3-1-1993

An Inservice Model to Impact Life-Science Classroom Practice: Part Two

David P. Butts
University of Georgia

Wyatt Anderson
Univesrity of Georgia

Mary Atwater
University of Georgia

Thomas Koballa
University of Georgia

Patricia Simmons
University of Georgia

See next page for additional authors

Authors
David P. Butts, Wyatt Anderson, Mary Atwater, Thomas Koballa, Patricia Simmons, and Rosalina Hairston

AN INSERVICE MODEL TO IMPACT LIFE SCIENCE CLASSROOM PRACTICE: PART TWO

DAVID P. BUTTS
WYATT ANDERSON
MARY ATWATER
THOMAS KOBALLA
PATRICIA SIMMONS
The University of Georgia
Science Education
Athens, Georgia 30602

ROSALINA HAIRSTON
The University of Southern Mississippi

This model for an inservice program describes why teachers change the nature of their students' experiences in science. In the evaluation study with 7th grade Life Science teachers in Southeast, evidence showed that as teachers' knowledge in specific topics in biology was enhanced, their classroom use of this knowledge also changed. As their knowledge of science and alternative teaching practices was expanded, their attitudes toward teaching showed that they were more aware that there was more to learn but were also more confident that they could acquire the new knowledge they needed. In their classroom, their concerns for students showed significant shifts toward involving students more in their learning rather than being most concerned about managing or controlling them. This was especially true if there was an institutional willingness for them to use different teaching strategies. Thus based on this evaluation study, teachers are more likely to change if the changes are consistent with the external demands of their schooling context; and their internal belief systems.

Introduction

A model inservice program built on a theoretical foundation for changing behavior which incorporates both teachers' knowledge, their attitudes as well as what they do has been described earlier (Butts, et al. 1992). Based on the Koballa model of reasoned behavior (1988), the three phases of the inservice program consist of awareness, arousal and action. Presented here is an evaluation of the use of this inservice model with seventh grade life science teachers involved in an institute designed to enhance their instruction.

The study

The evaluation of the usefulness of the model focused on these four questions:

1. Biological Knowledge

(Awareness)	What biology knowledge do teachers perceive they need?
(Arousal)	What do they get from participation?
(Action)	What is the long term impact of the institute on the science knowledge base of the teachers and its use in their classroom?

2. Attitudes toward biology and teaching
   - (Awareness) What are teachers' initial attitudes toward science and science teaching?
   - (Arousal) How do these change during their participation in the institute?
3. Pedagogical Knowledge
   - (Awareness) What changes in their teaching do teachers believe they need to make?
   - (Arousal) What changes in their teaching do they believe they gained from the institutes?
   - (Action) What changes in their teaching do they institute in their classrooms? What do their students see as changes of their teaching strategies?
4. Influencing Other Teachers
   - (Action) What changes in staff development activities were directly related to participation in the Leadership Resource Teams?

Sample

The sample consisted of 38 teachers who participated in the NABT Leadership Resource Team Project. The participants were members of twelve resource teams located in school districts that had applied for participation in the project. Each team consisted of a district science coordinator and 4 teachers. After the school district was selected for participation in the project, the teachers were selected by the science coordinator of the school district based on their interest and experience in teaching life science, their availability and their interest in participating in the summer institutes and working with other peer teachers. As noted in Table 1, 84% were female and 16% were male. Illustrating the diversity of the teaching population in the Southeast, African-Americans constituted 36% of the group. The certification of the teachers varied from secondary science to elementary with 55% having certification to teach science at the middle school level. They had an average of 11 years teaching experience.

The Design

There are various options for evaluating the impact of this model for inservice programs. Potential pitfalls in evaluating programs were well described by Suchman (1967) who classified six major types of techniques that can be used to distort the evaluation of a program as follows:

(1) "eye-wash", selecting for evaluating only those aspects of a program that appear to be successful;

Table 1
Sample Descriptors

Gender	Female	32 or 84%	
	Male	6 or 16%	
Certification	Secondary/Middle School Science		45%
	Secondary Science		35%
	Middle School Science		10%
	Elementary, General		10%

(2) "white-wash", covering up program failure by avoiding objective appraisal and securing "testimonials" from partisans;

(3) "submarine", attempting to torpedo or destroy a program, regardless of its worth because of power interests within the administration or system;

(4) "posture", making gestures toward "objective evaluation" which, however are not carried through and which are designed only to promote a favorable image;

(5) "postponement", seeking to delay or prolong the evaluation as much as possible in hope that concern about the program will dissipate over time;

(6) "substitution", attempting to shift attention from an essential part of the program that has failed to a minor part of the program that has succeeded. (p. 143).

One functional option for evaluating the inservice model is a discrepancy model described by Provus (1971):

> Evaluation is primarily a comparison of program performance with expected or designed program, and secondarily, among many other things, a comparison of client performance with expected client outcomes. (p. 12)

In this approach, comparison are made between what is observed and the expected standards of the program. If a program is satisfactory, the differences between output observations and input standards will be zero. While this engineering model for evaluation has many positive features, people, however, do not always respond merely in terms of input/output descriptions.

As described by Messick (1974), a medical model for evaluation goes beyond the engineering approach in that it recognizes that specific prescriptions for change and their evaluation must take into account, not only the reported symptoms, but other characteristics of the organism and its ecology as well. In addition, there must be constant concern for monitoring possible side effects of the treatment and documentation of both intended outcomes and other possible outcomes. A third feature of a medical evaluation model is that there must be careful concern for attitudes about the treatment itself. Thus, in a medical model, one goes beyond the concern for the effects and includes equal attention to the process that produces these effects, requiring that the design go beyond a simple pre/post change to a longer time for observing the full nature of both process and change.

In this study, the medical model of evaluation was used as illustrated in the design for the evaluation of the inservice model:

O: X4 Os.....O3.....O4

where O_1 = pretest
X_A = summer institutes
O_2 = post summer institute tests
$O_{3.4}$ = academic year telephone interviews.

The Treatment

The 4 week summer institutes were for teachers who had demonstrated leadership skills and were favorably recommended by their principals and school administrators. Most of the teachers were certified to teach science and had been teaching for at least three years. Before coming to the institutes, the teachers made a commitment to pursue intensive study of subject matter and teaching methods with the goal of improving their personal classroom practices. In addition, teachers made a commitment to serve as members of a resource team that would assist teachers in their school districts to improve biology instruction.

As a vehicle to model instruction that is user-friendly or student-centered, after they were selected the teachers helped in the identification of topics to be included in the institute agenda. As noted by Baird et al (1984), participation in the decision as to what they study is a significant factor in enhancing the mastery of the outcomes of that which is studied. Information from teachers as a source of building the agenda for their learning experiences was a vital component during the institute.

The updating session in current biology and its implications stressed modern biology, both molecular and environmental. The topics were clustered around three themes: molecular biology and genetics, ecology and evolution and physiology and neurobiology. Experiences with these topics enabled the teachers to be familiar with "new biology" in order for them to feel comfortable with subsequently introducing it into their curriculum. They also discussed the implications -- ethical, social and political -- of contemporary issues in biology for their students. Embedded in these sessions was the issue of "what it means to be a scientist" so teachers could share with their students modern views of scientific methodology, sociology of science and career opportunities. Each session was designed around hands-on involvement activities, based on the questions the participants generated, and focused on contemporary issues in biology. Included in this part of the session was time for scientists to share some of their own personal research and interests. Each session finished with a one-hour dialogue between the scientist and teachers in pursuit of further questions of mutual interest.

In the pedagogical sessions, the topics were clustered around five themes: motivating students, hands-on learning, meeting individual needs, managing personal responsibilities and goals and purposes of science in the middle school.

Experiences with these topic enabled the teachers to be familiar with a variety of teaching strategies to help them to feel comfortable with subsequently using them in their classroom. They also discussed the implications - ethical and social - of contemporary issues in schooling for their students. Embedded in these sessions was the issue of "what it means to learn"; so teachers could better understand why new strategies were appropriate for middle school students. Each session was designed around hands-on involvement activities, based on the questions the participants generated. Included also was time for the consultants to share some of their own personal research and interests. Each session finished with a one-hour dialogue between the consultant and teachers in pursuit of further questions of mutual interest.

Instruments

Two sources of data were used - low inference instruments and higher inference retrospective interviews. Since both sets of data are based on teachers' response to questions, a key concern is the validity of self-report data. Loree (1971) has noted that problem when he described this important concern: "One limitation of self reporting inventories is that a person's behavior and his belief statements may not correspond." (p. 104)

Recognizing this potential limitation, Nielsen and Kirk (1974) delineate key advantages to self-report techniques:

> ... self-report questionnaires are potentially more useful ... because they can be standardized, are economical, and can pick up far more data than observers in a much shorter amount of time. (p. 75)

One way to increase the validity of self-report data collection is to be sure that the person responding to the questions sees the process as no reflection on him or her.

Therefore self-report procedures, which guaranteed that no results would be released which could be identified with a specific individual were used.

Data were collected through retrospective interviews. In these interviews during the school year, the teachers were asked to reflect on the institutes experiences as they related to their teaching, e.g.

What two areas of biology that you teach do you feel least comfortable?

For this topic, what two questions do you want answered?

What do you see as the most persistent challenge in your teaching?

Four lower inference instruments were used: The Survey of Opinions Toward Middle/Junior High School, The Scientific Attitude Inventory, The Life Science Attitude Scale and the Test of Integrated Process Skills. A detailed description of each follows.

1. The SURVEY OF OPINIONS TOWARD MIDDLE/JUNIOR HIGH SCHOOL SCIENCE was used to measure attitudes toward life science teaching. This is a revision of the Survey of Opinions Toward Elementary School Science (Spooner, Szabo & Simpson, 1979). It consists of 20, 5 point Likert items. The range of scores is from 20 to 100, with a score of 60 indicating a neutral attitude toward life science teaching. Scores of 40 or 80 indicate strong attitudes toward life science teaching.

As reported by Spooner, Szabo and Simpson (1982) this instrument has a Cronbach's Alpha of 0.90. The instrument was reported to have content validity as established by its authors.

2. The SCIENTIFIC ATTITUDE INVENTORY was used to measure beliefs about science. Developed by Moore and Sutman (1970) this test has 12 scales equally devoted to positive and negative science beliefs. The range of scores is 0 to 15 on each scale, with a scale of 15 representing maximum acceptance of either negative or positive statements and a score of 7.5 indicating neutrality about the statement.

Using a test-retest method, the reliability coefficient was 0.93 (Moore and Sutman, 1970). Construct validity of the instrument was established in their report of the development of the instrument with two experimental groups and one control group of student.

3. The LIFE SCIENCE ATTITUDE SCALE measures teachers attitude toward life science as a discipline. This is a modified version of the Revised Math Attitude scale developed by Spooner, Szabo and Simpson (1982). It consists of 20, 5 point Likert items. In this study the instrument was modified to use "life science" for "science".

As reported by Spooner, Szabo and Simpson (1982) the reliability of this instrument was a Cronbach Alpha of 0.95. The content validity was established by the authors.

4. The TEST OF INTEGRATED PROCESS SKILLS measures process skill achievement of teachers. As designed by Dillashaw and Okey (1980), this test measures process skills of students in grades seven through ten. The test consists of 36 items.

Content validity of the TIPS was established by a panel of experts. Reliability of the instruments was documented using a Cronbach's Alpha of 0.89.

Data Analysis

Four research questions provided the focus for the evaluation of this model for inservice programs.

1. (Awareness) What biology knowledge do teachers perceive they need?

(Arousal) What do they gain from participation?

(Action) What is the long term

impact of the institute on the science knowledge base of the teachers and its use in their classroom?

To answer this question, data from the pre-institute telephone interviews concerning topics for the institute agenda, post-update-session responses and telephone interviews during the fall and spring of the year after the institute were compared and contrasted.

2. (Awareness) What are teachers' initial attitudes toward science and science teaching?

(Arousal) How do these change during their participation in the institute.

To answer this question, data from pre-post-institute responses on the attitude instruments were compared and contrasted with similar data from the students in the teachers classes during the following academic year.

3. (Awareness) What changes in their teaching do teachers believe they need to make?

(Arousal) What changes in their teaching do they believe they gained from the institutes?

(Action) What changes in their teaching do they institute in their classrooms? What do their students see as changes of their teaching strategies?

To answer this question, data from the pre-institute telephone interview, the post-session responses, the teachers' perceptions of how their students will know they have been part of the institute and the telephone interviews during the academic year were compared and contrasted. Analysis was directed toward identifying patterns that illustrate the influence of schooling expectations on practice.

4. (Action) What changes in staff development activities were directly related to participation in the Leadership Resource Teams?

To answer this question, telephone interviews with supervisors provided descriptors of usual patterns for staff development. Personal interviews with teachers were used to secure descriptions of staff development activities used by the team. Patterns of activity in the pre-post-institute staff development were then described.

Findings

Four research questions provided the focus for the evaluation of this model for inservice programs.

1. (Awareness) What biology knowledge do teachers perceive they need?

(Arousal) What do they gain from participation?

(Action) What is the long term impact of the institute on the science knowledge base of the teachers and its use in their classroom?

To answer these questions, 4 sets of data were analyzed. These included pre-institute telephone interviews concerning biology topics that were of highest interest to the participants, post-institute ratings of individual Science Up-date Seminars, retrospective telephone and written interviews concerning the personal usefulness they believed the individual science topics had for them plus their usefulness in their classroom with students.

Categories of biological knowledge were constructed based on the teachers initial interests and the content of the Science Up-date Seminars. As seen in Table 2, there were five categories of biological knowledge. Based on a rating scale of 5 = highest interest and 1 = lowest interest, teachers were most interested in environmental topics before the institute and least interested in topics related to genetics.

As reflected in Table 3, the institute had a profound effect on their view of most topics in biology, but noteworthy is the impact the institute had on their views of topics common to contemporary modern biology.

Table 4 illustrates the accuracy of biology content in the teachers' comments which they generated both before and after the sessions. These comments were judged by a biologist as to the focus of their content accuracy. It was clear that initially there were fewer "on target" questions for the modern biology topics of biochemistry and molecular biology. More "on target" questions were associated with controversial issues such as AIDS, endocrinology, drugs and genetic engineering. For classical topics, such as organisms (insects and plants) and environmental biology, questions tended to be more "on target."

For all topics, the knowledge level at which ideas were reported after the session was considerably higher than the level of questions posed before the session. It was clear that the sessions on biochemistry and molecular biology led to significant improvements in the knowledge base of the teachers.

One year later, the teachers continued to value their knowledge in all 5 categories of biology study. The value they reported for this knowledge for their personal use was consistently higher than it was for the use they could make of this information in their classroom.

As seen in Figure 1, over time, their perceptions of each category were somewhat lesser than immediately after the institute, except in the area of molecular/cell biology. Their classroom use of information in these areas was consistently lower than their personal use but showed a pattern similar to their initial interest, except in the area of genetics. It is interesting to note that their classroom use was highest in the area where their initial interest was the lowest. It is also interesting to note that impact of the Science Up-date Seminars appears to be less in the area of their highest interest, environmental issues.

Thus the results related to teachers' science knowledge base were as follows:

Awareness indicated that they thought they needed more knowledge related to topics they already knew and others linked to environmental issues;

Arousal illustrates that teachers gained much more information about issues of contemporary biology about which they had a very limited background.

Action in their classroom was most often seen in their increased confidence is working with concepts which were expected in the curriculum but which in previous years they had quickly slipped past.

Changes in the classroom thus reflected the dual influences of what the teachers wanted to know and what they believed they must do in the curriculum. Awareness and arousal differences were limited in their translation into action due to constraints in the schooling contest. Internal "want-to" beliefs thus are tempered by the external got-to constraints.

2. (Awareness) What are teachers' initial attitudes toward science and science teaching?

(Arousal) How do these change during their participation in the institute?

To answer this question, data from pre-post-institute responses on the attitude instruments were compared and conclusions

Figure 1 Contrast of Teachers Initial Interest and Post Institute Use of Biology Knowledge

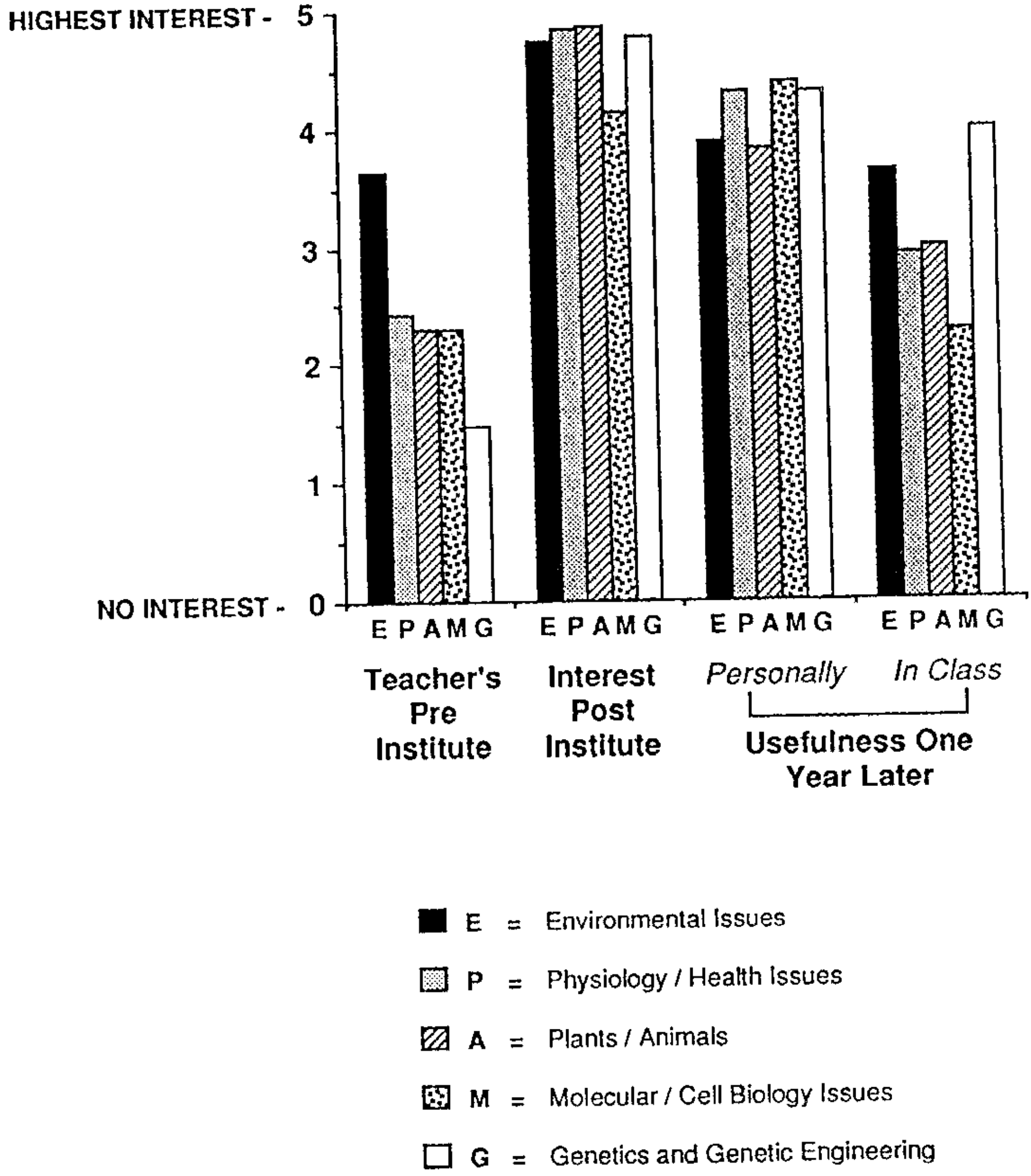


Table 2
Biological Content of Teachers' Initial Interests

Category	Examples of Initial Interest	Examples of Science Up-date Seminars
Issues of ecological and environment	Conservation Marine Sciences Costal Ecology Oil Spill Nuclear Medicine Space Biology	Ecology biodiversity Ecosystem Ecology Behavior Ecology Acid Rain
Issues of physiology and diseases	Human Body AIDS Immune Systems Pathology	Health Physiology/ Endocrinology Drug Additions Immunology Viruses Biology of the Brain
Issues of structure and functions	Dissections zoology Vertebrates Invertebrates	Insect Behavior Evolutionary Biology What it means to be a Plant?
Issues of molecular and cell biology	Histology Mitosis Biochemistry	Molecular biology Biochemistry Cell biology
Issues of genetics and genetic engineering	Mutations Biotechnology Birth defects Genetic Engineering	Genetics Genetics and Human Values Genetic Engineering DNA Laboratory Genetic Engineering in Plants

drawn from these contrasts.

Based on results in Table 5, there was a trend toward a less positive attitude toward science in general and science in the middle school after the institute when compared with teacher attitudes at the beginning of the institute. This result may reflect their enhanced knowledge of the content of that instruction and their awareness that there is much that they have yet to learn. There was

Table 3
Teachers Rating Science Up-Date Topics

Biology Category	Teacher's Pre Institute	Interest Post Institute	One year later Usefulness Personally	In Class
Environmental Issues	3.64	4.75	3.90	3.64
Physiology/ health Issues	2.43	4.86	4.32	2.92
Plants/ Animals	2.30	4.88	3.82	2.99
Molecular/ Cell biology issues	2.30	4.88	3.82	2.99
Genetics and genetic engineering	1.49	4.80	4.30	4.00

where 5 = high interest
1 = low interest

a trend toward a more positive opinion about teaching life science in the middle school. This finding may reflect their increased confidence in being able to cope with teaching based on their new knowledge base. The decline in their ability to use process skills may represent their increase awareness of the substantive nature of these skills.

Results related to teachers' attitudes were as follows:

Awareness suggest that they were very positive about science and science teaching before the institute;

Arousal showed changes after the institute in trends toward a less positive attitude about science teaching possibly due to their awareness of how much they had yet to learn but more positive about their ability to handle the situation due to their increased confidence in themselves.

3. (Awareness) What changes in their teaching do teachers believe they need to make?

(Arousal) What changes in their teaching do they believe they gained from the institutes?

(Action) What changes in their

Table 4
Biology Content of Teachers' Responses to Science Up-date Sessions

Biology Content	Percent of "On Target" Teacher Responses		
	Pre Institute	Post Institute	Change
Environmental Issues	34%	66%	32%
Physiology/ health Issues	40%	60%	20%
Plants/ Animals	42%	58%	16%
Molecular/ Cell biology issues	34%	66%	32%
Genetics and genetic engineering	40%	60%	20%

Table 5
Summary of Data on Teachers' Attitudes and Process Skills

Instrument			Pre Institute		Post Institute
Change	Mean	Range	Mean	Range	
Attitude Toward Life Science	90	61-100	95	83-100	Positive
Science Attitude Inventory	127	114-142	122	111-141	Negative
Opinion Toward Teaching Middle School Science	82	73-98	84	67-98	Positive
Test of Process Skills	29	22-35	26	20-30	Negative

teaching do they institute in their classrooms? What do their students see as changes of their teaching strategies?

To answer these questions, 4 sets of data were analyzed. These included pre-institute telephone interviews concerning teaching topics that were of highest interest to the participants, post-institute ratings of individual teaching enhancement seminars, retrospective telephone and written interviews concerning the personal usefulness they believed the teaching enhancement topics had for them in addition to their usefulness in their classroom with students.

Categories of teaching enhancement needs were constructed based on the teachers' initial interests and the content of the teaching enhancement seminars. As seen in Table 6, there were 5 categories of teaching topics. Based on a rating scale of 5 = highest interest and 1 = lowest interest, teachers were most interested with how to motivate students before the institute and least interested in topics related to goals or purposes of life science teaching. Thus, before the institute, teachers reported that they needed more information regarding handling the unmotivated student. They did not report that topics clearly related to issues about why teaching science in the middle schools were of interest to them.

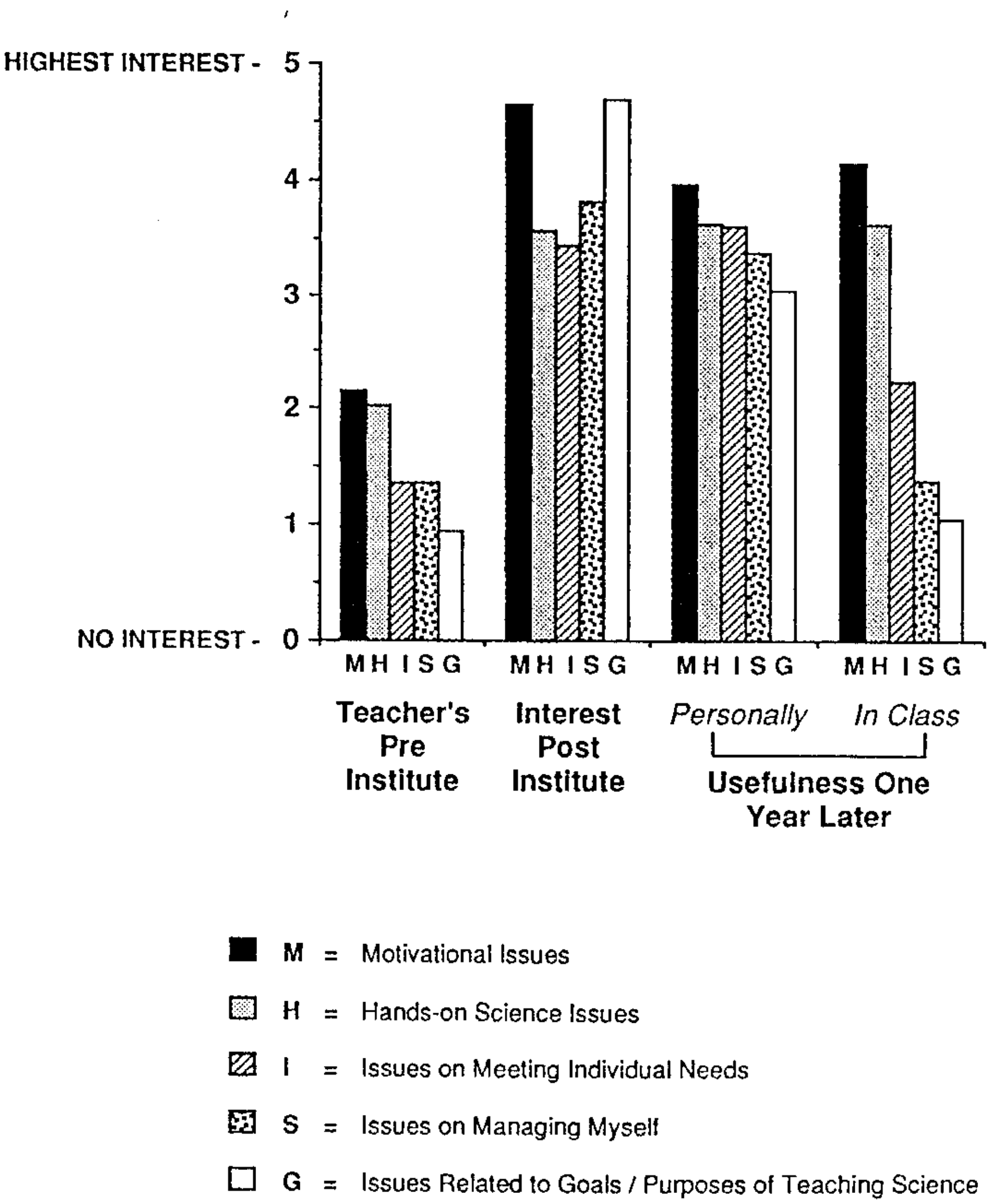
As reflected in Table 7, the institute had a profound effect on their view of all topics related to teaching, but noteworthy is the impact it had on both motivation strategies and purposes of science for the emerging adolescent.

One year later, the teachers continued to value their knowledge in 3 of the 5 categories of teaching enhancement. Their personal use of knowledge continued to be high for all 5 categories. Their classroom use, however, was highest for motivation strategies and classroom management methods for hands-on laboratory experiences. Clearly those areas of greatest classroom use were those over which teachers had control. In areas where teachers had less control of what they could do, there was less use of the information from the teaching enhancement seminars.

As seen in Figure 2, strategies for motivating students had the highest pre-institute interest or the highest perceived need by the teachers. Strategies for motivating students also showed nearly the highest improvement in post-institute rating with 24% of the teachers reporting that their students would see a difference in their use of motivation strategies in the classroom. One year later, teachers continued to see motivation strategies as useful to them personally but even more useful in their classrooms. They also reported that 29% of their students could see a contrast in the level of motivation in the classroom. Nearly 9 in 10 teachers reported that a key element in this increased motivation was the use of science in current events as a topic for discussion in their classroom, and 7 in 10 reported adding new emphasis on values and ethical issues to their discussion of life science topics.

Strategies for involving students in hands-on activities were ranked the second highest perceived need by the teachers. As indicated in Figure 2, teachers reported a substantial increase in interest in this are with 24% of their students expected to observe a change in the use of hands-on activities in their classroom. One year later, their personal use of strategies for hands-on science, as well as their classroom use of these strategies, continued at the high level of the post institute rating. Teachers reported using hands-on science activities 2.4 times per week after the institute. This was a change from their experience of less than once per two weeks before involvement in the institute. Clearly teachers wanted

Figure 2 Contrast of Teachers Initial Interest and Post Institute Use of Teaching Ideas



more ideas for hands-on science activities because they perceive that they are important for their students learning - and later their students experienced this change.

The needs of individual students had a relatively low perceived need for the institute. It was much improved in the post-institute rating with 12% of the students expected to see a difference in teachers' attention to their individual needs. One year later, their personal use of the information on dealing with individual needs was rated much higher than their use of this information in their classroom. About 6 in 10 reported specific modification of classroom teaching practices to fit the individual learning styles or reading levels of their students.

Clearly an increased awareness of the needs of individual students was successful. But changes regarding working with the needs of individual students in the classroom occurred on a much more limited scale. One explanation for this finding might be that it is a function of teachers' wanting to change but being restrained from making changes due to the schooling context.

Results related to teacher's instructional practices were as follows:

Awareness tended to be more concerned about how to handle the unmotivated student and how to control the behavior of other students in their classroom;

Arousal after the institute was clearly changed from how to handle the negative to how to better involve all students and to understand their behavior.

Action demonstrated how teachers used much more hands-on laboratory experiences and involvement strategies to help students learn rather than be so concerned about managing or controlling them.

4. (Action) What changes in staff development activities were directly related to participation in the Leadership Resource Teams?

Based on the pre-institute interviews with the science coordinators and the post-institute telephone surveys with both the coordinators and the team members, 4 clear patterns of changes in staff development were identified. As summarized in Tables 9 and 10, the team members have been actively involved in changing staff development as it had existed previously in their school districts.

The extent of their involvement is clearly noted in the fact that in the two years after the institute, these teachers delivered more than 400 hours of staff development to nearly 3000 teachers. These teachers earned more than 14,000 staff development hours of credit.

First, the leadership team members had a limited involvement in inservice programs. Before the institute, about half of them had participated as leaders in inservice sessions for other teachers. After the institute, 100% of the teachers reported being part of staff development presentation teams.

Second, the content of the staff development sessions showed a definite shift from a focus on curriculum and textbooks to the active involvement of students through hands-on lab and cooperative learning experiences. This fresh focus for staff development sessions reflected the change in the teachers' own practices in their classrooms. Prior to the institutes, they reported using hands-on labs with their students less than one period in a week. After the institutes, this had increased to more than twice per week. A second change in their classroom was their use of cooperative learning strategies with their students, which had increased from about once every 2 weeks to about 3 times per week.

Table 6
Initial Interests of Teachers in Teaching Enhancement Topics

Category	Examples of Initial Interest	Examples of Science Up-date Seminars
Issues of motivating students	How to capture student interests? How to get students to wonder about the world around them? How to capture the Attention of video-TV addicts? How to get students to succeed with homework?	Microteaching Cooperative Learning Drag/Brag sessions Motivation Creative Approaches
Issues of hands-on learning	How to organize and manage hands-on labs? How to do labs in rooms that have no water? How to minimize the textbook?	Field Experiences at Lake Herrick Lab Practice Lab Safety Informal science
Issues of meeting individual needs	How to work with slower students? How to make it possible for each student to succeed? How to meet individual needs in groups of ability? How to handle low performing students?	Computer Resources Active Listening/ Probing Strategies Student Learning Styles Classroom Management
Issues of managing myself	How do I handle my own lack of patience with middle schoolers? How can a generalist become a specialist? How to handle their behavior and my response? How to find time for doing what I think	Characteristics of Middle School Learners Handling Issues in the classroom Handling teacher burnout/stress
Issues of goals and purposes of science in middle school	How to write tests that fit what we should be teaching? How to relate science to everyday life? How to help students learn to solve problems?	Philosophy of Middle School Creating Approaches to Science Developing Support systems.

Table 7
Teachers Rating of Enhancing Teaching Topics

Biology Category	Teacher's Interest Pre Institute	Post Institute	One Year Later Usefulness Personally	In Class
Motivation Issues	2.16	4.64	3.95	4.15
Hands-on Science Issues	2.03	3.56	3.61	3.61
Issues on Meeting Individual Needs	1.35	3.44	3.60	2.24
Issues on Managing Myself	1.35	3.81	3.36	1.38
Issues related to goals/ purposes of teaching science	.95	4.69	3.03	1.05

Table 8
Content of Teachers' Responses to Teaching Enhancement Sessions

Teaching Content	Percent of "On Target" Teacher Responses Pre Institute	Post Institute	Change
Motivational Issues	35%	65%	30%
Hands/on Science Issues	43%	57%	14%
Meeting Individual Needs Issues	45%	55%	10%
Issues on Managing Myself	45%	55%	10%
Issues on Goal and Purposes of Life Science Instruction	36%	64%	18%

Third, there was a marked increase in teachers' active participation in state, regional and national meetings. During the two-year period after the institutes, members of the teams made presentations at 18 professional meetings. Prior to the institutes, most of the members of the teams had never actively participated as presenters in professional meetings.

Fourth, there was a marked concern for the well-being of their fellow teachers after the institute. Prior to the institute, the teachers were mostly concerned about their personal knowledge in biology and their ability to motivate and control their students. After the institute, they reported high satisfaction in sharing ideas with other teachers in their districts and in establishing networks through which they could continue this sharing process. Most of the team members expressed keen desire to have opportunity to continue these efforts. Their supervisors also described ways through which they intend to continue these efforts in strengthening the science students' experiences.

Discussion and Implications

The model of an inservice program was designed to explain why teachers can be helped to change the nature of science their students experience. It has three phases: Awareness, Arousal and Action. Based on the evidence from the NABT Leadership

Table 9
Changes in Teachers Participation in Staff Development

	Prior to Institutes	After Institutes
Presenter in Inservice Sessions in District	56%	100%
Topics of Highest Concern for Inservice Sessions	Curriculum Guides Introduce New Texts	Hands-on Labs Process Skills Cooperative Learning Strategies
Personal Classroom Practices with Students		
Hands-on Labs	1 time per 2 weeks	2.4 times per week
Cooperative Learning	1 time every other week	3 times per week
Presentations at Professional Meetings	4	18

Table 10
Outreach Activities of Leadership Teams 1990-1992

Year 1 Hours	People	Credit	Year 2 Hours	People	Credit	Total Hours	People	Credit
State:	Alabama		Team:	A				
7	52	230	17	58	556	24	110	786
State:	Alabama		Team:	B				
5	47	125	10	20	200	15	67	325
State:	Florida		Team:	C				
8	53	424	-	-	-	8	53	424
State:	Florida		Team:	D				
13	130	550	16	145	645	29	275	1195
State:	Georgia		Team:	E				
9	79	180	64	110	1240	73	189	1420
State:	Georgia		Team:	F				
35	214	630	9	170	320	44	384	940
State:	Georgia		Team:	G				
18	130	460	49	180	1560	67	310	2020
State:	Louisiana		Team:	H				
19	102	552	13	106	357	32	208	909
State:	Louisiana		Team:	J				
27	496	2618	25	150	880	52	646	3498
State:	Mississippi		Team:	K				
9	1175	655	15	220	510	24	395	1165
State:	Mississippi		Team:	L				
15	132	528	18	110	660	33	242	1188
State:	Tennessee		Team:	M				
2	26	52	9	60	180	11	86	232
Totals:								
167	1636	6994	245	1329	7108	412	2965	14,102

Institutes and their followup Outreach Sessions, it is clear that the impact of the inservice program is evident in teachers' knowledge base, teaching skills and attitudes.

In summary for the first question related to biological knowledge, teachers tended to express interest in biology topics for which they had some knowledge. In contrast, while areas of modern biology such as genetics were not strong in their initial interest, these areas were the ones showing greatest change in personal and classroom usefulness after the institutes.

The second question focused on teachers attitudes. They tended to be positive about science and science teaching before the institute. After the institute the mixed trends toward less positive attitudes may reflect their awareness of how much they had yet to learn but more positive about their ability to handle the situation due to their increased confidence in themselves.

For the third question related to pedagogical skills, initially the teachers tended to be more concerned about how to handle the unmotivated student and how to control the behavior of other students in their classroom. After the institute there was a marked change from how to handle the negative to how to better involve all students and to understand their behavior. In their classroom, teachers used much more hands-on laboratory experiences and involvement strategies to help students learn rather than be so concerned about managing or controlling them.

In their Outreach Sessions, the shift from the "Got-to-do's" or the following the curriculum or textbooks to the "Want-to-do's" or involving students in the excitement of learning is clearly illustrated. In the Outreach Sessions, the impact of the inservice model illustrates its value by helping confront teachers with their need for an increased knowledge base and enhanced teaching strategies; by helping teachers acquire new information and teaching practices and by selecting concepts and strategies that have immediate relevance to the classroom. There was a consistent linkage of the teachers' "Want-to-do's" with their "Got-to-do's".

Thus based on these findings, teachers will be more likely to change if the changes are consistent with the external demands of their schooling context and their internal belief systems. Building an inservice program on knowledge of the schooling context expectations thus is an essential component of the model. Beyond this identification of the content of the program, changing teachers' internal beliefs through awareness and arousal is a second key assumption of the model. Teachers who know they need to know more before given opportunity to acquire that new knowledge through personal involvement are more likely to translate the new knowledge into classroom action.

From a behaviorist viewpoint of learning, the three phases of the model have been seen to function successfully in helping teachers change toward a desired outcome. From a constructivist viewpoint, each teacher left the program with what they chose. The similarities of the outcomes, regardless of the assumptions about learning, suggest that the model works equally well under either assumption.

From a reflection on what can be done to enhance the effectiveness of an inservice program based on this model, the inclusion of more explicit study of schooling contexts and the identification of their constraints that are open to modification linked with more hands-on practical application of concept for each teacher are two ways the program could be modified to have a greater impact during the three phases. Both of these changes would probably result in an agenda for the inservice program that would be more responsive to the teachers' interests and the school's demands.

This model of awareness, arousal and action as a way to engineer change in teachers has been used with middle school life science teachers. Three questions emerge for future study.

Does the model have equal application for elementary or secondary teachers?

Would a similar model of linking classroom expectations (external "Got-to-

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simply the old concept that the whole is (or should be) greater than the sum of its component parts.

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Richard A. Kenyon is Professor of Mechanical Engineering at Rochester Institute of Technology and Chair, Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

INSERVICE MODEL - PART TWO

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do's") to students beliefs (internal "Want-to-do's") result in science having a stronger impact on student behavior?

How can the environmental constraints for teachers be modified to enable them to translate more of their beliefs into action?

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