A description of the Teacher, Industry and Environment (TIE) educational improvement project at Central Missouri State University is provided in this report. TIE is designed for Missouri high school chemistry teachers, involving 73 of them in a weekend workshop, meeting with chemists, engineers, and educators to assist them in using resources beyond the standard textbook. Following the workshop, they designed and developed a teaching packet or research project and participated in a Reporting Conference in which they reported on their packets or projects. Among TIE's objectives are: to enrich participant knowledge of the chemical industry of Missouri and the Missouri Department of Natural Resources; to enrich opportunities regarding the applications of computers; and to find examples of laboratory activities and research projects that have shown promise. Probably the single most exciting unanticipated outcome of the TIE conference is the desire of other states to host their own TIE workshop. Appended are: the 1987 TIE workshop evaluation; the TIE pre-workshop questionnaire; the TIE 87 reporting conference evaluation; the TIE participant survey; and the TIE 87 teacher participant list. Tables are included. Contains 10 references. (Author/SM)
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Funding Agency: National Science Foundation
(NSF Award No. 8650101)
Missouri Chemical Council
Department of Natural Resources
Central Missouri State University

Date: February 1987

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AASCU/ERIC Model Programs Inventory Project

The AASCU/ERIC Model Programs Inventory is a two-year project seeking to establish and test a model system for collecting and disseminating information on model programs at AASCU-member institutions—375 of the public four-year colleges and universities in the United States.

The four objectives of the project are:

- To increase the information on model programs available to all institutions through the ERIC system
- To encourage the use of the ERIC system by AASCU institutions
- To improve AASCU's ability to know about, and share information on, activities at member institutions, and
- To test a model for collaboration with ERIC that other national organizations might adopt.

The AASCU/ERIC Model Programs Inventory Project is funded with a grant from the Fund for the Improvement of Postsecondary Education to the American Association of State Colleges and Universities, in collaboration with the ERIC Clearinghouse on Higher Education at The George Washington University.
TEACHER, INDUSTRY AND ENVIRONMENT (TIE)

Abstract

TIE is an educational enrichment project for Missouri high school chemistry teachers that is the result of a cooperative effort by individuals from the Department of Chemistry and Physics at Central Missouri State University, the Chemical Council of Missouri and their prospective members, and the Missouri Department of Natural Resources in conjunction with the Missouri Department of Elementary and Secondary Education. It involved 73 teachers in a week-end workshop, meeting with chemists, engineers, and educators. Following the workshop the participants designed and developed a teaching packet or research project and participated in a Reporting Conference during which they reported on their packets or research projects.

The project was supported by the National Science Foundation, 27 chemical companies, the Chemical Council of Missouri, the Missouri DNR, and the Chemistry Department at CMSU. The objectives of TIE are to provide: (1) enrichment of the participants knowledge of the chemical industry of Missouri and of the Missouri DNR, (2) communication links for the teachers, industry representatives and the Department of Natural Resources, (3) enrichment opportunities regarding the applications of computers, (4) examples of laboratory activities and research projects that have shown promise, and (5) encouragement for each participant to structure part of their science classes to include: Missouri chemical industries, the DNR and their school’s local environment.

There is ample evidence that the teacher participants have benefited from the Workshop, the development of either a teaching packet or research project and the sharing at the Reporting Conference. Probably the single most exciting unanticipated outcome of the TIE experience is the desire of other states to host their own Teacher, Industry and Environment Workshop.
BACKGROUND

The third Teacher, Industry and Environment (TIE) project was directed to certified career teachers of Chemistry in the high schools of Missouri. Missouri has about 450 schools teaching at least one unit of high school chemistry (1). The project emphasis was on assisting these teachers in the use of resources beyond the standard textbook. Many of the estimated 500 chemistry teachers are well qualified academically but have had little opportunity in recent years to enrich their teaching through contact with the various professional chemistry personnel working in Missouri (2)(3).

Missouri is rich in human resources, including many individuals involved in chemical research and product design and manufacture for business, industry and government. This project is an effort to provide a mechanism whereby these individuals and the agencies they represent can be organized into a working group for the purpose of improving what happens in the chemistry classrooms of Missouri high schools.

The project is directed to the interfaces identified by Broudy, Jacobson, Hurd and others during the sixties and seventies (4)(5)(6). These interfaces are evident from the priorities for science education as identified by Hurd more than a decade ago (7):

1. Science must be a viable strand in the education of every student.
2. Technological achievements with all their ramifications throughout modern society constitute a new priority in science teaching.
3. Science should be taught in a social context.
4. A priority for learning science in the 1970's [and the 1980's] is the formation of those values which may serve to convert knowledge into wisdom and make for responsible social action.

5. The science curriculum ought to prepare students to cope with a world of change.

6. The process of education should provide the student with skills and intellectual attitudes to understand the emerging world and to mediate the future; the priority becomes how best to teach and learn the future.

Recent publications and public out-crying about the problems of science and mathematics education in America contain the basic elements of Hurd's priorities (8)(9)(10). Teachers with years of experience and advanced degrees do not know what products and processes take place in the various chemical facilities in their home state.

The Pre-workshop Questionnaire for TIE-86 contained several items designed to determine if the participants were knowledgeable about the chemical companies in their geographical location and also knowledgeable about the products and processes used therein. Three specific items have been pulled from this questionnaire to illustrate the above point, and they are:

1. Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?

4. For any one of the member companies of the Missouri Chemical Council, how many industrial processes utilized by this company can you name?

5. Of the many products manufactured by the member companies of the Missouri Chemical Council, how many can you name?
Seventy-two percent (48/66) could name a maximum of only four of the approximately 24 member companies of the Missouri Chemical Council. Fifty-two percent (34/66) could not name one of the industrial processes utilized by any one of the member companies. Approximately one third, 34% (23/66), could not name one of the products manufactured by any one of the member companies. The member companies include for example, Dow, Monsanto, American Cyanimid, DuPont and Mobay Corporation; well-known firms not only located in Missouri, but with nationwide facilities.

Prior to the first T.I.E. Workshop it was suspected that, in addition to the above, few of the teachers had any first hand knowledge of the activities within the government agencies such as the Missouri Department of Natural Resources. Conversations with the first TIE Workshop participants substantiated this suspicion.

In addition to questions to solicit whether or not the participants of TIE-86 were knowledgeable about the chemical industry of Missouri, they were also asked about the organization and operation of the Missouri Department of Natural Resources. Three items have been pulled from the TIE-86 Pre-workshop Questionnaire to illustrate the participants knowledge and utilization of the Missouri DNR, and they are:

6. Of the five divisions of the Missouri Department of Natural Resources, how many can you name?

7. Of the five policy making commissions assigned to the Division of Environmental Quality, how many can you name?

8. How many times have you contacted the Environmental Education Specialist at the Missouri Department of Natural Resources for assistance in your classroom teaching?
Fourty-three percent (28/66) could not name any one of the five divisions of the Missouri DNR. Eighty-six percent (56/66) could not name any one of the five policy making commissions assigned to the Department of Environmental Quality which operate within the DNR. Only 3 of the 66 questionnaire respondents had contacted the Environmental Education Specialist at the Missouri Department of Natural Resources more than 4 times for assistance in their classroom teaching.

Examination of the requirements for teacher certification and the test items of the National Teachers Examination reveal that these priorities for science education, mentioned above, continue to be largely ignored by those preparing and certifying teachers. This project is designed to bring the forces of industry, environment and education into a communications network with high school teachers in an effort to provide a base from which teaching changes can be realized.

The T.I.E. Projects are bringing product providers, environment protectors and academicians together in an effort to help teachers relate and update their instruction. The project description is divided into six phases:

PHASE ONE - ORGANIZATION AND PLANNING OF THE PROJECT
PHASE TWO - PARTICIPANT SELECTION
PHASE THREE - THE INTERFACES WORKSHOP
PHASE FOUR - THE CHEMISTRY-ENVIRONMENT TEACHING PROJECT
PHASE FIVE - REPORTING CONFERENCE
PHASE SIX - THE PROJECT EVALUATION
PHASE-ONE: ORGANIZATION AND PLANNING OF THE PROJECT

The planning phase of this project was an indispensable series of meetings between members of the industrial team, Department of Natural Resources, area chemistry teachers on the planning committee and the project directors.

Members of the TIE-87 Planning Committee included:

Luane Barnes  
Elmer Boehm  
Dr. William Boulter  
Howard (Gene) Cornell  
James Downes  
Mrs. Mary Harris  
Dr. Neal Holmes  
George F. Lewenczuk  
Ms. Elaine Osborne  
William Palmer  
Dr. Michael H. Powers  
Marc W Romine  
Steve Schnieder  
Mrs. Marie Sherman  
Robert L. Suits  

Dow Chemical Company  
Monsanto Industrial Chemical Co.  
Science Consultant DESE  
Chemistry Teacher, Sherwood R-VIII  
Monsanto Industrial Chemical Co.  
John Burrough School  
Professor of Science Ed., CMSU  
American Cyanamid  
Mobay Corporation  
Missouri DNR  
Associate Professor of Chem., CMSU  
Science Teacher, Russellville H.S.  
Environ. Educ. Spec., Missouri DNR  
Chemistry Teacher, Ursuline Academy  
Chemistry Teacher, Hickman H.S.

The planning sessions dealt with program design and presenters, public relations, statewide teacher notifications and participant selection, including funding commitments by individual chemical company sponsors.

PHASE-TWO: PARTICIPANT SELECTION

Examination of the data comparing locations of schools and the various chemical companies of Missouri reveals that the companies are largely located near the two major metropolitan areas of Kansas City and St. Louis. It had been hoped that a direct matching of teachers and companies would be possible but the distances between teachers and companies would not allow such a selection process.
Examination of the number of schools versus student population, students versus student population per school, number of chemical companies versus average student population, and number of teachers versus student population per school, indicate that a matching of chemical companies and chemistry teachers would not give the selection process the coverage that was desired. It was decided that the teachers would be selected based on the number of students per school. Non-public schools would be considered in the same manner as the public schools.

Each high school principal was notified by letter and publicity brochure of Project T.I.E. They were asked to provide the name of a candidate teacher to the Chemical Council Selection Committee. The committee selected participants at random within each student population interval or class. The number of participants depended upon funding available with a present target population of about 70 teachers.

PHASE THREE: THE INTERFACE WORKSHOP

The interface workshop was held in late February 1987. This date allowed the teacher participants sufficient time during the remaining three months of the Spring semester to make use of the workshop resources in their classrooms and to complete the Industry/Environment Teaching/Research Project. Each participant could enroll in Special Problems in Chemistry (Chem 4911) for two (2) semester hours of graduate credit from Central Missouri State University. Successful completion of a resource teaching packet or a research project involving industrial chemistry and/or the environment was expected by the Spring Reporting Conference proposed for May 1987.
The workshop staff involved professional chemists and engineers from the Missouri Chemical Council, environmental quality personnel from the Department of Natural Resources, members of the Central Missouri State University Chemistry Department and senior teachers from several Missouri high schools.

The workshop is structured around seven basic goals. These goals are, To provide:

1. Enrichment of the participants knowledge of the Chemical Industry of Missouri - their products, plants and processes.

2. Communication links for the teacher and industry through personal contact.

3. Enrichment of the participants knowledge of the Missouri Department of Natural Resources and it's functions.

4. Communication links for the teacher and the Department of Natural Resources through personal contact.

5. Enrichment opportunities regarding the applications of computers to: (a) Learning through the use of existing programs and (b) Collecting and processing data by interfacing methods.

6. Examples of laboratory activities and research projects that have shown promise for high school chemistry students involving the environment.

7. Encouragement for each participant to structure some part of their chemistry instruction to include; Missouri chemical industries, The Department of Natural Resources and their own local environment.

Housing and workshop sessions were at the Ramada Inn, Jefferson City, Missouri. The following agenda was approved for TIE-87(Spring 1987).
TEACHERS, INDUSTRY, AND THE ENVIRONMENT WORKSHOP AGENDA

THURSDAY, FEBRUARY 26, 1987

6:00 p.m., Registration

Mixer, featuring displays by Missouri Chemical companies, Department of Natural Resources and CMSU.

FRIDAY, FEBRUARY 27, 1987

a.m.

7:00- 7:45 Continental Breakfast

7:45 Registration

8:00 Introduction and Opening Remarks

FRIDAY, FEBRUARY 27, 1987

a.m.

7:00- 7:45 Continental Breakfast

7:45 Registration

8:00 Introduction and Opening Remarks

FRIDAY, FEBRUARY 27, 1987

a.m.

7:00- 7:45 Continental Breakfast

7:45 Registration

8:00 Introduction and Opening Remarks

8:30 Keynote Address:

G. Douglas Nelson
Monsanto Company

Demonstration of Analysis of Plant Constituents

Karen Pither
Mobay Corporation

Thin Layer Chromatography

Nancy Luxton
Syntex Agri Business Inc.

Modern Environmental Controls

J. Brad Willett
American Cyanamid

Noon Lunch

p.m.

1:00 p.m., Luncheon Address:

Dr. Edwin M. Kaiser
University of Missouri-Columbia
FRIDAY, FEBRUARY 27, 1986
p.m.

1:30 Interpretation: Technique in Teaching Environmentally
Hermitage Room
Steve Schneider
Environmental Education Spec.
Department of Natural Resources

3:00 Chemistry Data Acquisition Activities
Hermitage Room
Marie Sherman
Chemistry Teacher
Ursuline Academy, St. Louis

Blue Group
Simplified Titration and Some Applications
Hermitage Room
Gen Cornell
Chemistry Teacher
Sherwood R-VIII, Clinton

Green Group
Water Quality Activities and Projects
Hermitage Room
Bob Suits
Chemistry Teacher
Hickman H S., Columbia

Red Group
Colorimetric Methods and Applications
Hermitage Room
Carol Thieman
Chemistry Teacher
Knob Nor-fer H.S.

Yellow Group
Microcomputer Based Laboratories
Roanoak Room
Sandy Custard
Recycling Coordinator
Regional Recycling Program
Mid-America Regional Council

5:30 Break

6:30 Dinner
Dinner Address: Resource Recovery
Hermitage/ Roanoak Room

8:00 Chemistry Fair: A Chemistry Potpourri

SATURDAY, FEBRUARY 28, 1987
a.m.
8:00 Session Convenes
Hermitage Room

8:15 The DNR Laboratory
Jim Long, Director
Laboratory Services Program
Department of Natural Resources

9:00 Tour of DNR Laboratory
Hermitage Room

10:30 Evaluation Session

11:00 Wrap-up Session
Dr. Mike Powers
CMSU
Personnel for the various sessions were provided by the member companies of the Missouri Chemical Council, the Department of Natural Resources and Central Missouri State University. Senior teachers, individuals that are not participants, were used as group leaders for the "hands on" sessions during the Workshop and as reporting group moderators for the Reporting Conference.

Support for the Teacher-Industry-Environment Workshop has and continues to be very strong from academic, governmental and industrial institutions. Support specifically allocated by the Missouri Chemical Council and its prospective members amounted to $16,500 and represents about 34% of the estimated cost of the planning meetings, workshop and reporting conference. A significant amount of additional support, which is not evident from budget reports or is not explicitly mentioned elsewhere, comes from industrial firms and the DNR in terms of personnel costs, computer time, mailing expenses, displays, travel, meals and lodging. Some support for TIE-86 by Missouri industrial firms and the Missouri DNR has been generally unreported by virtue of donations. Such unreported support amounted to $11,790 and represents about 24% of the estimated cost of TIE-87, assuming other amounts remain constant. Therefore, the industrial and state governmental components of T.I.E. support about 58% of the total estimated cost. Forty-two percent represents a decrease of 3% in the support requested from NSF for TIE-87 compared to TIE-86.
PHASE FOUR: THE CHEMISTRY - ENVIRONMENT TEACHING PROJECTS

This part of the project was the responsibility of the participating teachers and took place in the time between the Workshop and the Reporting Conference. Each teacher was encouraged to use imagination and creativity in the selection and development of the teaching packet or research project. Project reports were shared and discussed at the reporting conference. A final collection of all project abstracts, the TIE Field Book, was mailed to each participant during the summer or fall of 1988, as was done for TIE-86. A major part of the grade for Chemistry 4911 was based on the project reports. If a participant enrolled for graduate credit, attended the Workshop, developed a project and reported on that project at the Reporting Conference, the maximum grade was an A. If a participant completed all of the above mentioned tasks, but submitted a paper rather than attended the Reporting Conference, the maximum grade was a B. If the participant enrolled for graduate credit and attended the Workshop only, then the maximum grade was a C.

Samples of the topics for teaching packets or research projects chosen by the TIE-86 participants included:

- Slide Show of Community Chemical Applications
- Acid Rain
- Analysis of NaCl in Snack Foods
- Transportation of Chemicals Safely
- Soil-Its Characteristics and Quality
- The Effect of Emulsifiers on Process Cheese
- Determination of the Percent Chromium in Razor Blades
PHASE FIVE - THE EVALUATION AND REPORTING CONFERENCE

The T.I.E. staff and teacher participants met in May 1987 on the campus of Central Missouri State University to listen to and videotape reports from the teacher participants and to give them their teaching project evaluation reports. The teachers were divided into four sections with approximately 18 teachers in each section. Each participant had twenty minutes to present their packet or research project and ten minutes to respond to questions. Dr. Holmes, Dr. Powers and teacher consultants served as group leaders. Since time did not permit all participants to observe all reports, video tapes of all sessions were made available for the participants who wished to see the reports of others, as was done for TIE-86.

PHASE SIX: THE PROJECT EVALUATION

Each participant was asked to evaluate the T.I.E. project and a compilation of these evaluations formed a major part of the project evaluation. An evaluation questionnaire was used following the TIE-85 and TIE-86 workshops. The participants were asked to "grade" twenty aspects of the workshop with either an A, B, C, D or F. The questionnaires were analyzed by assigning points to the "grades" such as A=4, B=3, C=2, D=1 and F=0. A grade on a scale of 4 to zero was calculated for each of the twenty items.

If the aspects of the workshop evaluated are grouped according to the type of presenter, i.e., professional teacher (items 8, 9, 10, 11, 14, 16), industry person (items 2, 3, 4, 5, 6, 7) and environmental person (items 12, 15), the cumulative "grade point averages" were 3.30, 3.55 and 3.45, respectively. Whether or not these G.P.A.'s are statistically different or not has not been determined.
However, these data do seem to indicate that the participants tend to favor the involvement of the persons from the industrial component. A possible reason for this outcome might be because the industry persons present material which is most unfamiliar to the participants, whereas the material presented by the professional educators is more familiar and, hence, the participants are more critical. The interpretation is open to debate, in part due to the limited amount of data collected.

A fourth category, namely, Workshop Environment (items 1, 13, 17, 18, 19) received a G.P.A. of 3.56, the highest of the four categories. In addition, all of the participants responded affirmatively when asked if they would favor having other workshops of this type for teachers that were not selected as participants for TIE-87. Similar results were obtained for TIE-85 and TIE-86.

In order to assess whether or not the goals of the workshop have been achieved, all workshop participants were required to complete a Pre-workshop Questionnaire. Following the workshop the participants were administered a Post-workshop Questionnaire. An analysis was conducted to determine whether or not a significant change had transpired.

To assess whether or not the goals of T.I.E. were achieved, a comparison was made of the Pre- and Post-workshop Questionnaire responses. An example of this comparison is provided in the following paragraph.
One of the goals for T.I.E. is to provide enrichment of the participants knowledge of the chemical industry of Missouri, their products, plants and processes. Items one, two and four on the questionnaires were designed to measure changes in this category registered by the participants. The following table lists the responses by percentage for the pre- and post-questionnaire responses to Item Number 1 (Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?)

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Pre-Workshop Percentages</th>
<th>Post-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>72</td>
<td>9</td>
</tr>
<tr>
<td>5-9</td>
<td>23</td>
<td>65</td>
</tr>
<tr>
<td>10-14</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>15-19</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>20-24</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Prior to the workshop, 72% of the participants could identify a maximum of only 4 member companies of the Missouri Chemical Council. Following the workshop, 65% could name as many as 9 of the member companies. Similar positive results were achieved for each of the other six goals. In addition, the evaluation of the teaching packets and the research projects designed and implemented by the participants constituted a significant part of the determination of whether or not the goals of the workshop were achieved.

In part to assess the effectiveness of the Reporting Conference to facilitate the achievement of the goals for T.I.E., a Post-reporting Conference Questionnaire was given to the teacher participants.
One of the several items on the questionnaire asked the respondent to indicate the number of presentations made in their group for which they would request additional materials or information. This relates specifically to Goals 6 and 7 (see page 7). The following table summarizes the results of this particular post-reporting conference questionnaire item.

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2</td>
</tr>
<tr>
<td>1-3</td>
<td>40</td>
</tr>
<tr>
<td>4-6</td>
<td>46</td>
</tr>
<tr>
<td>7-9</td>
<td>6</td>
</tr>
<tr>
<td>&gt;9</td>
<td>6</td>
</tr>
</tbody>
</table>

As the above table indicates most of the teachers participating in the Reporting Conference (98%) observed one or more examples of laboratory activities or research projects involving the environment and/or the chemical industry which they recognized as promising for their students.

Several sources of information are available for assessing the effectiveness of the Workshop and Reporting Conference activities in achieving the goals set forth previously. Formal assessment items include the Pre and Post-workshop Questionnaires, the Workshop Evaluation "grade" report and the Post-Reporting Conference Questionnaire. In addition each of the above formal instruments requested anecdotal comments from the participants. Hundreds of anecdotal comments continue to be very helpful in assessing the effectiveness of the Workshop activities and any follow-up involvement, as well as, aiding the planning and execution of future Teacher, Industry and Environment projects.
Another good evaluation indicator is the level of support provided by the various contributors to the TIE Project. Support for the Teacher-Industry-Environment Workshop has and continues to be very strong from academic, governmental and industrial institutions, as well as individuals. These individuals include representatives from the Chemical Council of Missouri, the Missouri Department of Natural Resources and Central Missouri State University.

Perhaps the commitment of the Missouri chemical industry, particularly the Chemical Council of Missouri to continue support of TIE was best expressed by George Lewenczuk, Chairman of the Education Committee of the Council, when he said in his letter of 9 January 1987, "We [the Council] are planning to continue our effort to provide high school chemistry or science teachers the opportunity to work with industrial chemists and chemical engineers. We want to continue in creating partnership between educators and the chemical industry across the state of Missouri by continuing the TIE program."

The above are but a few examples of the evaluation phase of the TIE Project. The following pages describe in detail all of the evaluation instruments used and provide details of the responses provided by the teacher participants from the 1987 Teachers, Industry and Environment Workshop and Reporting Conference.
Evaluation Instruments:

Five instruments were designed to evaluate the workshop and the teacher participants. These instruments included: (1) the TIE Workshop Grade Report, (2) the Pre-Workshop Questionnaire, (3) the Post-Workshop Questionnaire, (4) the Reporting Conference Questionnaire, and (5) the TIE Participant Survey. The purpose of each of the above instruments was to evaluate the efforts of various contributors to the total learning system, as well as, to determine how effectively the Project accomplished the seven goals expressed previously. Application of these instruments and results obtained therefrom are detailed in the sections to follow.

Results:

TIE Workshop Grade Report

The Workshop Grade Report asked participants to grade nineteen aspects of the workshop with either an A, B, C, D or F. The Grade Reports were scored by assigning points to the "grades," i.e., A=4, B=3, C=2, D=1 and F=0. A grade on a scale of 4 to zero was calculated for each of nineteen items. The questionnaire and the detailed results of the analysis are shown in Appendix I. If the aspects of the workshop evaluated are grouped according to the type of presenter, i.e., professional teacher(items 7, 9, 10, 11 and 12), industry person(items 2, 3, 4, 5 and 6) and environmental person(items 8, 13, 15 and 16), then the following table results.
Table I.

<table>
<thead>
<tr>
<th>Professional Teacher</th>
<th>Industry Person</th>
<th>Environmental Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.75</td>
<td>2.80</td>
<td>2.72</td>
</tr>
<tr>
<td>3.70</td>
<td>3.69</td>
<td>3.42</td>
</tr>
<tr>
<td>3.17</td>
<td>3.31</td>
<td>3.20</td>
</tr>
<tr>
<td>3.28</td>
<td>3.62</td>
<td>3.25</td>
</tr>
<tr>
<td>3.72</td>
<td>3.18</td>
<td></td>
</tr>
<tr>
<td>&lt;3.52&gt; Mean &lt;3.32&gt;</td>
<td>Values &lt;3.15&gt;</td>
<td></td>
</tr>
</tbody>
</table>

These results differ from those for TIE-86 in which the mean GPA’s of 3.30, 3.55 and 3.45 were observed for the professional teacher, industry person and environmental person, respectively. For TIE-87 the mean GPA’s, although different, are not statistically different as determined by a one-way analysis of variance treatment. The results of the ANOVA treatment are shown in Appendix I.

A fourth category, Workshop Environment, included items 1, 17, 18 and 19 on the Grade Report. A mean GPA of 3.44 was calculated for this category. In addition the Workshop Grade Report asked the teacher participants to respond to three questions listed as 20, 21 and 22 on the response form (see Appendix I). An unedited compilation of the written comments are contained in Appendix I. In general, all of the participants responded affirmatively when asked if they would favor having other workshops of this type for teachers that were not selected as participants for TIE-87. Similar results were obtained for previous TIE workshops.
Pre- and Post-Workshop Questionnaires

In order to assess whether or not the goals of the workshop were achieved, all workshop participants were required to complete a Pre- and Post-Workshop Questionnaire as shown in Appendix II. A comparison was made between the responses of these questionnaires.

Goal 1 was to provide enrichment of the participants' knowledge of the chemical industry of Missouri, its products, plants and processes. Items one, two and four (one, two and five on the Post-Workshop Questionnaire) were designed to measure possible changes registered by the participants. The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to Item 1; "Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?"

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Item 1 Pre-Workshop Percentages</th>
<th>Item 1 Post-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>1-4</td>
<td>66</td>
<td>8</td>
</tr>
<tr>
<td>5-9</td>
<td>21</td>
<td>46</td>
</tr>
<tr>
<td>10-14</td>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>15-19</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>&gt;19</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Prior to the workshop, 77% of the participants could identify a maximum of only 4 member companies of the Missouri Chemical Council. Following the workshop, 46% of the participants could name as many as 5 companies and 36% could name as many as 10 member companies of the Missouri Chemical Council.
The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to Item 2; "Of the companies involved in the Missouri chemical industry in your vicinity, to how many have you taken (would you consider taking) your class on a fieldtrip?"

Table III.

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Item 2 Pre-Workshop Percentages</th>
<th>Item 2 Post-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>85</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>34</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>&gt;4</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

As shown in the above table, 85% of the participants had never taken their chemistry class on a fieldtrip to a chemical industry in the vicinity of their school. However, after the Workshop 77% of the participants would consider taking their chemistry classes on a fieldtrip to at least one chemical industry in their vicinity and 20% to as many as three.

The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to the question; "Of the many products manufactured by companies involved in the Missouri chemical industry, how many can you name?"
Table IV.

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Item 4 Pre-Workshop Percentages</th>
<th>Item 5 Post-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>44</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>&gt;4</td>
<td>5</td>
<td>74</td>
</tr>
</tbody>
</table>

Prior to the Workshop nearly one-half (44%) of the participants could not name one product manufactured by the Missouri chemical industry. Following the Workshop nearly three-fourths (74%) of the participants could name more than four products and all participants could name at least one product manufactured by the Missouri chemical industry.

Goal 2 was to provide communication links for the teacher and industry representative through personal contacts. Item 3 on the Pre- and Post-Workshop Questionnaire was designed to measure possible changes registered by the participants. The following table lists the responses by percentage for the Pre- and Post-Questionnaire responses to Item 3: "Of the companies involved in the Missouri chemical industry, how many individuals within these companies would you feel comfortable contacting for assistance with your classroom teaching?"
Table V.

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Item 3 Pre-Workshop Percentages</th>
<th>Item 3 Post-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>44</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>&gt;4</td>
<td>7</td>
<td>35</td>
</tr>
</tbody>
</table>

As shown in the above table nearly one-half of the participants would not feel comfortable contacting even one individual from industry to assist with their classroom teaching prior to the Workshop. Following the Workshop all of the respondents felt comfortable contacting at least one industrial person and over 90% felt comfortable contacting two or more to assist with their classroom teaching.

Goal 3 was to provide enrichment of the participants knowledge of the Missouri Department of Natural Resources and its functions. Item 6 of the Pre-Workshop Questionnaire asked, "Of the five divisions of the Missouri Department of Natural Resources, how many can you name?" Item 7 of the Pre-Workshop Questionnaire asked, "Of the five policy-making commissions assigned to the Division of Environmental Quality, how many can you name?"

The results of the Pre-Workshop Questionnaire Items 6 and 7 indicated that the participants knowledge in this regard was lacking. The following tables show the results from the Pre-Questionnaire.
As the above table indicates nearly one-half (44%) of the workshop participants could not name one division of the Missouri DNR and over three-fourths (78%) could not name one of the five policy making commissions of the Missouri DNR. Although this lack of knowledge probably does not have a serious effect concerning the teaching expertise of the workshop participants, it does indicate a lack of knowledge of the structure of the Missouri DNR.

Of a more serious concern is the workshop participants' utilization of the Environmental Education Specialist at the Missouri DNR. Goal 4 was to provide a communication link for the teacher and the Missouri DNR. Items 8 and 5 on the Pre- and Post-Workshop Questionnaires, respectively, addressed this goal. Item 8 asked, "How many times have you contacted the Environmental Education Specialist at the Missouri DNR for assistance in your classroom teaching within the past 5 years?" Item 5 asked, "As a result of this workshop[TIE-1987], how many individuals from the Missouri DNR would you feel comfortable in contacting to obtain help with your classroom teaching?" The following table summarizes the results for Items 8 and 5.
As the above table indicates, over eighty percent (83%) of the workshop participants had not contacted the Environmental Education Specialist in the previous five years. Following the workshop 98% of the participants indicated that they would feel comfortable contacting at least one person from the Missouri DNR. Nearly one-fourth (24%) indicated that they would feel comfortable contacting more than four people associated with the Missouri DNR for help with their classroom teaching. Since the Missouri DNR has only one Environmental Education Specialist, the results indicate that a communications link was established between several individuals from the Missouri DNR and the workshop participants.

Goal 5 was to provide examples of computer activities for learning through the use of existing programs and collecting and processing laboratory data by computer interfacing methods. The Pre-Workshop Questionnaires for TIE from 1985 through 1988 were quite revealing concerning the participants knowledge and application of microcomputers in the science classroom. The following table summarizes the responses to the questions shown for four groups of participants. Values in the table represent percentages of those responding to the questions.
1. Do you have at least one microcomputer available for use in your laboratory teaching?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>81</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>1986</td>
<td>80</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td>1987</td>
<td>70</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>1988</td>
<td>77</td>
<td>21</td>
<td>2</td>
</tr>
</tbody>
</table>

2. Do you use microcomputers in your chemistry teaching?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>55</td>
<td>43</td>
<td>2</td>
</tr>
<tr>
<td>1986</td>
<td>47</td>
<td>48</td>
<td>5</td>
</tr>
<tr>
<td>1987</td>
<td>38</td>
<td>58</td>
<td>4</td>
</tr>
<tr>
<td>1988</td>
<td>45</td>
<td>51</td>
<td>4</td>
</tr>
</tbody>
</table>

3. Do you have a working knowledge of the programming language BASIC?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>62</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>1986</td>
<td>45</td>
<td>52</td>
<td>3</td>
</tr>
<tr>
<td>1987</td>
<td>43</td>
<td>57</td>
<td>0</td>
</tr>
<tr>
<td>1988</td>
<td>51</td>
<td>45</td>
<td>4</td>
</tr>
</tbody>
</table>

4. Do you do any programming in BASIC related to your chemistry teaching?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>33</td>
<td>64</td>
<td>3</td>
</tr>
<tr>
<td>1986</td>
<td>13</td>
<td>82</td>
<td>5</td>
</tr>
<tr>
<td>1987</td>
<td>11</td>
<td>87</td>
<td>2</td>
</tr>
<tr>
<td>1988</td>
<td>9</td>
<td>87</td>
<td>4</td>
</tr>
</tbody>
</table>

5. Do you use microcomputers as a measuring or data logging device in your laboratory?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>14</td>
<td>84</td>
<td>2</td>
</tr>
<tr>
<td>1986</td>
<td>11</td>
<td>86</td>
<td>3</td>
</tr>
<tr>
<td>1987</td>
<td>13</td>
<td>85</td>
<td>2</td>
</tr>
<tr>
<td>1988</td>
<td>23</td>
<td>70</td>
<td>7</td>
</tr>
</tbody>
</table>
6. Do you use non-commercial devices for laboratory interfacing projects?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>10</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>1986</td>
<td>6</td>
<td>82</td>
<td>12</td>
</tr>
<tr>
<td>1987</td>
<td>15</td>
<td>81</td>
<td>6</td>
</tr>
<tr>
<td>1988</td>
<td>13</td>
<td>74</td>
<td>13</td>
</tr>
</tbody>
</table>

7. Have you ever attended a workshop concerned with the interfacing of transducers with microcomputers?

<table>
<thead>
<tr>
<th>Year</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>17</td>
<td>80</td>
<td>3</td>
</tr>
<tr>
<td>1986</td>
<td>17</td>
<td>82</td>
<td>1</td>
</tr>
<tr>
<td>1987</td>
<td>23</td>
<td>77</td>
<td>0</td>
</tr>
<tr>
<td>1988</td>
<td>17</td>
<td>81</td>
<td>2</td>
</tr>
</tbody>
</table>

The responses of the four groups are quite consistent, with perhaps the exception of Question 4 which shows a decreasing trend in those who do programming in BASIC related to their chemistry teaching. The majority of all groups, approximately 80%, have access to at least one microcomputer for use in their laboratory teaching. However, only about 50% actually use them in teaching chemistry and fewer than 15% are using a microcomputer as a measuring or data logging device.

Whether or not TIE-87 was successful in altering the participants use of microcomputers in their teaching strategies was not determinable from the Post-Workshop Questionnaire. However, Item 8 on the Post-Workshop Questionnaire did address the efforts of the workshop staff to achieve Goal 5 by asking, "How many ideas for classroom activities have you obtained from this workshop [TIE-87] which relate to computer applications?" The following table summarizes the responses to Item 8.
Table VIII.

<table>
<thead>
<tr>
<th>Item 8 Response Category</th>
<th>Post-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-4</td>
<td>61</td>
</tr>
<tr>
<td>5-9</td>
<td>33</td>
</tr>
<tr>
<td>10-14</td>
<td>1.5</td>
</tr>
<tr>
<td>15-19</td>
<td>1.5</td>
</tr>
<tr>
<td>&gt;19</td>
<td>3</td>
</tr>
</tbody>
</table>

All of the workshop participants indicated that they had obtained at least one idea concerning the application of microcomputers to their classroom teaching. Additional information pertaining to this issue will be presented later in this report.

Goal 6 of TIE-87 was to provide examples of laboratory activities and research projects that have shown promise for junior/senior high school students of chemistry involving industry and/or the environment. Item 9 on the Pre-Workshop Questionnaire asked the participants to indicate how many of their chemistry course activities specifically involved the Missouri chemical manufacturers and their products. The results shown in the following table indicate that nearly two-thirds (64%) used no activities related to the Missouri chemical manufacturers or their products.

Table IX.

<table>
<thead>
<tr>
<th>Item 9 Response Category</th>
<th>Pre-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>64</td>
</tr>
<tr>
<td>1-5</td>
<td>27</td>
</tr>
<tr>
<td>6-10</td>
<td>2</td>
</tr>
<tr>
<td>11-15</td>
<td>2</td>
</tr>
<tr>
<td>&gt;15</td>
<td>2</td>
</tr>
</tbody>
</table>
Item 6 on the Post-Workshop Questionnaire was designed to assess the achievement of Coal 6 by asking, "How many ideas for classroom activities have you obtained from this workshop[TIE-87] which relate to industrial applications?" The following table summarizes the responses of the teacher participants following the workshop.

<table>
<thead>
<tr>
<th>Item 6 Response Category</th>
<th>Post-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-4</td>
<td>20</td>
</tr>
<tr>
<td>5-9</td>
<td>38</td>
</tr>
<tr>
<td>10-14</td>
<td>21</td>
</tr>
<tr>
<td>15-19</td>
<td>10</td>
</tr>
<tr>
<td>&gt;19</td>
<td>11</td>
</tr>
</tbody>
</table>

The above table indicates that all of the participants were able to glean at least one idea that showed promise for use with their students involving industrial applications.

Item 10 on the Pre-Workshop Questionnaire asked the participants to indicate how many of their chemistry course activities deal specifically with the quality of the Missouri environment. The results shown in the following table indicate that over one-third (39%) used no activities related to the quality of the Missouri environment.

<table>
<thead>
<tr>
<th>Item 10 Response Category</th>
<th>Pre-Workshop Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>1-5</td>
<td>57</td>
</tr>
<tr>
<td>6-10</td>
<td>2</td>
</tr>
<tr>
<td>11-15</td>
<td>0</td>
</tr>
<tr>
<td>&gt;15</td>
<td>0</td>
</tr>
<tr>
<td>N/R</td>
<td>2</td>
</tr>
</tbody>
</table>

---
Item 7 on the Post-Workshop Questionnaire was designed to assess the achievement of Goal 6 by asking, "How many ideas for classroom activities have you obtained from this workshop (TIE-87) which relate to environmental applications?" The following table summarizes the responses of the teacher participants following the workshop.

<table>
<thead>
<tr>
<th>Item 7 Response Post-Workshop Category</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-4</td>
<td>18</td>
</tr>
<tr>
<td>5-9</td>
<td>48</td>
</tr>
<tr>
<td>10-14</td>
<td>23</td>
</tr>
<tr>
<td>15-19</td>
<td>7</td>
</tr>
<tr>
<td>&gt;19</td>
<td>4</td>
</tr>
</tbody>
</table>

The table shown above indicates that all of the participants were able to glean at least one idea that showed promise for use with their students involving the quality of the Missouri environment.
Goal 7 for TIE-87 was to provide encouragement for each participant to structure some part of their chemistry instruction to include: the Missouri chemical industries, the Missouri Department of Natural Resources and the participants local environmental quality. Certainly the workshop staff provided encouragement to the participants to structure a part of their chemistry classroom activities around industrial and/or environmental applications. The extent to which this encouragement was effective has not been accurately measured. However, there are some indicators that reflect the effectiveness. Fifty-one participants enrolled in Special Problems in Chemistry at Central Missouri State University in order to receive graduate credit for TIE-1987. Of those receiving graduate credit twenty attended the Workshop, completed a special problem or research project and attended the Reporting Conference to report on their efforts. The 30 projects submitted have been distributed within six categories as shown in the following table.

Table XIII
Participant Project Summary

<table>
<thead>
<tr>
<th>Catagory</th>
<th>Number of Projects</th>
<th>Catagory Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>11</td>
<td>37%</td>
</tr>
<tr>
<td>Industrial</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Pure Chemistry</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Consumer Chem.</td>
<td>7</td>
<td>23</td>
</tr>
<tr>
<td>Chemical Safety</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Non-Chemistry</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Totals&gt;</td>
<td>30</td>
<td>100%</td>
</tr>
</tbody>
</table>
As can be seen from the above table, the largest category contained projects concerning the environment and nearly one-half (40%) of the projects were either oriented toward industrial or environmental applications.

The situation as a whole could have been better if more participants had followed through and completed projects and, in addition, if more of the completed projects were oriented toward environmental and industrial applications. The most probable reason for the apparent lack of participation in the Reporting Conference was that it occurred during Memorial Day weekend. This would appear to be poor planning, if it were not for the fact that the Workshop participants voted for the date on which the Reporting Conference would be held.

Reporting Conference and Questionnaire

Of the 73 TIE-87 Workshop participants (see Appendix V), 51 enrolled for the available graduate credit. Of the 51 that enrolled, 20 attended the Workshop, completed a teaching packet or research project and reported on their accomplishments at the Reporting Conference. The Reporting Conference was a one-day meeting on the campus of Central Missouri State University held approximately three months following the Workshop. Those attending gave a 10 to 20 minute oral presentation and demonstration concerning their teaching packet or research project that resulted from attending the 1987 Workshop.
The purpose of the Reporting Conference Questionnaire (see Appendix III) was to assess the effectiveness of the Reporting Conference and the overall effectiveness of the Teachers, Industry and Environment Workshop experience.

Of those responding to the Reporting Conference Questionnaire, 37% indicated that it was the most important workshop activity, while 63% indicated that it was important, but not essential. When asked, "What was the most positive aspect of the Reporting Conference?", most of the respondents indicated that the fellowship with other teachers and the sharing of ideas was the most important.

When the participants were asked to indicate the importance of the Reporting Conference in helping them structure part of their chemistry/science classes to include the Missouri chemical industry, the Missouri DNR and their school's local environment, 28% indicated that it was very important and 67% indicated that it was important, but not essential.

The Reporting Conference Questionnaire also asked the participants to rate the TIE Workshop (total program) on the basis of other inservice education experiences they had had. One-third indicated that it was the best they had ever attended, 50% indicated that it was better than most they had attended. One respondent indicated that TIE was similar to most of the inservice workshops they had attended and two respondents indicated that TIE was their first inservice experience. Other items on the Reporting Conference Questionnaire dealt more specifically with the execution of the Reporting Conference and these results are contained in Appendix III.
TIE Participant Survey

A survey was sent to all TIE participants for the years 1985, 1986 and 1987 to solicit their responses concerning the effectiveness of their TIE experiences (see Appendix IV). Ninety-four teachers responded with nearly equal representation for each of the three years.

Several of the items in the survey are of interest with respect to the respondents awareness, attitude and the attainment of the Workshop goals. For example, Item 15 on the survey stated that "Missouri has more chemical industries than I thought," to which 83% of the respondents agreed or strongly agreed. This also relates to the attainment of Goal 1. Item 4 on the survey stated that "Since TIE I feel more comfortable talking to industry chemists," to which nearly 60% either agreed or strongly agreed. This also relates to the attainment of Goal 2. Item 2 stated "I got some good teaching ideas from the TIE Program," to which 99% agreed or strongly agreed. This is evidence that Goal 6 was attained, i.e., the providing of examples of laboratory activities and research projects that have shown promise for junior/senior high school students.

Perhaps Items 3 and 11 and the responses thereto are as important as any of the other items in as much as they relate to the participants attitudes. Item 3 stated that "I believe the Missouri Chemical Council really cares about high school science teaching," to which 90% of the respondents either agreed or strongly agreed and 10% were neutral. Item 11 stated that "I would like to attend another TIE," to which 88% either agreed or strongly agreed and 10% were neutral.
Summary:

There are several indications that TIE is and has been successful for the workshop instructors, the TIE Planning Committee, the Missouri chemical industry, the Missouri Department of Natural Resources and above all the teacher participants.

Three industrial chemists representing Monsanto Corporation, Mobay Corporation and American Cyanamid participated as workshop instructors during the "industrial break-out sessions." Each were well received by the teacher participants and each have commented on how well they enjoyed the teachers and their enthusiasm. The representative from Monsanto, now retired, serves on the TIE Planning Committee and has been a regular participant since the inception of TIE. Four highly qualified secondary chemistry teachers participated as workshop instructors during the "teacher break-out sessions." As is usually the case, these individuals are those most readily received by the teacher participants as indicated on the TIE Workshop Evaluation. Three of these four individuals have served as workshop instructors for TIE from 1985 through 1988.

Probably the most successful aspect of TIE is the extensive planning carried out by the TIE Planning Committee. Each year the committee begins planning the February workshop in June of the preceding year and meets monthly except for December. The committee is chaired by a member of the industrial community, usually a member of the Missouri Chemical Council. Sub-committees are setup for publicity, teacher selection, the workshop program, arrangement of physical facilities and budget.
In 1987 the TIE Planning Committee received the Resource Steward Award. This award is the highest award given by the State of Missouri and the Department of Natural Resources for "preserving and wisely using our priceless natural resources." This award, signed by the Governor of the State of Missouri and usually given to an individual, was, for the first time, given to a committee.

The Missouri chemical industry, particularly the Missouri Chemical Council, has from the inception of TIE graciously supported the concept and the reality of TIE. Each year their contribution to TIE increases. In 1988, when NSF funding ceased, the Missouri Chemical Council increased their contributions to compensate for much of the former NSF support. However, the Reporting Conference was not held and teacher participants were required to pay for optional graduate credit from Central Missouri State University due to lack of funding. In return for their contributions of money and "man-power", the chemical industry has made contact with approximately 250 (through 1988) of Missouri's 600 secondary chemistry teachers. The number of students contacted through teachers from 1985-1988 can only be estimated. For example, the 94 teachers that responded to the TIE Participant Survey discussed earlier, reported they taught a total of 233 chemistry classes or about 2.5 classes per teacher. If this is true for the 250 TIE teacher participants, then for classes of 24 students each the chemical industry may have had an impact on 15,000 Missouri chemistry students.
All Pre-Workshop Questionnaires from 1985 through 1988 have indicated that the teacher participants have not been in contact with the Environmental Education Specialist of the Missouri Department of Natural Resources for help with their teaching and they have not included many course activities that deal specifically with the quality, or lack thereof, of the Missouri environment (see Appendix II). As a result of the TIE Workshop every teacher participant not only meets the DNR Environmental Education Specialist, but has the opportunity to hear and see his expertise in regard to the Missouri environment. In addition each teacher participant has the opportunity to meet other DNR officials and discuss various ideas concerning Missouri’s environmental issues. The DNR distributes a variety of information to the teacher participants which ultimately ends up in the hands of students. The TIE Fieldbook contains many student activities, demonstrations and research projects that TIE participants have used in their chemistry classrooms with their students. Many of these activities are the direct result of the TIE Workshop and they deal directly with environmental issues pertinent to the state of Missouri (see Appendix IV).

The TIE-1987 teacher participants, as well as the other TIE participants, have benefited from the Workshop, their efforts to develop either a teaching packet or research project and the sharing at the Reporting Conference.
Evidence for this is contained within the responses to the formal evaluation instruments such as the Workshop Evaluation, the Post-Workshop Questionnaire, the Reporting Conference Questionnaire and the Participant Survey, as well as the many comments made by the teacher participants to the TIE Project staff (see Appendices I, II, III and IV). One of the unanticipated outcomes on the part of the TIE staff, particularly the Project Directors, is that the TIE Workshop and Reporting Conference has afforded the opportunity to observe and select future TIE instructional personnel. One of the workshop instructors for the "teacher break-out sessions" in 1987 was a 1986 teacher participant. In addition, one of the workshop instructors for the "teacher break-out sessions" in 1988 was a 1987 teacher participant. Both of these individuals became interested enough in TIE as a participant to be selected as a member of the workshop instructional staff. Other participants have expressed similar interests.

Probably the single most exciting unanticipated outcome of the TIE experience is the desire of other states to host their own Teachers, Industry and Environment Workshop. In 1986 a group from Tennessee attended the Workshop and subsequently hosted a TIE in their state the following year. Some of the Missouri TIE staff and Planning Committee helped with the Tennessee workshop. In 1987 a group from Delaware attended the Missouri Workshop and plan to hold a TIE in their state in the near future. Interest from other states such as Ohio and Texas has also been expressed. Perhaps it is true that "imitation is the sincerest form of flattery."
The desire by other states to implement a TIE type program is largely due to the efforts of Mr. Elmer Boehm, a founder of TIE in Missouri and a retired chemical engineer of the Monsanto Corporation. Mr. Boehm has taken the "TIE Story" to several states as indicated in the following table.

Table XIV
Dissemination and Outreach Activities

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 1987</td>
<td>St. Louis, MO</td>
<td>Am. Inst. of Chemical Engineers Sym.</td>
</tr>
<tr>
<td>May 1987</td>
<td>St. Louis, MO</td>
<td>Parkway Parent Teachers Assoc.</td>
</tr>
<tr>
<td>Oct 1987</td>
<td>St. Louis, MO</td>
<td>Monsanto Fund Meeting</td>
</tr>
<tr>
<td>Feb 1988</td>
<td>Wilmington, DE</td>
<td>Delaware Chemical Industry Council</td>
</tr>
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</table>

Additional outreach activities are planned for 1988 including the Science Teachers of St. Louis and the Fifth National Symposium on Partnerships in Education.

There is more than ample evidence that considerable support by and collaboration with appropriate constituencies, agencies and organizations exists. Probably the best example of collaboration is the composition of the TIE Planning Committee. The following table summarizes the composition of the Committee by listing their names, position within their respective organizations and their organization affiliation.
Table IX
The 1987 TIE Planning Committee

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Affiliation</th>
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</thead>
<tbody>
<tr>
<td>Walt Bivins</td>
<td>Chemical Engineer</td>
<td>Dow Chem. Co.</td>
</tr>
<tr>
<td>Elmer Boehm</td>
<td>Emergency Response Man.</td>
<td>Monsanto Co.</td>
</tr>
<tr>
<td>Dr. Wm. Boulter</td>
<td>Science Consultant</td>
<td>MO DESE</td>
</tr>
<tr>
<td>Gene Cornell</td>
<td>Chemistry Teacher</td>
<td>Sherwood R-VIII</td>
</tr>
<tr>
<td>Mary Harris</td>
<td>Chemistry Teacher</td>
<td>John Burroughs</td>
</tr>
<tr>
<td>Dr. Neal Holmes</td>
<td>Professor, Sci. Ed.</td>
<td>CMSU</td>
</tr>
<tr>
<td>George Lewenzuck</td>
<td>Manager, SPC &amp; E</td>
<td>Amer. Cyanamid</td>
</tr>
<tr>
<td>Elaine Osborne</td>
<td>Public Relations, Man.</td>
<td>Mobay Corp.</td>
</tr>
<tr>
<td>Bill Palmer</td>
<td>Dir., Public Inform.</td>
<td>MO DNR</td>
</tr>
<tr>
<td>Dr. Mike Powers</td>
<td>Assoc. Prof. Chem.</td>
<td>CMSU</td>
</tr>
<tr>
<td>Steve Schneider</td>
<td>Envir. Ed. Specialist</td>
<td>MO DNR</td>
</tr>
<tr>
<td>Marie Sherman</td>
<td>Chemistry Teacher</td>
<td>Ursaline Acad.</td>
</tr>
<tr>
<td>Bob Suits</td>
<td>Chemistry Teacher</td>
<td>Hickman H.S.</td>
</tr>
</tbody>
</table>

An example of support by appropriate constituencies, agencies and organizations is the direct and indirect monetary support by the industrial component, particularly the Chemical Council of Missouri. The direct support by the industrial component for TIE-87 was $17,551.12. This amount does not include unreported support estimated in the grant application to be about $12,000 for TIE-86. This estimated unreported support is in all probability an underestimate since it does not include the expenses of the Eastern Division General Manager of Dow Chemical Company who gave the keynote address, company displays that cost over $2000 to transport and manage, and other unseen costs. A conservative estimate of the total reported and unreported cost to the industrial supporters is about $35,000. The figures listed above do not include direct and indirect costs covered by the Missouri Department of Natural Resources which has assumed most of the expense of publicity and printing, as well as considerable manpower.
Teachers, Industry and Environment was conducted in 1988 and plans are currently underway for the 1989 version. Without NSF funding the Reporting Conference was not conducted following the 1987 workshop and it is not planned for 1989. The members of the Planning Committee believe that the Reporting Conference plays a vital role in the total TIE program, but efforts to date to find adequate and alternate funding have not been successful.

The TIE Planning Committee would like to express their collective appreciation to the National Science Foundation for its support (Grant TEI-8650101), without which the Teacher, Industry and Environment Project could not have achieved as much as it has.
REFERENCES CITED


1987 TIE WORKSHOP EVALUATION

We want to thank you for your participation in the third TIE Workshop. Please take a few minutes to help us make the next one better. Circle our grades and give us your comments.

1. The TIE mixer with Chemical company exhibits

   A B C D F

2. The Friday AM Keynote Address- Tom Smolarek

   A B C D F

3. Grocery Store Chemistry- Doug Nelson

   A B C D F

4. Plant Constituent Analysis- Karen Pithel

   A B C D F

5. Thin Layer Chromatography- Nancy Luxton

   A B C D F

6. Modern Environmental Controls- Brad Willett

   A B C D F

7. Friday Luncheon Address- Dr. Edwin Kaiser

   A B C D F

8. Teaching Environmentally- Steve Schneider

   A B C D F

9. Blue Group - Marie Sherman

   A B C D F

10. Green Group - Gene Cornell

    A B C D F

11. Red Group - Bob Suits

    A B C D F

12. Yellow Group- Carol Thieman

    A B C D F

13. Resource Recovery- Sandra Leigh Custard

    A B C D F

14. Chemistry Fair!

    A B C D F

15. DNR Tour

    A B C D F

16. The DNR Laboratory- Jim Long

    A B C D F

17. The Ramada Rooms

    A B C D F

18. The Ramada Food

    A B C D F

19. The Overall Workshop Planning

    A B C D F

20. If you were to add just one thing, what would it be?

21. If you were to subtract just one thing, what would it be?

22. Should we have more of these workshops?  ___Yes  ___No

   Please explain briefly.
TIE WORKSHOP EVALUATION SUMMARY

Grade Point Average by Year

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<th>Activity</th>
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<th>1986</th>
<th>1985</th>
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<tr>
<td>1. The TIE mixer with Chemical company exhibits</td>
<td>3.22</td>
<td>3.23</td>
<td>3.61</td>
</tr>
<tr>
<td>2. The Friday AM Keynote Address- Tom Smolarek</td>
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<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3. Grocery Store Chemistry- Doug Nelson</td>
<td>3.69</td>
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<td>4. Plant Constituent Analysis- Karen Pither</td>
<td>3.31</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5. Thin Layer Chromatography- Nancy Luxton</td>
<td>3.62</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>6. Modern Environmental Controls- Brad Willett</td>
<td>3.18</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>7. Friday Luncheon Address- Dr. Edwin Kaiser</td>
<td>3.75</td>
<td>3.36</td>
<td>???</td>
</tr>
<tr>
<td>8. Teaching Environmentally- Steve Schneider</td>
<td>2.72</td>
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<td>N/A</td>
</tr>
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<td>9. Blue Group - Marie Sherman</td>
<td>3.70</td>
<td>3.83</td>
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<td>11. Red Group - Bob Suits</td>
<td>3.28</td>
<td>3.47</td>
<td>2.98</td>
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<td>12. Yellow Group- Carol Thieman</td>
<td>3.72</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>13. Resource Recovery- Sandra Leigh Custard</td>
<td>3.42</td>
<td>N/A</td>
<td>N/A</td>
</tr>
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<td>14. Chemistry Fair!</td>
<td>3.76</td>
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</tr>
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<td>15. DNR Tour</td>
<td>3.20</td>
<td>3.31</td>
<td>3.50</td>
</tr>
<tr>
<td>16. The DNR Laboratory- Jim Long</td>
<td>3.25</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>17. The Ramada Rooms</td>
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<td>3.37</td>
<td>3.49</td>
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<tr>
<td>18. The Ramada Food</td>
<td>3.55</td>
<td>2.54</td>
<td>3.37</td>
</tr>
<tr>
<td>19. The Overall Workshop Planning</td>
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<td>3.91</td>
<td>3.88</td>
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</table>

Overall GPA(1)...

<table>
<thead>
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<th>1985</th>
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</thead>
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<tr>
<td>3.42</td>
<td>3.44</td>
<td>3.53</td>
</tr>
</tbody>
</table>

20. See attached sheets for summary.
21. See attached sheets for summary.
22. See attached sheets for summary.

1. The Overall GPA includes only the nine items for which GPA's are available for all three years.
1987 TIE WORKSHOP EVALUATION COMMENTS SUMMARY

Item 20. If you were to add just one thing, what would it be?

List of places and methods for chem disposal from the stockroom. Also divide the groups better.

More in Chem Fair.

More area for the industry sessions, so you don't have the interference from adjacent groups.

Scrambled eggs at breakfast.

More time for the sessions and label by name all the special handouts, i.e. the bags etc.

More time for the sessions—possibly 3 days?

More companies at the mixer or time in the various groups particularly computer interfacing.

More on genetic engineering.

A little more time to observe projects.

Make sure you always have hands on experiments—they are wonderful.

More info on how to tap into industry and government on an engineering basis for classroom help.

Much more preparation at the DNR Lab.

Great job, more demos if possible.

Can I come again?

More demonstrations, they were super.

Bus to lab (DNR).

Even more demonstrations of experiments, if we could find the time.

Do a specific environmental lab.

Food companies participating.

A. Have industrial reps in on teacher meetings. B. Heat to meeting rooms.

I would change nothing. Very Good.

Make Chemistry Fair a little more interesting and exciting.
Appendix I

More time spent for brainstorming ideas with other teachers.

More time for 9-12.

1 or 2 more Fair displays.

Provide a bus for the tour in that a portion of the people did not drive.

Means for participants from each region meeting at end of workshop to set-up means to continue as a group in each of their regions.

Better lighting for slides. More company displays for mixer. Really did not have enough time to do "labs" in our groups.

Several planned breaks during the day.

More teacher participation activities. Allow more teachers to participate in the chemistry fair with a demonstration or something.

More specific resources or info about chemical disposal or pick-up.

1. Establishment of an information disseminating network with a newsletter (2/yr?) for TI3 alumni. 2. Invitations for participants to bring their favorite lab or activity and show them in the "chemistry fair". 3. Realistic help or guidelines for chemical disposal.

More activities with smaller groups.

More time to discuss chem. individually with teachers.

More examples or methods of chemistry incorporating computers into the classroom.

More time to interact with industrial representatives.

List of industry - environmental contact persons that describes their major area of expertise.

More on safety, chem disposal, accident prevention. Chem teacher newsletter?

Time to question speakers, especially Tom S.

Wish we could look forward to something like this every year, even at our own expense, it was that good.

More specific information about what to do about chem. in la1.

More displays by companies.

Spend more time with the chemistry lab portion of the DNR tour.

Replace DNR tour with presentations similar to Friday.
Appendix I

Specifics on what chemicals we need to get rid of in lab and how to dispose of.

Have a Chemical Company tell more about product manufacturing and how handle chem. like cyanamide, on how they handle chem. waste.

Informal Friday night meal (Fish fry, etc.).

More individual sessions.

Perhaps have teachers bring copies of favorite lab to copy off and distribute.

Item 21. If you were to subtract just one thing, what would it be?

The poor PA system.

Nothing.

I thought for 15 minutes and could not come up with even one thing I would eliminate. the whole workshop was great!

It was great.

Nothing.

The bad microphone system.

DNR lab. Make more interesting examples of problems. Talk about facts about State of MO like Steve Schneider did at end of conference Talk more about ecosystems-tie together chemistry and biology. Talk about parks in Missouri and springs and lakes-many participants are not MO natives.

I really can't think of anything.

DNR lab Tour.

Be as positive as possible at end... Neil Holmes should have said, "And be sure to write a letter of Thanks to your sponsor..." in a positive note not a negative note.

The DNR was awful. Their people seemed unconcerned which aggravated me especially when Steve Schneider preached to us for a 1 1/2 hour about why we should be environmentally concerned. Also I felt they were very unknowledgable.

I can't think of anything.

Nothing.
DNR length of tour--lab was good to see.
Nothing.
Too much sitting and information on Friday.
One less speaker so there would be more time for sessions.
Wasn't impressed with DNR Representatives. (enjoyed tour and lab.)
No smoking.
I can't think of anything I would subtract.
Nothing.
Have less speeches.
Nothing.
I wouldn't subtract anything.
Have 4 groups meet in just 1 room at the same time.
Sitting in one room, in same chair, for 2 hours.
DNR tour--did not add to conference at all.
Tour of DNR.
None.
Waste Management Water pollution.
Tom Smolarek.
Long speeches.

Item 22. Should we have more of these workshops?
Yes. If possible please consider tours of chemical plants and/or workshops on safety in the labs and stockrooms.
Yes. You used the time very effectively--I really appreciated all the "hands-on" material, and the concentrated efforts of everyone was great! Very valuable--I would recommend this to anyone! It has helped me get so many ideas for teaching! and community involvement--and industry's role. Thank you--everyone was friendly--accomodations were great--participants were all helpful, too! Chemistry Fair was a very good asset to your program. This is the 1st conference that I could actually use all the information.
Yes. I believe these workshops do three things. 1. Rejuvinate your attitude by being with other teachers. 2. Evaluating your own science program from a standard set by a group. 3. Encouraging you to interface with the industry of the community and realize them as possible resources.

Yes. Because it's good. Can we come more than 1 year?

Yes. This workshop is extremely useful in making educators aware of available help in the classroom--as far as careered new ideas.

Yes. Very valuable.

Yes. I think this was a very worthwhile activity--My students should benefit.

Yes. This is a great way to talk and exchange ideas with my fellow teachers and people from industry.

Yes. Any one session would have made it a valuable addition to my teaching repertoire: we haq--what, 8, 10, 12?

Yes. This was an excellent opportunity for me to learn from other teachers and gain great experience. I would definitely recommend this to other teachers.

Yes. Next year.

Yes. Workshops like this make me feel appreciated and renew my pride in the work I do. Teachers don't get enough of this. It also provides the opportunities to discuss problems/successes with fellow Chemistry teachers.

Yes. The interactions involved here (T I E and T T) are valuable to the classroom teacher of chemistry.

Yes. This was an extremely beneficial experience.

Yes. Good for new teachers.

Yes. Teachers need the interaction with other teachers. We need these kinds of demonstrations to keep us excited about teaching chemistry.

Yes. Many teachers need exposure to real examples in industry and environment.

Yes. The take-home materials are fantastic. Thank you. I feel the contact with fellow teachers was great.

Yes. I think it is extremely important for this type of interaction. Just as the students don't realize the work that goes into preparing a lab, I didn't realize all the work that goes into preparing for this meeting. Thanks.
Yes. Useful in terms of making contacts, obtaining ideas and information.

Yes. They were very informative, especially the workshops by high school teachers.

Yes. These are so helpful! Also, talking to industry people (making contracts, etc.) of the handouts were very helpful and exciting! Thank you for an excellent workshop!

Yes. Enjoyed hearing industries concerns about the environment from them--not from the media.

Yes. Good for new teachers.

Yes. Excellent.

Yes. Conference is extremely valuable! Special thanks to Dow Co. Why not have representatives from the chemical companies that we order our school supplies from?

Yes. I appreciate the opportunity to get with other teachers and discuss our similarities, differences, strengths, and weaknesses.

Yes. Excellent resource.

Yes. Excellent! Great practicality!

Yes. Definitely--it is a great help to teachers to find out more information and what others are doing.

Yes. I have learned of many sources of new information sources. This is important to teachers.

Yes. The more teachers that could be involved would be a very definite positive effect.

Yes. Perhaps organized regional, district, or area teacher exchange programs. This could be arranged by area teachers, similar to conference (athletic) superintendents, principals, and coaches meeting.

Yes. Thank You!!

Yes. Contact with Chemistry teachers from areas across the state.

Yes. Definitely! I thoroughly enjoyed it. Most important, "It picked-me-up", motivated me to want to do a better job while at the same time let me know that I have been doing a good job.

Yes. Very interesting and very informative. Made many new contacts.

Yes. I did get many ideas to take back to school. I’ll be digesting this material for a long time. I will also be many years in attempting to implement it.
Yes. These workshops help to stimulate—to get a sense of what others do, similar students, budgets, etc. Also liked meeting folks from industry.

Yes. Excellent learning and sharing experiences.

Yes. It made me aware of the Chemical Co. I wish they covered more about type of working procedures and job opportunities.

Yes. Every chemistry teacher in the state should be given the opportunity to participate. Furthermore, many of us who have attended would like to again, especially if the variety of the presentations changes over the years.

Yes. I've enjoyed the ones in the past through DNR—especially Wast Management Conference.

Yes. It has been a good opportunity to get new ideas and to share ideas with other teachers. It has been very beneficial to learn about environmental issues and their applications.

Yes. I thought it was great. I learned more than I would have in years on my own.
### Appendix I

TEACHERS, INDUSTRY AND ENVIRONMENT

Project Final Report
NSF Grant No. TEI-8650101

Table I.*

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean*</th>
<th>Std. Dev.</th>
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<tbody>
<tr>
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<tr>
<td>Industry Person</td>
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<td>.4051781</td>
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<tr>
<td>Environ. Person</td>
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*Only the first four points were used.

ONE-WAY ANALYSIS OF VARIANCE
(see Table I above)

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<th>MS</th>
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<tr>
<td>Between groups</td>
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<td>Within groups</td>
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<td>.11334</td>
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<td></td>
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</table>
Appendix II

Teacher-Industry-Environment
Pre-Workshop Questionnaire
(version T87.2)

Please write in your name and social security number in the spaces provided. Then answer each of the questions which follow by circling the response of your choice.

Name________________________ S.S.N.________________

1. Of the approximately 24 member companies of the Chemical Council of Missouri, how many can you name?
   (circle one) >19 19-15 14-10 9-5 4-1 0

2. Of the companies involved in the Missouri chemical industry in your vicinity, to how many have you taken your class on a fieldtrip?
   (circle one) >4 4 3 2 1 0

3. Of the companies involved in the Missouri chemical industry, how many individuals within these companies would you feel comfortable contacting for assistance with your classroom teaching?
   (circle one) >4 4 3 2 1 0

4. For any one of the companies involved in the Missouri chemical industry, how many industrial processes utilized by this company can you name?
   (circle one) >4 4 3 2 1 0

5. Of the many products manufactured by companies involved in the Missouri chemical industry, how many can you name?
   (circle one) >4 4 3 2 1 0

6. Of the five divisions of the Missouri Department of Natural Resources, how many can you name?
   (circle one) 5 4 3 2 1 0

7. Of the five policy making commissions assigned to the Division of Environmental Quality, how many can you name?
   (circle one) 5 4 3 2 1 0

8. How many times have your contacted the Environmental Education Specialist at the Missouri Department of Natural Resources for assistance in your classroom teaching within the past 5 years?
   (circle one) >4 4 3 2 1 0

56
9. How many of your chemistry course activities (laboratory exercises, fieldtrips, guest speakers, etc.) specifically involve Missouri chemical manufacturers and their products?

(circle one) >15  15-11  10-6  5-1  0

10. How many of your chemistry course activities (laboratory exercises, fieldtrips, guest speakers, etc.) deal specifically with the quality of the Missouri environment?

(circle one) >15  15-11  10-6  5-1  0

11. How many of your chemistry course activities (laboratory exercises, fieldtrips, guest speaker, etc.) have you created in the past 5 years which deal specifically with the quality of the Missouri environment?

(circle one) >15  15-11  10-6  5-1  0

Please check the appropriate column for each question below.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>Question</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Do you have at least one microcomputer available for use in your laboratory teaching?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Do you use microcomputers in your chemistry teaching?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Do you have a working knowledge of the programming language BASIC?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Do you do any programming in BASIC related to your chemistry teaching?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5. Do you use microcomputers as a measuring or data logging device in your laboratory?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6. Do you use non-commercial devices for laboratory interfacing projects?</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7. Have you ever attended a workshop concerned with the interfacing of transducers with microcomputers?</td>
</tr>
</tbody>
</table>

On the lines below please indicate your preferred mailing address:

__________________________
__________________________

Thank you for your help by completing this form.
Appendix II

Teacher-Industry-Environment
Post-Workshop Questionnaire
(version T87.1)

Please write your name in the space provided. Then answer each of the questions which follow by circling the response of your choice.

Name

1. Of the approximately 24 member companies of the Missouri Chemical Council, how many can you name?
   (circle one) >19 19-15 14-10 9-5 4-1 0

2. Of the companies involved in the Missouri chemical industry in the vicinity of your school, to how many would you consider taking your class on a fieldtrip?
   (circle one) >4 4 3 2 1 0

3. Of the companies involved in the Missouri chemical industry, how many individuals within these companies would you feel comfortable contacting for assistance with your classroom teaching?
   (circle one) >4 4 3 2 1 0

4. Of the many products manufactured by the member companies of the Missouri Chemical Council, how many can you name?
   (circle one) >4 4 3 2 1 0

5. As a result of this workshop, how many individuals from the Missouri DNR would you feel comfortable in contacting to obtain help with your classroom teaching?
   (circle one) >4 4 3 2 1 0

6. How many ideas for classroom activities have you obtained from this workshop which relate to industrial applications?
   (circle one) >19 19-15 14-10 9-5 4-1 0

7. How many ideas for classroom activities have you obtained from this workshop which relate to environmental applications?
   (circle one) >19 19-15 14-10 9-5 4-1 0

8. How many ideas for classroom activities have you obtained from this workshop which relate to computer applications?
   (circle one) >19 19-15 14-10 9-5 4-1 0

Do you wish to have housing accommodations made for May 23rd. for the Reporting Conference?

___ Yes, in Hudson Hall.
___ No, thank you.
___ Perhaps. I will contact you.
TIE-87 REPORTING CONFERENCE EVALUATION

Appendix III

Date: 23 May 1987
Location: Central MO State
Group: Color Sump

A. Please share your general impressions of the Reporting Conference (today's program) by checking the box most appropriate for each category:

<table>
<thead>
<tr>
<th>Physical</th>
<th>Organization</th>
<th>Objectives</th>
<th>Content</th>
<th>Facilities</th>
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<td>/9/</td>
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<td>/y/</td>
<td>/0/</td>
<td>/0/</td>
<td>/0/</td>
</tr>
</tbody>
</table>

B. Please check the number of presentations made in your group for which you will request additional materials or information.

/2/ None
/1/ 1-3
/4/ 4-6
/0/ 7-9
/0/ More than 9.

C. Please indicate the relative importance of the Reporting Conference (today's program) as part of the T.I.E. Workshop (total program).

/7/ Most Important Workshop Activity
/1/ Important, but not Essential
/0/ Helpful, but not Important
/0/ Not a very useful Activity
/0/ Least Important Workshop Activity

D. Please indicate the importance of the Reporting Conference (today's program) in helping you structure part of your chemistry/ science classes to include the Missouri chemical industries, the DNR and your school's local environment.

/5/ Very Important
/1/ Important, but not Essential
/1/ Helpful, but not Important
/0/ Not very Important or helpful
/0/ Of no Importance
E. Please rate the T.I.E. Workshop (total program) by checking the box most appropriate to each category:

Presentations were: 44/ Very Clear 4/ Clear 0/ Unclear
Content was: 40/ Very Important 8/ Important 0/ Unimportant
Materials were: 42/ Very Useful 6/ Useful 0/ Useless
Speakers were: 7/ Very skilled 1/ Skilled 0/ Unskilled
Objectives were: 1/ Very Clear 7/ Clear 0/ Unclear

F. Please rate the T.I.E. Workshop (total program) on the basis of other inservice education experiences:

The workshop was: 6/ the best I have ever attended.
9/ better than most I have attended.
1/ similar to most I have attended.
0/ worse than most I have attended.
0/ the poorest I have ever attended.
2/ my first inservice experience.

G. What was the most positive aspect of the Reporting Conference? See attached sheets.

H. What would you recommend we do to strengthen future Reporting Conferences? See attached sheets.

I. Do you intend to use any information you obtained today?___ If so, how? See attached sheets.

J. Can the CMSU Chemistry Department be of further assistance to you?___ If so, how? See attached sheets.
WHAT WAS THE MOST POSITIVE ASPECT OF THE REPORTING CONFERENCE?

Hearing other ideas—giving me applications to my classroom.
Sharing project ideas and talking to other teachers.
Exchanging ideas.
Teachers sharing with other teachers and exchange of information.
Learning many quick and simple experiments.
Got some good ideas.
Exchange of ideas.

Having a verbal presentation of some of the abstracts that will appear later. It will help when trying to use these ideas.

A couple of the reports.
The exchange of ideas of teachers.
Fellowship with other teachers.
The presentation of industry's involvement in education and the various possibilities for integration with program.

Sharing practical ideas with classroom teachers.
Learning new ideas for use in classroom.
Hands on experimentation.

(1) Seeing creative applications of chemical principles that are presented to other classes. (2) Identifying resource personnel and obtaining addresses to write for materials.

New ideas—sharing of memorics and labs.
Talking with, and sharing information with reference to science.
WHAT WOULD YOU RECOMMEND WE DO TO STRENGTHEN FUTURE REPORTING CONFERENCES?

Keep the presentations **short**. (50 minutes and 30 min = TOO LONG for me!!)

Have it earlier in the month of May or late April--this still allows plenty of time to prepare a project.

Figure out some way to get more people to attend.

Stress time factor to people. suggest they bring handouts.

Very good as it is.

I thought that by having the chance to exchange useful ideas would be all that was needed--yet many people didn't show.

Hold a different weekend.

I think it is tremendous the way it is.

Do whatever is necessary to insure greater participation.

Maybe this years date was bad!

Make a lab presentations instead of cataloging chemicals. I want new exciting lab ideas.

Get more people to attend.
DO YOU INTEND TO USE ANY INFORMATION YOU OBTAINED TODAY?
IF SO, HOW?

Yes. I will use some of the experiments and ideas that are currently being used by other teachers.

Yes. To make my classes better--more interesting.

Yes. Lab safety.

Yes. I would like to incorporate most of the activities presented.

Yes. Don't know yet but will probably use parts in many classes.

Yes. To modify a couple of existing activities and perhaps add 1 or 2 others.

Yes. To integrate into my classes, new material.

Yes. As an idea for a science fair project.

Yes. Physical science class--use of spoons and weights. Trying to induce more critical thinking.

Yes. As labs.

Yes. Will be able to teach skills with some of this material.

Yes. New ideas for labs and projects.

Yes. Going to incorporate some of them into my science curriculum.

Yes. Experiments in lab (many).

Yes. In class experiments and/or demonstrations.

Yes.

X

YES!!!

YES!!!
CAN THE CMSU CHEMISTRY DEPARTMENT BE OF FURTHER ASSISTANCE TO YOU? IF SO, HOW?

Help me get rid of my chemicals!!

Yes. By disseminating information on these presentation to all of us.

No.

Yes. Would love some list to help separate my chemicals. They're all in 1 cabinet. #16's presentation may help. (It did some) ?

No. Not at this time--maybe next year. Thanks.

I'll let you know.

No.

I intend to contact an emeritus chem teacher for help in determining age of a bone.

Yes. I need to take a noncalculus based chem course in physical chemistry if available.

No.

Yes.

Yes. Informing teachers of events and seminars similar to TIE. At the high school level, we rarely obtain valuable notices such as these.

Yes. Let me know about NSF programs or new coordination between high school and elem. school science.

Yes. In having more of this type of workshops. Thanks.
T.I.E. PARTICIPANT SURVEY

NAME SUMMARY OF RESULTS REPORTED IN PERCENTAGES

I. PERSONAL

1. Circle the year you were a T.I.E. participant. 37% 31% 32%

2. Circle the number of H.S. chem classes you teach. 0 1 2 4 5

3. Does your current principal know about T.I.E.? Yes 95% No 5%

4. Have you visited with your sponsor? Yes 43% No 57%

II. PROJECT: Make a check mark the appropriate space to indicate your agreement (disagreement) with each of the following statements

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Our school teaches chemistry only to those who are going on to college.</td>
<td>6</td>
<td>28</td>
<td>13</td>
<td>86</td>
<td>16</td>
</tr>
<tr>
<td>2. I got some good teaching ideas from the T.I.E. Program.</td>
<td>35</td>
<td>64</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td>3. I believe Missouri Chemical Council industry really cares about H.S. science teachers.</td>
<td>38</td>
<td>52</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. Since T.I.E. I feel more comfortable talking to industry chemists.</td>
<td>11</td>
<td>48</td>
<td>38</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>5. Environmental Science should be taught in all science classes.</td>
<td>41</td>
<td>48</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>6. Kids in our school are interested in consumer chemistry.</td>
<td>6</td>
<td>61</td>
<td>27</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>7. I have shared ideas with other T.I.E. teachers.</td>
<td>9</td>
<td>54</td>
<td>21</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>8. Our chem curriculum is concept driven.</td>
<td>12</td>
<td>61</td>
<td>20</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9. I have cleaned up our chemical storage.</td>
<td>21</td>
<td>52</td>
<td>13</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>10. We don’t teach any organic chem.</td>
<td>5</td>
<td>24</td>
<td>13</td>
<td>36</td>
<td>20</td>
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<tr>
<td>11. I would like to attend another T.I.E.</td>
<td>57</td>
<td>31</td>
<td>10</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>12. T.I.E. should give more concrete examples like toothpaste.</td>
<td>32</td>
<td>57</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13. T.I.E. should have commercial suppliers exhibits.</td>
<td>23</td>
<td>61</td>
<td>9</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>14. We would like to know more about “basic” industrial resources.</td>
<td>27</td>
<td>68</td>
<td>4</td>
<td>1</td>
<td>0</td>
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<tr>
<td>15. Missouri has lots more chemical industries than I thought.</td>
<td>32</td>
<td>51</td>
<td>13</td>
<td>3</td>
<td>0</td>
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<tr>
<td>16. A microcomputer should be available for use in my laboratory.</td>
<td>50</td>
<td>34</td>
<td>11</td>
<td>4</td>
<td>1</td>
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<tr>
<td>17. Microcomputers are essential to my chemistry/science teaching.</td>
<td>6</td>
<td>32</td>
<td>34</td>
<td>21</td>
<td>5</td>
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<tr>
<td>18. Computer programming should be taught along with science teaching.</td>
<td>14</td>
<td>29</td>
<td>25</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>19. Microcomputers as data logging devices are not useful.</td>
<td>2</td>
<td>2</td>
<td>20</td>
<td>38</td>
<td>36</td>
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<tr>
<td>20. Non-commercial devices for laboratory interfacing are advantageous over commercial devices.</td>
<td>6</td>
<td>22</td>
<td>61</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>21. Microcomputer interfacing workshops are not useful for high school teachers.</td>
<td>1</td>
<td>2</td>
<td>14</td>
<td>45</td>
<td>37</td>
</tr>
</tbody>
</table>

*SA=Strongly Agree A=Agree N=Neutral D=Disagree SD=Strongly Disagree
### TIE-87 Teacher Participant List

(Teacher/Sponsor/School)

1. Gerald Axelbaum/Monsanto Co./Crossroads School
2. Timothy Backes/Mo. Chem. Coun./Tipton R-VI
3. Marjorie Bay/Mo. Chem. Coun./Rock Bridge H.S.
4. Alvis Beersman/DNR/Adair Co. R-I
5. Kathleen Bell/Mo. Chem. Council/Southwest R-V
6. Dennis Bradley/Dow Chemical/Festus Road
8. Theresa Brightwell/Mobay Corp./Oak Grove H.S.
9. Bob Brillhart/Mobay Corp./Center Sr.H.S.
10. Betty Buchanan/Ethyl Corp./Acad. Math/Science
11. Charles Busenhart/Carboline Co./St. Louis Univ. H.S.
12. Cynthia Castle/Mo. Chem. Coun./Pilot Grove H.S.
13. Sharon Cato/Monsanto Co./Dora R-III H.S.
14. Joe Clark/Transchem. Inc./Clayton H.S.
15. Beth Cook/CMSU Chem. Dept./Holden H.S.
16. Robert Crockett/Mo. Chem. Coun./Albany R-III
17. Vernice Dirigo/Hercules Inc./Buchanan H.S.
18. Martha Dodson/Monsanto Co./Sikeston Sr. H.S.
19. Gary Eatherton/Monsanto Co./Montgomery Co. R-2
20. Robert Farrell/Buchman Labs/Valley H.S.
21. Steve Fischer/Mobay Corp./Pleasant Hill R-3
22. Rita Floberg/Union Carbide/Liberty Jr. High
23. Byron Foster/Union Carbide/Bishop LeBlond
24. Pamela Gabel/Monsanto Co./Chillicothe H.S.
25. Linda Gaither/CHERVON Chem. Co./Grace Christian
26. Kim Graves/Alcolac Inc./Smith-Cotton H.S.
27. John Hali/Mobay Corp./Rock Port R-II
28. Roslyn J. Harmon/Monsanto Co./Washington Sr.H.S.
29. Jeff Howell/Mallinckrodt/Holcomb H.S.
30. Bill Jameson/Amer. Cyanamid Co./Hannibal Jr. High
31. Frank S. Johnson/Mo. Chem. Coun./Greenfield H.S.
32. Theresa Johnson/Mo. Chem. Coun./Dadeville R-II
33. David Johnston/SYNTEx Agri-Bus./Aurora H.S.
34. Terry Keeton/CHEMCENTRAL/Center Sr. H.S.
35. Theresa Kendrick/Amer. Cyanamid Co./Palmyra Sr. H.S.
36. Virginia Kirwin/A.I.Ch.E./Ursuline Academy
37. Jane Lynn/Monsanto Co./Crawford Co. R-I
38. Daniel S. Lane/Mallinckrodt/University City H.S.
39. Kerry Magruder/Mallinckrodt/Eureka S. H.S.
40. Connie Montgomery/Monsanto Co./West Plains R-7
41. Richard Nolte/Monsanto Co./McKinley H.S.
42. Mrs. Artie Pearse/Mo. Chem. Coun./Heritage H.S.
43. Nathan Peck/Monsanto Co./Mary Institute
44. Phyllis Perry/Mo. Chem. Coun./Jefferson City H.S.
45. Ted Pethel/Adco Inc./Sedalia Mid. School
46. Dan Phillips/Monsanto Co./Rock Bridge H.S.
47. Wilma Pollock/Monsanto Co./Hazelwood East
48. Roger Price/Farmland Indus./Central H.S.
49. Evelyn Roach/Monsanto Co./O'Fallon Tech.
50. Laurann Robertson/Eagle-Picher/Lamar High School
51. Marc Romine/Dow Chemical/Russellville H.S.
52. Harlan Sadler/Mo. Chem. Coun./Scott City H.S.
53. Sue Salamon/Monsanto Co./Wentzville H.S.
54. Thurlow D. Schauffler/E.I. DuPont Co./Westran H.S.
55. Ann Scheidt/DNR/Callaway Co. R-3
56. Alberta Shaw/Amer. Cyanamid Co./Marion Co. R-2
57. Andrew Shaw/Chemtech Indust./W. Minster Christian

58. Charles J. Smith/Mo. Chem. Coun./Osceola H.S.
59. James D. Smith/Monsanto Co./Notre Dame H.S.
60. Br. Mark Snodgrass/Moba, Corp./Archbish. O'Hara
61. Michael Spitz/DNR/Helias H.S.
62. Sr. Kathy Sullivan, SL/Merck and Co./Rosati-Kain H.S.
63. Richard R. Summers/SYNTAX Agri-Bus./Willard H.S.
64. Edwina Taylor/Mallinckrodt Hancock H.S.
65. Judy Taylor/Monsanto Co./Poplar Bluff H.S.
66. Oleta M. Thomas/PPG Industries/Hazelwood West
67. Cliff Tucker/Amer. Cyanamid/Canton R-V
68. Joan Twillman/N.L. Industries/St. Charles West
69. Linda Wilson/Atlas Powder Co./Webb City H.S.
70. Lance Wnkler/DNR/ Jefferson City H.S.
71. Kathy Wright/Monsanto Co./Central H.S.
72. Connie Wyrick/DNR/Cole Co. R-V
73. David Yates/Chlorox Corp./Smithville H.S.
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<td>Union Carbide/St. Joseph and N. Kansas City</td>
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<td>Department of Natural Resources/Jefferson City</td>
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<td>SYNTAX Agri-Business/Springfield</td>
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<td>CMSU Chemistry Department/Warrensburg</td>
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