semantic differential format with identical pairs of adjectives for both instruments was used.

The responses were scored on a 5-point scale based upon the project director's and research course instructor's consensus as to what the "desirable" teacher attitudes and perceptions would be. The participants responded to these instruments prior to the first class in the Summer and at the last group meeting in the late Spring. The Cronbach Alpha internal consistency reliability for the pretest and posttest attitude and perception scales range from .66 to .94 related to educational innovations and .81 to .95 related to educational research. The overall Cronbach Alpha internal consistency reliability for the educational research instrument is .93 for the pretest and .89 for the posttest.

In addition to the attitude and perception scales, the teachers were given log books in which to record their perceptions, thoughts, reactions, and noteworthy events related to the courses, their action research projects in particular, and the program in general. The teachers' presentations at the end of the conference were videotaped; the reports (teacher innovations and action research) were compiled; the completed written evaluations (rating scales and open-ended responses) of the conference and of the overall program were collected and compiled; and updates on professional activity, development, and accomplishments were gathered. A comprehensive portfolio has been kept, including letters from participants and from other school personnel, public media recognition (e.g., newspaper, radio, and television reports), and academic accomplishments (e.g., starting and/or completion of graduate degrees, honors, awards, and grants).

Analysis and Results

The means and standard deviations for pretest and posttest responses on the instruments related to the specific educational innovations are given in Table 1. The program involved 79 participants. Complete data was collected for 68 of these. As can be seen by inspection of the statistics in Table 1, the mean scores generally increased from pretest to posttest.

Insert Table 1 about here

The means and standard deviations for the pretest and posttest responses to the educational research instruments are given in Table 2. As can be seen by inspection of the statistics in Table 2, the mean scores generally increased from pretest to posttest. The apparent change in attitude and perceptions related to Educational Research is consistent across all five years of the program.

Insert Table 2 about here

A multivariate analysis of variance (MANOVA) with repeated measures (pretest and posttest) for attitudes and perceptions related to educational innovations and educational research was computed for each of the five years spanning 1988-1993 and these results are given in Tables 3 - 7.

Insert Tables 3 through 7 about here

The multivariate and univariate analyses of variance result in significant ($p \leq 0.05$) movement of the participants toward the "desirable" attitudes and perceptions for two of the five years. The 1988-1989 and 1991-1992 groups approach significance ($p \leq 0.074$ and $p \leq 0.053$). Of the nine different topics for innovation there was only one (Visualizing the Curriculum) which resulted in sample means which decreased from pretest (M=60.18) to posttest (M=59.00).

The univariate analyses of the attitudes and perceptions related to the innovation topics resulted in significant ($p \leq 0.05$) gains in four of the nine topics. These included: Educational Technology; Alternative Learning Environments; Whole Language; and Teaching Science, Technology, and Society.

The univariate analyses of the attitudes and perceptions related to Educational Research resulted in apparent positive changes in the responses for all five years. The changes for years 1988-1989, 1989-1990, and 1992-1993 were significant ($p \leq 0.05$) and the 1990-1991 and 1991-1992 years were approaching significance ($p \leq 0.111$ and $p \leq 0.119$).

The univariate analysis combining the 68 participants with complete data for 1988-1993 resulted in significant ($p \leq 0.000$) positive mean changes from the pretest (M=59.16) to the posttest (M=64.82) related to attitudes and perceptions toward Educational Research. (See Table 8.)

Insert Table 8 about here

Based upon both quantitative and qualitative data, the results suggest that this year-long action research program a) enhanced teacher attitudes toward educational innovations; b) enhanced teacher attitudes toward educational research; c) increased teacher involvement in local, state, and national professional activities as presenters and leaders; d) increased grant-writing efforts and successes; e) facilitated the implementation of educational innovations and improved teaching and learning in individual classrooms; f) changed the participating teachers views of their classroom roles to include reflection and inquiry; and g) stimulated academic collaborations within school buildings, across school districts, and with university and business partners.

Many of the teachers developed a strong sense of personal and professional worth. They became more aware of the importance of their own capabilities and professional responsibility for identifying and making curricular and instructional changes. These teachers can now serve as change agents related to their classroom and school, systemic reform, and the professional and social environment of teaching.

This five-year, longitudinal study along with results from subsequent implementations of the BWARM Program have confirmed our commitment to action research. Collaborative action research between university faculty and classroom teachers can forge a partnership characterized by respect; continuous, open communication; and mutual support and benefit. The result is the improvement of teaching and learning and enhanced teacher professional development. Our goal is not to translate research into practice, but to move research into practice.

Epilogue

We can not be certain that these teachers would not have exhibited these positive changes in attitudes and perceptions toward educational innovations and educational research without this experience. Nor are we ready to claim that there are not other equally likely professional development activities to inspire teachers. We do have the sense from both the quantitative and qualitative data that the BWARM Program has great potential for advancing the implementation and evaluation of educational innovations and promoting the professionalization of teachers. However, the interactions with the teachers has also convinced us that a professional environment supportive of action research demands opportunities for collaboration and communication, time and resources (human and material), and recognition in the form of commendation and compensation. Action research should not be an add-on, but a valued and supported professional enterprise.

References

Berlin, D. F. & Krajcik, J. (Eds.) (1994, March) *What are appropriate relationships between practice and research in science education?* Science Education Research Agenda (SERAC) Working Conference of The National Center for Science Teaching and Learning, Columbus, OH.

Hollingsworth, S. (1992, August) *Teachers as researchers: A review of the literature*. East Lansing, MI: The Institute for Research on Teaching, College of Education, Michigan State University.

Holly, P. (1991) Action research: The missing link in the creation of schools as centers of inquiry. In A. Lieberman & L. Miller (Eds.) *Staff Development for Education in the '90's*. New York: Teachers College Press.

Kemmis, S. & McTaggart, R. (1988a) *The Action Research Planner*, 3rd edition. Geelong, Victoria, Australia: Deakin University Press.

Kemmis, S. & McTaggart, R. (Eds.) (1988b) *The Action Research Reader*, 3rd edition. Geelong, Victoria, Australia: Deakin University Press.

Klapper, M. H., Berlin, D. F., & White, A. L. (1994, Autumn) Professional development: Starting point for systemic reform. *COGNOSOS*, 3, pp. 1-5.

McCutcheon,G. & Jung, B. (1990, Summer) Alternative perspectives on action research. *Theory into Practice*, 29, pp. 144-151.

National Council of Teachers of Mathematics. (1991) *Professional Standards for Teaching Mathematics*. Reston, VA: Author.

National Research Council. National Committee on Science Education Standards and Assessment. (1994, November) *Draft National Science Education Standards*. Washington, DC: National Academy Press.

Noffke, S. E. (1989, March) *The Social Context of Action Research: Comparative and Historical Analysis*. Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA. (ERIC Document Reproduction Service No. ED308 756)

Noffke, S. E. (1990, April) *Action Research and the Work of Teachers*. Paper presented at the Annual Meeting of the American Educational Research Association, Boston, MA. (ERIC Document Reproduction Service No. ED320 871)

Richardson, V. (1994) Conucting research on practice. *Educational Researcher*, 23, pp. 5-9.

Shymansky, J. A. & Kyle, Jr. W. C. (1991, March) *Establishing a Research Agenda: The Critical Issues of Science Curriculum Reform*. Report of a conference held April 8, 1990. Sponsored by the National Association for Research in Science Teaching and funded by the National Science Foundation, Atlanta, GA.

U.S. Department of Education - Professional Development Team. (1994, October 31) *Draft Mission Statement and Principles of Professional Development*. Washington,DC: United States Department of Education.

Watt, M. L. & Watt, D. L. (1993) Teacher research, action research: The Logo action research collaborative. *Educational Action Research*, 1, pp. 35-63.

White, A. L. & Klapper, M. (1994, Summer) An agenda for science education research. *COGNOSOS*, 3, pp. 1-5.

White, R. T. & Tisher, R. P. (1986) Research on natural sciences. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching*, Third Edition (pp. 874-905). New York, NY: Macmillan Publishing Company.

Figure 1. The Three Phases of the Berlin and White Action Research Model (BWARM)

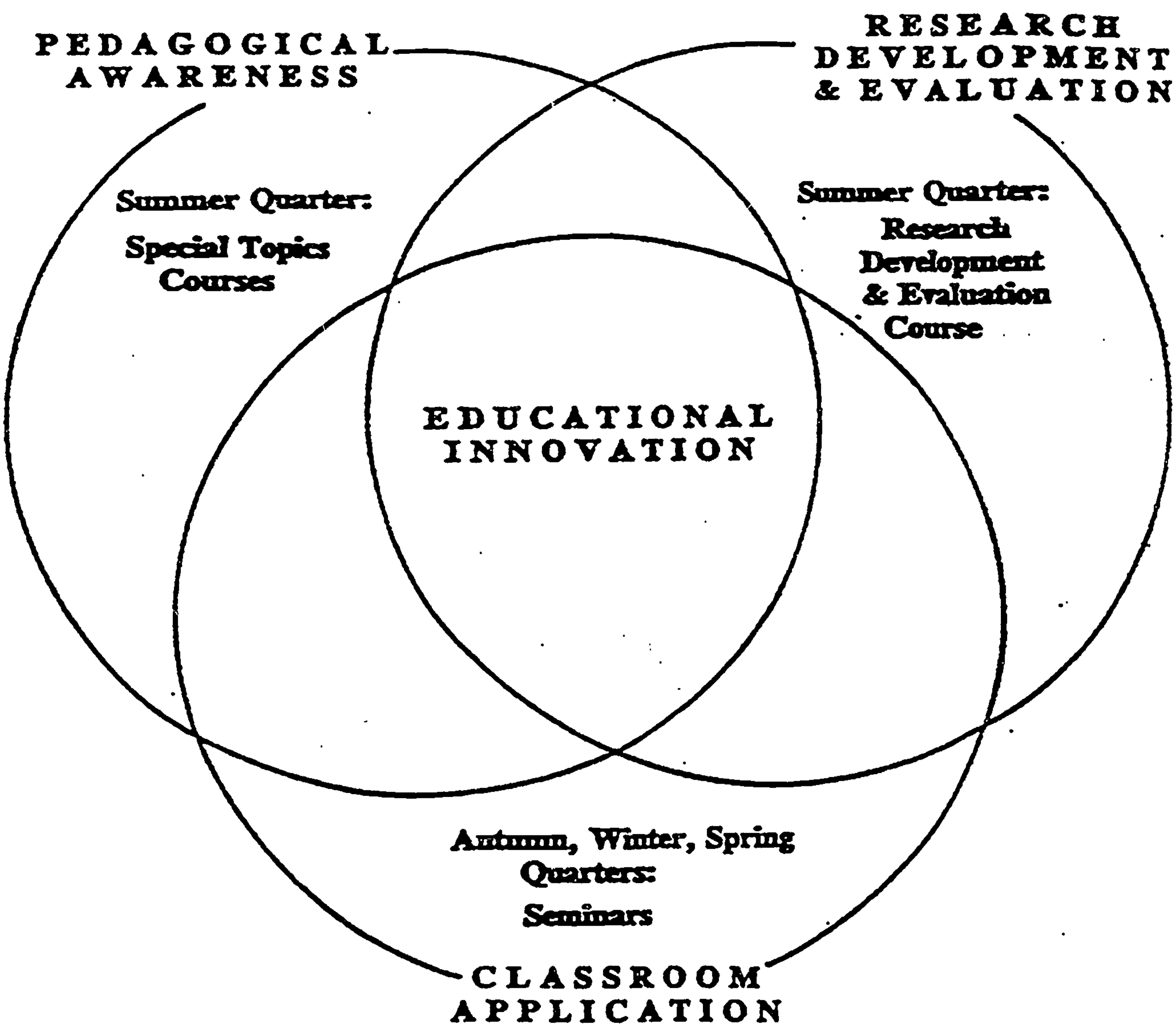

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Table 1

Means and Standard Deviations for Attitudes and Perceptions Related to Educational Innovations

		Test Time	
		Pretest	Posttest
INNOVATIONS			
1988-89			
Educational Technology	M	69.00	71.06
Technology	SD	5.54	4.04
	N	17.00	17.00
1989-90			
Alternative Learning	M	63.42	71.05
Environments	SD	7.93	3.64
	N	19.00	19.00
Whole Language	M	61.95	71.05
	SD	7.13	3.70
	N	19.00	19.00
1990-1991			
Visualizing the	M	60.18	59.00
Curriculum	SD	9.63	7.69
	N	11.00	11.00
Teaching Science,	M	55.64	66.91
Technology, and Society	SD	8.05	5.54
	N	11.00	11.00
1991-92			
Logical Thinking	M	64.00	66.50
	SD	6.83	6.47
	N	10.00	10.00
Multicultural Education	M	60.10	61.50
	SD	8.96	10.09
	N	10.00	10.00
1992-93			
Mathematics Education	M	62.20	67.10
Reform	SD	7.41	6.82
	N	10.00	10.00
Science Education	M	61.90	67.60
Reform	SD	7.48	6.93
	N	10.00	10.00

Table 2

Means and Standard Deviations for Attitudes and Perceptions Related to Educational Research

		Test Time	
		Pretest	Posttest
1988-1989	M	65.88	68.94
	SD	5.54	4.04
	N	17.00	17.00
1989-1990	M	58.00	65.00
	SD	8.74	7.00
	N	19.00	19.00
1990-1991	M	55.09	61.09
	SD	10.18	6.43
	N	11.00	11.00
1991-1992	M	60.10	63.90
	SD	10.69	7.30
	N	10.00	10.00
1992-1993	M	52.50	62.60
	SD	11.07	7.68
	N	10.00	10.00
1988-1993	M	59.16	64.82
	SD	9.89	6.77
	N	68.00	68.00

Table 3

Repeated Measures MANOVA 1988-1989 Pretest and Posttest Attitudes and Perceptions Related to Educational Technology and Educational Research

Multivariate: Educational Technology and Educational Research

Source of Variance	Wilks	MS(df)	Error(df)	F	p
Trial	0.71	2	15	3.11	0.074

Univariate: Educational Technology

Source of Variance	SS	Df	MS	F	p
Within Cells	94.47	16	5.90		
Trial	36.03	1	36.03	6.10	0.025

Univariate: Educational Research

Source of Variance	SS	Df	MS	F	p
Within Cells	275.47	16	17.22		
Trial	79.53	1	79.53	4.62	0.047

Table 4

Repeated Measures MANOVA 1989-1990 Pretest and Posttest Attitudes and Perceptions Related to Alternative Learning Environments, Whole Language, and Educational Research

Multivariate: Alternative Learning Environments, Whole Language, and Educational Research					
Source of Variance	Wilks	MS(df)	Error(df)	F	p
Trial	0.32	4	15	8.00	0.001

Univariate: Alternative Learning Environments					
Source of Variance	SS	Df	MS	F	p
Within Cells	419.21	18	23.29		
Trial	553.29	1	553.29	23.76	0.000

Univariate: Whole Language					
Source of Variance	SS	Df	MS	F	p
Within Cells	628.89	18	34.94		
Trial	787.61	1	787.61	22.54	0.000

Univariate: Educational Research					
Source of Variance	SS	Df	MS	F	p
Within Cells	513.00	18	28.50		
Trial	465.50	1	465.50	16.33	0.001

Table 5

Repeated Measures MANOVA 1990-1991 Pretest and Posttest Attitudes and Perceptions Related to Visualizing the Curriculum; Teaching Science, Technology, and Society; and Educational Research

Multivariate: Visualizing the Curriculum; Teaching Science, Technology, and Society; and Educational Research

Source of Variance	Wilks	MS(df)	Error(df)	F	p
Trial	0.16	4	7	9.49	0.006

Univariate: Visualizing the Curriculum

Source of Variance	SS	Df	MS	F	p
Within Cells	546.82	10	54.68		
Trial	7.68	1	7.68	0.14	0.716

Univariate: Teaching Science, Technology, and Society

Source of Variance	SS	Df	MS	F	p
Within Cells	386.09	10	38.61		
Trial	698.91	1	698.6[illegible]	18.10	0.002

Univariate: Educational Research

Source of Variance	SS	Df	MS	F	p
Within Cells	646.00	10	64.60		
Trial	198.50	1	198.50	3.07	0.111

Table 6

Repeated Measures MANOVA 1991-1992 Pretest and Posttest Attitudes and Perceptions Related to Logical Thinking, Multicultural Education, and Educational Research

Multivariate: Logical Thinking, Multicultural Education, and Educational Research					
Source of Variance	Wilks	MS(df)	Error(df)	F	p
Trial	0.25	4	6	4.40	0.053

Univariate: Logical Thinking					
Source of Variance	SS	Df	MS	F	p
Within Cells	135.25	9	15.03		
Trial	31.25	1	31.25	2.08	0.183

Univariate: Multicultural Education					
Source of Variance	SS	Df	MS	F	p
Within Cells	421.20	9	46.80		
Trial	9.80	1	9.80	0.21	0.658

Univariate: Educational Research					
Source of Variance	SS	Df	MS	F	p
Within Cells	218.80	9	24.31		
Trial	72.20	1	72.20	2.97	0.119

Table 7

Repeated Measures MANOVA 1992-1993 Pretest and Posttest Attitudes and Perceptions Related to Mathematics Education Reform, Science Education Reform, and Educational Research

Multivariate: Mathematics Education Reform, Science Education Reform, and Educational Research					
Source of Variance	Wilks	MS(df)	Error(df)	F	p
Trial	0.36	4	6	2.71	0.133
Univariate: Mathematics Education Reform					
Source of Variance	SS	Df	MS	F	p
Within Cells	290.45	9	32.27		
Trial	120.05	1	120.05	3.72	0.086
Univariate: Science Education Reform					
Source of Variance	SS	Df	MS	F	p
Within Cells	313.05	9	34.78		
Trial	162.45	1	162.45	4.67	0.059
Univariate: Educational Research					
Source of Variance	SS	Df	MS	F	p
Within Cells	325.45	9	36.16		
Trial	510.05	1	510.05	14.10	0.005

Table 8

Repeated Measures Pretest and Posttest ANOVA of Attitudes and Perceptions Related to Educational Research for 1988-1993

Source of Variance	SS	Df	MS	F	p
Within Cells	2226.61	67	33.23		
Trial	1089.89	1	1089.89	32.80	0.000