

# **National Teacher Enhancement Network**

## **Final Report**

### **Volume 1 Participant Satisfaction with NTEN and Overview of Impacts**

by

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## Appendix

# Participant Satisfaction with NTEN and Overview of Impacts

## I. INTRODUCTION

The National Teacher Enhancement Network (NTEN) operates from the Burns Telecommunications Center at Montana State University (MSU) with support from two successive grants from the National Science Foundation. Since 1994, NTEN has offered graduate-level science and mathematics courses for secondary teachers, primarily teachers of grades 9–12. Since the project's inception, an external evaluation (conducted by Horizon Research, Inc.) has focused on course-level impacts, gauging the quality and impact of courses each semester. Through questionnaires and interviews, the evaluation assesses impacts on participants' feelings of preparedness to teach the subject matter of the course in which they are enrolled and on participants' perceptions of the content knowledge they gain.

Hundreds of NTEN participants have taken more than one course, raising the question of cumulative impacts, or impacts within individuals across a number of courses. Designing a study to address this question turned out to be more difficult than anticipated. An initial challenge was how to define the "treatment" when courses vary from semester to semester and address course-specific goals rather than the more general project-level goals. We decided that the courses were similar enough that we could aggregate across courses in defining the treatment. Despite the course-specific nature of NTEN, a project culture evolved early on such that courses tend to have a number of common emphases. First and foremost, courses focus clearly on developing science (or in some cases mathematics) content in participants. A second common feature is a reliance on class discussions as the primary pedagogy. These discussions are facilitated by means of a sophisticated, mainly asynchronous on-line conferencing platform. Third, courses tend to stress working with real data; e.g., participants retrieving and analyzing water quality data on-line or participants collecting and analyzing soil samples. Fourth, courses often incorporate long-term projects, frequently semester-long and group oriented. And finally, courses typically include at least some emphasis on transferring subject matter to participants' classrooms. For the most part, NTEN courses do not focus on training participants to use *specific* instructional strategies, but rather on translating course content for the students in participants' own classes.

A second challenge in designing a cumulative impact study was how to categorize participants. Many have taken eight or more NTEN courses dating back to 1994, but the majority have taken only one or two. The problem became more complex when in 1996, Montana State University introduced the distance-based Master of Science in Science Education (MSSE) program. Degree candidates spend two summers in residence at MSU, but the rest of their course work (mostly science courses) is done on-line through NTEN courses. The program includes required courses that focus on encouraging reform-oriented science instruction, and substantial overlap exists between participants who have taken a large number of NTEN courses and MSSE students, making the effects of the two programs difficult to tease apart.

Despite these obstacles, project staff and evaluators designed a study to test the hypothesis that as participants take more NTEN courses, they change in their knowledge of science content and in the instructional strategies they employ. The study, a detailed description of which follows, included survey, interview, and observation methodologies.

## II. METHODOLOGY

### A. Survey

In September 1999, HRI collected the names and e-mail addresses of everyone who had taken an NTEN course during the preceding two years. This yielded a list of 493 participants, quite a few of whom had taken multiple courses. HRI sent e-mail messages to all participants asking them to respond to a web-based questionnaire. After follow-up, HRI received 199 questionnaire submissions for a response rate of 40 percent. Further follow up with non-respondents took place using a paper version of the questionnaire and U.S. mail. An additional 97 responses were received, bringing the final response rate to 60 percent.<sup>1</sup>

A copy of the survey instrument is included in Appendix A. The major topics addressed were participants':

- ∞ Current teaching practices;
- ∞ Perceived impacts of NTEN courses;
- ∞ Reasons for not finishing courses (where applicable); and
- ∞ Demographic characteristics.

### B. Interview

From the 296 survey respondents, HRI drew a stratified random sample of 20 NTEN participants to follow up with a telephone interview. The sample was stratified as follows:

- Group 1: Nine were selected from among the 151 survey respondents who *were not* MSSE students *and* who had taken only one or two NTEN courses.
- Group 2: Four were selected from among the 19 survey respondents who *were* MSSE students *and* who had taken more than four NTEN courses.<sup>2</sup>
- Group 3: Seven were selected from among the 12 survey respondents who *were not* MSSE students *and* who had taken more than four NTEN courses.

This stratification allowed HRI to examine effects of the number of courses taken and participation in the MSSE degree separately.

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<sup>1</sup> Given that many of the e-mail and mailing addresses were as much as two years old, it is likely that some were invalid. Sixty percent is a conservative estimate of the response rate, since some participants had no opportunity to respond.

<sup>2</sup> Only science and mathematics courses were included in the tally, even though some MSSE education courses were taught on-line using the NTEN system.

In each group, some number of participants declined to participate in the interview; each person that declined was replaced with the next participant on the list by order of randomly assigned number.<sup>3</sup> HRI interviewed each participant by telephone in the Spring of 2000 for approximately 45 minutes using a structured protocol, a copy of which is included in Appendix A. All interviews were tape recorded and transcribed. Topics addressed in the interviews included:

- ∞ Participants' teaching situation;
- ∞ Satisfaction with the NTEN experience;
- ∞ Perceived importance of course applicability to the participants' teaching situation;
- ∞ Impacts of NTEN on participants' content knowledge and teaching practice; and
- ∞ Role of NTEN in participants' portfolio of professional development experiences.

### **C. Observation**

From the 20 participants interviewed, HRI selected 10 for day-long visits to their classrooms. Three participants were randomly chosen from Group 1, two from Group 2, and five from Group 3. As with the interviews, some participants declined to participate and were replaced by the next person on the list in order of randomly assigned number.<sup>4</sup>

All site visits were conducted in the Spring of 2000 and were complemented by an on-site interview. (See Appendix A for a copy of the interview protocol.) In contacting five of the participants to arrange site visits, HRI learned of other teachers at the same schools who had taken NTEN courses.<sup>5</sup> Some of these teachers offered to be observed as well, increasing the number of classroom observations from 10 to 15. When possible, these teachers were also interviewed on-site.

The observations and on-site interviews focused on: (1) the impact of NTEN on lessons observed;<sup>6</sup> (2) the impact of NTEN on participants' teaching generally, and (3) the extent to which they perceived NTEN courses were designed with classroom teachers in mind.

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<sup>3</sup> In Group 1, three declined; in Group 2, none; and in Group 3, one.

<sup>4</sup> In Group 1, one declined; in Group 2, none; and in Group 3, one.

<sup>5</sup> Project records did not include participants' school name. Participants' spontaneously identified and organized for HRI to visit other NTEN-treated teachers who were also at their school.

<sup>6</sup> Teachers were not required to teach a lesson relating to their NTEN experience, but could choose to if convenient.

## D. Demographics

As noted above, 296 participants responded to the questionnaire (60 percent response rate). Demographic characteristics of respondents are shown below in Table 1. Characteristics of participants in the interview and observation sub-samples are also presented.

More detailed information about participants' backgrounds was collected from those taking part in phone interviews (n=20). Information gathered at this level of the study revealed diversity in a number of different respects, including geographic location, background, and teaching situation of study participants. This diversity, in combination with HRI's stratified random sampling technique, allowed for a more complete perspective on the NTEN experience.

**Table 1**  
**Demographics of Study Participants by Data Collection Method**

Demographic Category	Percent of Participants		
	Survey (n=296)	Interview (n=20)	Observation (n=10)
<b>Number of courses completed</b>			
0*	9	5	-
1	43	15	5
2	18	25	10
3	10	-	-
4	8	5	-
5 or more	11	50	70
<b>Participating in MSSE program</b>			
Yes	16	20	20
No	84	80	80
<b>Race/Ethnicity</b>			
American Indian or Alaskan Native	2	-	-
Asian	1	-	-
Black or African American	1	-	-
Hispanic or Latino	2	-	-
White	94	100	100
<b>Gender</b>			
Male	57	75	80
Female	42	25	20
<b>Currently teaching in grades K-12</b>			
Yes	71	100	100
No	29	-	-
<b>Grades taught</b>			
K-2	3	-	-
3-5	5	5	-
6-8	27	20	30
9-12	78	80	80
<b>Subjects taught</b>			
Physics	30	35	40
Life Science/Biology	27	30	30
Earth/Space Science	27	30	30
Chemistry	21	25	40
Physical Science	19	20	20
Mathematics	14	15	10
General or Integrated Science	14	10	-
Other	32	25	30

\* These individuals (n=26) started at least one NTEN course, but did not complete any. Thirty percent of survey respondents indicated they had dropped at least one NTEN course at some point during their NTEN participation.

### III. RESULTS

Utilizing a range of data collection methodologies allowed HRI to harvest a wealth of both quantitative and qualitative data. With successively smaller sampling frames, each nested within the other, data analysis could move from the broad to the specific. At the survey level, HRI discovered broad trends in the quantitative data, identifying areas that suggest the existence of a cumulative effect of taking NTEN courses. These areas were examined in more detail at the interview level, and again at the observation level. HRI learned first-hand how impacts reported at broader levels of the study played out in a classroom setting.

Results of the study are presented in two volumes. Volume 1 provides an overview of cumulative impact findings. In addition, participants' satisfaction with the NTEN experience overall is discussed and the role of NTEN within participants' wider professional development portfolio is outlined. In Volume 2, findings that focus on cumulative impact are presented in more detail.

Data collected using the various evaluation methods, both quantitative and qualitative, are woven throughout the Results section of this report. The vignettes are products of the site visit process.

#### A. Cumulative Impact of NTEN Course Taking

HRI designed the survey instrument to test the hypothesis that a cumulative effect of taking NTEN courses exists; i.e., that the number of NTEN courses taken predicts certain outcomes. The questionnaire asked participants to rate a number of impacts that they might attribute to NTEN courses. (See Table 2.) The scale ranged from 1 "not at all" to 10 "a great impact." HRI used regression to look at the relationships between each item and the number of courses completed and found that for 6 of the 8 areas, number of courses completed significantly predicts the magnitude of perceived impact ( $p \leq 0.05$ ); i.e., the more courses taken, the greater the perceived impacts.<sup>7</sup> Table 2 shows the impact items and the regression coefficient for number of courses, which indicates the amount of increase in participants' ratings associated with each additional course. For example, each additional course is associated with an increase of 0.283 in participants' ratings of the extent to which NTEN increased their knowledge of subject matter content. These data strongly suggest that a cumulative effect of taking NTEN courses does exist. The lack of cumulative impact with regard to telecommunications and use of the Web is consistent with other evaluation data, which suggest that over the years, participants have come to NTEN much more savvy in these areas. For less knowledgeable participants, their first NTEN course seems to get them up-to-speed.

HRI recognizes that apparent impacts may be due to characteristics of those who choose to take multiple courses. Judging by demographic data only, those who take one or two courses are quite similar to those who take more than four. For instance, the percentage of males in each group is approximately the same (just over 50 percent). Further, the proportion of middle school

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<sup>7</sup> These data were analyzed only for respondents who reported they were currently teaching at the K–12 level, N=205.

and high school teachers (who comprise the vast majority of NTEN participants) is consistent between these groups.

The data in Table 2 suggest that NTEN has the greatest *cumulative* impact in four areas:

- ∞ Initiating conversations with other teachers;
- ∞ Expanding the range of teaching strategies used;
- ∞ Renewing enthusiasm for teaching; and
- ∞ Increasing knowledge of subject matter content.

**Table 2**  
**Cumulative Impact of NTEN Courses on Various Areas**

Considering the cumulative impact of all your NTEN courses, please rate the extent to which each of the following occurred:	Regression Coefficient* for Number of Courses Completed (Standard Error)	Mean	Standard Deviation
Initiated conversations with teachers around the nation that continued beyond the course(s)	**0.569 (0.063)	4.48	3.28
Expanded the range of teaching strategies I use	**0.440 (0.071)	6.00	2.48
Renewed my enthusiasm for teaching	**0.429 (0.075)	6.37	2.67
Increased my knowledge of subject matter content	**0.283 (0.086)	7.96	2.05
Gave me the content knowledge to teach courses I was previously unprepared to teach	**0.257 (0.082)	5.67	2.69
Furthered my knowledge of resources for my teaching	**0.190 (0.100)	7.42	2.23
Learned about telecommunications	0.019 (0.095)	6.44	2.79
Became an active user of the Internet/World Wide Web	0.163 (0.101)	6.00	2.94

\* Each coefficient is for a different model, where number of courses taken was used to predict the outcome of interest.

\*\* Indicates a significant difference at the p 0.05 using linear regression.

Given the heavy emphasis that NTEN courses place on science content, it is perhaps surprising that the quantitative data do not reflect cumulative impact in this area. A closer analysis, however, shows that in general, NTEN participants perceive the impact on their content knowledge as high regardless of the number of courses completed, as illustrated in Table 3. While between group differences do exist for ratings of impact on content knowledge, they are quite small compared to those for the four areas mentioned above.



**Table 3**  
**Impact in Various Areas, by Number of Courses Completed**

Area of Impact	Mean Rating		
	1-2 (n=115)	3-4 (n=39)	>4 (n=26)
Increased my knowledge of subject matter content*	7.75	8.69	8.92
Furthered my knowledge of resources for my teaching	7.22	8.00	8.00
Learned about telecommunications	6.65	6.54	6.40
Became an active user of the Internet/World Wide Web	5.97	6.49	6.29
Renewed my enthusiasm for teaching*	5.89	7.11	7.88
Gave me the content knowledge to teach courses I was previously unprepared to teach	5.53	6.51	5.92
Expanded the range of teaching strategies I use*	5.45	7.05	7.69
Initiated conversations with teachers around the nation that continued beyond the course(s)*	3.73	5.72	6.72

\* Using a one-way ANOVA, differences between the 1–2 course group and the 3–4 course group are significant at the p = 0.05 level. Differences between the 1–2 course group and the >4 course group are similarly significant. Differences between the 3–4 course group and the >4 course group are not statistically significant.

Analysis of the study’s qualitative data provides further insight into each of the four areas mentioned above. Findings, primarily as they relate to cumulative impact, for each area are summarized below.

### 1. Impact on Connectedness to Other Teachers

- *Participants who had taken multiple NTEN courses frequently reported interacting with other teachers on-line and some developed lasting professional connections.*

NTEN appears to have had a greater impact on participants’ connectedness to a wider education community if they took more than four courses. Almost all of the interviewed participants who had taken multiple NTEN courses reported interacting with fellow NTEN participants on-line outside of any required discussions while taking NTEN courses. Eight of 11 participants in these two groups (compared to 2 of 9 who had taken only one or two NTEN courses) also reported continuing such interactions after the courses. On-line interactions comprised both professional exchanges and personal “chat.” In a few cases, participants reported ongoing and substantive connections with fellow NTEN participants. For example, one repeat participant now shares class-collected scientific data on-line with another NTEN participant’s classroom for their students to analyze. In another case, where multiple teachers from one school participated repeatedly in NTEN, professional relationships and instructional practices were strengthened through collective and collaborative NTEN experiences.

- *Interaction with other NTEN participants provided a unique avenue for reflection on practice, particularly for those who repeatedly returned to the NTEN environment.*

A few of those who had only taken one or two NTEN courses and nearly all repeat participants identified and credited the NTEN experience with making them more reflective practitioners. In linking them to other educators across the country, these experienced NTEN participants felt that the on-line format had widened their perspective on various teaching contexts, prompting them to more deeply reflect on their own practice. For example, one repeat participant explained that

he used NTEN “as a barometer to measure how well [he] was doing” which was something that he “could never do in a regular class because you’d never meet somebody from another part of the country.”

The opportunity to gain access to other educators and insight into their teaching was particularly important for participants in more isolated teaching situations. Participants in remote locations described how lack of access to other colleagues teaching the same subject, lack of funds, lack of accessibility, or lack of time for involvement in national level professional development or professional meetings curbed their chances for developing connections. Meeting other teachers on-line through NTEN helped broaden their experience in this respect. Participants in large schools, who may also lack opportunity to interact with colleagues, also found NTEN a successful vehicle for helping them forge needed professional connections.

➤ *The on-line format of NTEN facilitated the forging of strong student-instructor bonds for some participants.*

Roughly one-quarter of interviewed participants (most having taken multiple NTEN courses) reported having interacted with course instructors outside of class discussion or maintaining contact with instructors once a class had ended. Participants in the MSSE program also recognized the benefit of being able to meet with instructors and fellow NTEN participants face-to-face during the on-campus MSSE component to further strengthen bonds established on-line. Other interviewed participants who were not part of the MSSE program, but had attended professional meetings at which NTEN held a reception also noted the benefit of meeting their “electronic friends” in person.

## **2. Impact on Range of Teaching Strategies**

➤ *Some types of teaching strategies were more heavily impacted by NTEN than others. Extent of impact, however, could often be linked to the number of NTEN courses a participant had taken.*

HRI asked interviewed participants about the impact of NTEN on a number of different teaching strategies. (See Table 4.) Overall, the NTEN experience appeared to impact specific teaching strategies to a great extent while having little influence on others. Data also suggest that there was differential impact, both in terms of the proportion of participants reporting impact and the strength of evidence provided for some strategies, dependent on the number of NTEN courses participants had taken.

**Table 4**  
**Individual Reports of Impact of NTEN**  
**Experience on Specific Teaching Strategies, by Group\***

	Percent of Interviewees		
	Group 1 (n=9)	Group 2 (n=4)	Group 3 (n=7)
Use of computers (other than Internet)	22	75	86
Hands-on/laboratory activities	11	50	71
Use of Internet	66	75	71
Discussion	22	0	57
Collecting/using real data	44	100	57
Use of lecture (e.g., decreased use)	55	100	57
Long-term projects/extended science investigations	66	75	57
Group work/collaborative work	44	0	43
Fieldwork	11	25	24

\* Interview responses were tallied for each group. Number of responses confirming impact on a specific strategy were divided by total number of participants in a group.

- ***The greatest impact of the NTEN experience on participants' pedagogy was related to technology.***

Fifteen of the 20 participants interviewed reported that NTEN had impacted their use of technology in some form, be that use of computers, the Internet, or other technologies, such as graphing calculators. For some participants, NTEN was their first intensive exposure to technology and led to an increase in both familiarity and confidence working with new media.

Use of the Internet, in particular, was a strategy through which NTEN had a significant impact on the majority of participants in all three groups. As a result of their NTEN experiences, participants reported altering their classroom practice in a number of different respects including:

- ∞ Provision of more Internet-based laboratory experiences for students;
- ∞ Integration of Internet sites into course curriculum;
- ∞ Use of the Internet to gather additional classroom resources and activities; and
- ∞ Use of the Internet for directed student research.

- ***Findings suggest a cumulative impact of NTEN on participants' use of computers as a teaching strategy.***

While the majority of participants across all three groups reported impact from their NTEN experience on Internet use, repeat participants spoke most directly about impacts related to their use of computers. NTEN appears to provide participants with a better understanding of how to direct the use of computers in a classroom setting. For participants who had taken more than four NTEN courses, impact on the use of computers was at times profound. Eight of 11 repeat participants reported that they were using computers in new ways. Introduction to new software

packages through NTEN and the opportunity afforded during on-line courses to practice using the software and develop avenues to introduce it in a classroom setting was invaluable, leading to significant changes in participants' teaching practice.

- ***The collection and use of real data in the classroom was also a widespread impact, particularly for the more experienced NTEN participants.***

All participants in the MSSE program reported significant changes in this area of their practice, as did four of seven in the non-MSSE, repeat participant group. Comparatively few individuals who had taken only one or two NTEN courses reported change in their use of real data. Concentration on integrating the use of real data into the science curriculum was a key factor for effecting change in this teaching strategy. Many participants provided examples of using the computer as an interface to collect data from probes or the Internet. Others found that NTEN helped them to develop other technology skills, such as the graphing calculator, which allowed them to give more attention to data collection and analysis. In general, participants linked collection and use of real data in their teaching to a greater awareness of and more effective use of technology resources.

- ***The impact of NTEN on the use of hands-on and exploratory-type activities was most evident in those participants who had taken multiple NTEN courses.***

The majority of participants reported that they already felt that they used hands-on strategies in their classroom, and those who had taken only one or two courses generally did not report increases as a result of NTEN. In contrast, the acquisition or development of new hands-on activities and their integration into the classroom were frequently cited by repeat participants as main benefits of the NTEN experience. Use of hands-on activities was at times linked by participants to their use of activities that encouraged more open-ended exploration.

- ***The majority of participants across all groups reported impact on their use of long-term projects or extended science investigations.***

NTEN tended to provide participants with ideas for new projects or avenues to extend investigation of a particular topic. Again, a number of participants talked about the influence of their enhanced Internet knowledge in this respect. NTEN exposed participants to a variety of different websites which could be used as a starting point for further investigation by students. An influx of new ideas and experience working on longer-term projects during NTEN courses led a few participants to allot more time in their curriculum for extended investigations.

- ***The majority of participants also acknowledged NTEN as a factor that influenced their use of lecture.***

With the increase in content knowledge afforded by NTEN courses, some participants discovered they were able to incorporate new material into their lectures. Others felt that they had learned how to pose more "higher level thinking questions" while lecturing. Many participants, and all of those in the MSSE program, felt that NTEN had contributed in some fashion to decreasing the amount of lecture that they use. For some, this decrease was primarily

due to the fact that NTEN had introduced them to a variety of other strategies through which they could engage their students.

- ***Regardless of number of courses taken, NTEN did not appear to have a major impact on participants' use of discussion, group/collaborative work, or fieldwork.***

Many participants described class discussion as a typical strategy that they have always used in their classroom. Although a majority of repeat, non-MSSE participants reported impact in this area, changes described were often couched in terms of NTEN contributing new ideas for discussion topics rather than as a change in pedagogical approach. Across all three groups, collaborative or group work was depicted either as a strategy that participants did not use regularly or one they already felt comfortable employing prior to NTEN. Similarly, fieldwork was already an integral part of some participants' repertoire while limited for others by external constraints such as school regulations about taking students off campus or budget restrictions.

- ***In general, MSSE participants reported that the MSSE experience had a greater overall impact on their classroom teaching strategies than did the NTEN courses.***

For some individuals, participation in the MSSE program confounded the effect of NTEN. Three of 4 interviewed participants, when asked about the impact of NTEN on their teaching, spontaneously brought up the MSSE experience. MSSE participants talked about learning a number of different teaching strategies through their on-line or on-campus education courses including how to approach assessment and improve their questioning strategies.

### **3. Impact on Enthusiasm for Teaching**

- ***Qualitative findings from open-ended survey responses and participant interviews suggest that one of the areas NTEN has the greatest cumulative impact is in renewing participants' enthusiasm for teaching.***

Qualitative data indicate that taking NTEN courses can rejuvenate teachers in a number of ways, including:

- ⌘ Providing inspiration to delve into new areas of knowledge;
- ⌘ Creating excitement about trying new things in the classroom;
- ⌘ Affording an opportunity to pursue an area of personal interest;
- ⌘ Keeping one involved and aware of what is current in the teaching profession through information presented and networking;
- ⌘ Acting as a catalyst to raise confidence level in a subject taught or classroom strategy employed; and
- ⌘ Providing an avenue for continued learning.

#### 4. Impact on Content Knowledge

➤ *Across all groups, NTEN participants report increased content knowledge.*

Almost all participants, 17 of 20 interviewed, commented that they had learned new content, or updated and broadened their existing content knowledge by taking NTEN courses. Expanded knowledge, for many participants, appeared to lead to changes in the content they presented in their classrooms. In terms of content, changes to classroom practice described by interviewed participants included:

- ⌘ Enhancing or expanding topics already taught;
- ⌘ Prioritizing content taught by spending less time on some topics in order to fit in more up-to-date content; and
- ⌘ Presenting new lessons, units, or courses using content learned.

Exposure to up-to-date content and science issues through NTEN was greatly valued by participants. Required use of the Internet in many NTEN courses provided the necessary motivation and skills through which new content knowledge could be obtained.

A number of participants were excited about being able to provide new information to their students garnered from the field as opposed to taking it out of a textbook that was likely outdated. The NTEN experience encouraged some to undertake additional research to learn more about certain topics.

➤ *Cumulative impact in the area of content knowledge was perhaps most strongly evidenced in the study's qualitative findings.*

Survey data, reported above, indicated that NTEN participants perceive the impact on their content knowledge as high, regardless of the number of courses completed. While this is also true of the qualitative findings in general, interviews with participants suggest bigger between-group differences than was evidenced through the survey data.

With only one or two NTEN courses, participants tended to report new content learned in terms of gaining more up-to-date knowledge in a content area. Participants with experience taking multiple NTEN courses described broader changes to their content knowledge in comparison. These NTEN-experienced participants talked about strengthening their knowledge, which in turn enabled them to delve more deeply into a content topic with their students or gaining insight from NTEN into why certain concepts were important to teach and their real-life applications.

An increased depth of knowledge was often linked to a change in completeness or accuracy of content delivered. Nine of 11 repeat participants reported impact in the area of content accuracy compared to only two of nine who had taken only one or two NTEN courses. Participants talked not so much about discovering that they had been teaching an incorrect concept, but rather that

they were now able to go into more detail about a subject and therefore provide their students with a more complete conceptual picture.

Five repeat participants also talked about implementing, or plans to implement, new content units in their curriculum. In a few cases, plans were underway to introduce whole new courses based on content knowledge gained through NTEN. It seems clear in examining data from across the study's stratified participant groups that as a teacher takes more NTEN courses, the depth and breadth of impact on content knowledge increases accordingly.

➤ *Vignette 1 outlines the experience of one study participant whose experiences highlight all four areas of cumulative impact discussed above.*

The experience of Mr. Holmes,<sup>8</sup> a participant in the study's observation sub-sample, provides a powerful example of the wide ranging and lasting impact NTEN can have on an individual's instructional practice. Mr. Holmes is a high school teacher in an urban setting and has taken a number of different graduate-level courses on-line through NTEN. Of particular interest is the fact that each of the impacts reported by Mr. Holmes was identified as a key indicator of the cumulative effect of NTEN course taking.

### Vignette 1

#### **Making Multiple Connections Between the NTEN Experience and Instructional Practice**

Mr. Holmes recognized strong connections between his NTEN experience and his classroom practice. In fact, in every area of his instruction that HRI sought to learn more about (e.g., use of computers, use of fieldwork, use of real data), Mr. Holmes could give a plethora of examples of how NTEN had impacted each. "I've used almost everything that I've gotten out of those classes, one way or another in some place in my class," Mr. Holmes explained.

Among all the impacts reported by Mr. Holmes, there were four areas in particular where the connection between NTEN and instructional practice was strongest. First, NTEN enabled Mr. Holmes to become comfortable with a wide breadth of content. As he explained during the on-site interview:

*I'm so comfortable with what I have learned. I went to a...professional conference...[experts in the field] talked about black holes and black hole theory, and I know for a fact that if I had not taken that [NTEN] course I would not have really understood a lot of what they were saying. Now I have this really clear comprehensive understanding of what they were talking about. It made it a lot more enjoyable. Like going to a doctor's office and being given a diagnosis and not knowing what they are saying. I at least know the vocabulary and I know a lot of the terms and I understand what they are talking about.*

Exposure to new content and activities through NTEN allowed Mr. Holmes to exceed his expectations in terms of making connections between NTEN content and his classroom curriculum:

*I was hoping that I would be able to take some of the NTEN course material, the subject matter and incorporate it in the classroom. When I first started taking [courses], it was really just because I was interested in the subject and was hoping I could learn more and maybe be able to apply something to the classroom. And frankly I'm amazed at how much I could transfer. It was a lot more than I ever even expected...Definitely, it's been worthwhile.*

Second, Mr. Holmes discovered that his NTEN experience could be combined with other interests and exposures to create new learning avenues for students. One example of this was observed during HRI's site visit to Mr. Holmes' high school physics classroom where students were working on an atomic bomb unit. The unit, designed by Mr. Holmes, was a culmination of merging his NTEN-gained knowledge, past work experience in the scientific realm, research, and science fiction reading. A few years ago, as part of an NTEN final assignment, Mr. Holmes had written a problem that used Kepler's Law. At the time, he had just finished reading a science fiction novel that inspired him to present the problem within the context of a story. As Mr. Holmes described:

*The advantage of the NTEN project was that unlike a normal [course] where you take a test and a final exam, I had to build something. And to make it interesting, I turned it into an extension of somebody's novel and it made it a lot more fun.*

This experience led Mr. Holmes to think about using scenarios to lead students into an exploration of other content. He then

<sup>8</sup> Pseudonyms are used in place of participants' real names to ensure anonymity.

began to work on the scenario that was to later form the backbone of his atomic bomb unit. Similar to many of his NTEN assignments, Mr. Holmes wanted to design something that would let students work on physics concepts while applying it to a real world context.

The unit he developed focused on having students work in discrete groups to each complete one aspect of a mission to simulate the study, design, and construction of the first atomic bomb. Each group (theoretical physics, materials and production, bomb design, bomb assembly, bomb effects, and planning and policy) were given a set of focus questions to help channel their research efforts. To gain necessary knowledge to complete their own tasks, groups were required to interact with each other. During the post-observation interview, Mr. Holmes explained that he aimed for the unit to help students understand the essential content of nuclear physics. Further, he wanted them to realize how much scientific research relies on effective interaction among experts, group work, and strong communication skills. The unit, covering the span of a few weeks, was to culminate in each group presenting its findings to a wider audience of peer and school administrators. While this was the most extensive unit of the year, Mr. Holmes stated, students work together on similar, but smaller scale problems leading up to it.

Third, Mr. Holmes' enthusiasm for NTEN and the new approaches to delivering content he was investigating as a result of his on-line experiences was a catalyst for other's curiosity and excitement. Mr. Holmes' school, a science and mathematics magnet school for the district, now offers its own on-line course. Inspired by Mr. Holmes' NTEN experiences, his colleagues began talking about offering on-line courses at the high school level using the same approach. Organizing such a course became a reality this year when one of his colleagues moved a Bioethics class on-line. Using different conferencing software than NTEN, students are expected to communicate over the Internet. The course is designed around a series of readings and issues. Students exchange viewpoints and research with each other by sending e-mails. Some of the students, being local, participate in the course using the school's computers. They also meet with the teacher once a week. Students in more remote locations of the region are involved from a distance. The teacher travels to see these students in person about once a month. While structured somewhat differently, the course is a direct result of applying the NTEN format in a high school setting. While not involved in its implementation, Mr. Holmes was a critical resource for the design of this course. Impact in this case extended beyond the NTEN-exposed teacher to affect his colleagues.

Fourth, for Mr. Holmes, NTEN provided a sense of connectedness to other educators and their experiences that he had not been able to gain elsewhere. The immediacy of the exchange of ideas and the power to communicate with others through the on-line format allowed Mr. Holmes to explore new ways to view content and strategies for presenting it to his students. Mr. Holmes' own comments illustrate this point:

*I had an opportunity to continue my education without going through the formality of the old fashioned university approach....the experiences in NTEN are not like a regular college where you sit and listen to a lecture and you practice enough to be able to respond on a test. This was an experience in which it was a lot of give and take and we understood the process and the subject better because when someone said, "I can't visualize what light is" someone else said, "Well light is like a ball of yarn that when it strikes the side of something it unravels and therefore it looks like a wave. But if you catch it on the other side and it hasn't touched anything it feels like a particle. It's got both characteristics." Now, light is no ball of yarn, but the model makes so much sense that you can suddenly think, "I can see that." Whereas the very same day, until you got on that chat line and you started some of those discussions, you still couldn't understand what it looked like. You had no good model. But someone else comes up with that idea and oh my gosh, everybody now knows how that works.*

Clearly, Mr. Holmes has made a number of important connections between his NTEN experiences and instructional practice—connections that are likely to continue impacting his teaching into the future.

## **B. Satisfaction with the NTEN Experience**

Interviewed participants reported taking a variety of different NTEN classes. Most had chosen courses that were linked to subjects they taught, although some had taken courses for more general interest or to satisfy a specific teaching certification requirement. Nine of the 20 participants started taking NTEN courses prior to 1995, with the rest having become involved in NTEN within the last five years. Overall, as illustrated by the quotes below, participants had positive experiences with NTEN courses:

*I was able to take several courses, and I enjoyed them all. I thought they were all pretty well run. [Participant taking >4 courses]*

*I've been very happy with virtually every course I've taken. I've gotten different things from each course, but I've always found something valuable from them. [Participant taking >4 courses]*



*I would [describe it as] fair. I won't say it was outstanding. I think that there was a lot of really good information and there is a lot of stuff that I was able to put in that I have applied very widely in my classroom. [Participant taking 1–2 courses]*

*I've been taking NTEN classes since—I think 1992 was the first class I took. I've gained a lot content wise, resource wise, networking wise with other teachers, contacts with professors at the university, and I was a complete neophyte when it came to telecommunications when I took my first class. So it's had a positive impact. [MSSE Participant]*

➤ **Participants identified specific factors that contributed to the success of a NTEN course.**

When asked about elements of an ideal NTEN course, interviewed participants listed a number of items based on their own experiences. (See Table 5.)

**Table 5  
Participants Identifying Elements of an Ideal NTEN Course**

<b>Element</b>	<b>Number of Participants (n=20)</b>
Use of discussion format	9
Effective instructors	6
Recognition of participants' (as full-time teachers) need for flexibility	6
Well organized and coherent course (i.e., syllabus, conferences, assignment parameters)	6
Linking course to classroom context	6
Accessibility (i.e., seamless and versatile—allowing for transfer of text and graphics—telecommunications)	4
Opportunity to work in groups with other teachers	4
Provision of quality course materials	4
Frequent communication with course instructor	3
Valuable, strong, and interesting content	3
Introduction and use of new technologies	3
Chance to take NTEN course with a colleague	1
Access to others' course work	1

Participants spoke about some of the ideal elements listed in the table above from various perspectives. For example, with use of discussion format, some participants identified requiring consistent interaction through discussions as an important aspect of an NTEN course. Others talked about the importance of setting up focused discussions with higher-order questions or discussions with a variety of different formats (i.e., open-ended, structured, live chat).

Similarly, participants had various views about what aspects were most important in contributing to an instructor's effectiveness. Some felt that instructor familiarity with technology and/or openness to the on-line format was essential.

*The instructors are very key. They have to be real open to this new format. If they are not open to the new format I don't think it works. And I really admire those that jump right in and try it out. [MSSE Participant]*

For others, having an instructor with both the science content and science education knowledge who could accurately gauge the necessary level at which to deliver content to an audience of teachers was most critical. Passion for the subject being taught and an ability to treat the participants with respect and professionalism were other aspects mentioned with regard to key attributes of an NTEN instructor. As these participants reported:

*I really noticed, oddly enough, even though we never talked to them or anything, the personality of the professors coming through. I just found some of them a little easier to deal with. A couple of them, one in particular...was so unfailingly courteous. No matter what a person would say his reply was just as courteous as it could be. Because it's kind of an awkward medium just writing back and forth—you can't really convey humor or emotions very well and he treated everybody just so nicely. And I think that's a real big component so when you say something stupid, and you find out that you did, you need to find out in a nice way. So I think that kind of personality on the part of the professor is important. [Participant taking >4 courses]*

*Our instructors and the assistants were always patient. They were always non-judgmental. They recognized the difficulty of doing things long distance so I think they took extra care to make sure that you felt okay. And they never made you feel like "why can't you do this?" [Participant taking 1–2 courses]*

*I think definitely the teachers...the way they really had a passion for what they taught...they really knew their stuff and they were really involved with the class. [Participant taking 1–2 courses]*

Other factors specifically mentioned by participants that helped to create a quality NTEN experience included: (1) the support provided by course instructors and Montana State University staff; (2) the challenging level of course material; (3) the excitement of working on-line; and (4) the fact that courses were developed with teachers in mind. The quotes below are illustrative of these factors:

*I think I also have to say that their customer service aspects were great. When you called into the office and talked to the administrative staff, they were wonderful. They were good troubleshooters. They researched your questions and they got back to you. So that was very good. [Participant taking 1–2 courses]*

*Well I think they have been rigorous enough. That's for sure. I think they are well done overall. I think that the content is there. And of course at a graduate level a lot of that has to be independent anyway. They've definitely required that of us so at the end I feel that I have learned something. And it's practical, I should say, because it is designed for teachers. [MSSE Participant]*

➤ **All participants felt that course content needed to be applicable to their teaching situations.**

Half of the interviewed participants felt strongly that having a direct connection between NTEN course content and the content taught in their classrooms was necessary. Recognizing how NTEN content fit directly into their own curriculum was key and of particular import given the amount of time invested in taking an on-line course.

*I think [content fit is] very important. If you are going to spend time taking a course, particularly the amount of hours that it's been on a graduate level course, I think it should be able to apply in with what you are doing. That's the reason I took both of these [NTEN] courses that I took. I could apply them not only in the math and physics, but in the technology and research programs and so forth that I do to. [Participant taking 1–2 courses]*

*Well at this stage of the game, for me anyway, having taught for 30 years [content needs to be] directly applicable. That's the only reason I take [NTEN courses], so I can pick up some stuff. It's good to get background information but it's also, for me in particular, I was looking for things I could do and adapt to my class. [Participant taking >4 courses]*

*The ecology class that I teach is natural resources. It's not like a big global thing, it's what's in our backyard. That's the way I've always done ecology...and I'm also big with the Envirothon program which is also a state, natural resources program. And that's why I was searching for a course specifically on soils and I found it [through NTEN] and it was good so that's what I wanted. So in that vein, [applicability of content] is important to me. [Participant taking 1–2 courses]*

Most of the participants who spoke about NTEN course content from the perspective of fit with their students' particular grade level did not feel this was critical as they could always pick and choose what they deemed important enough to gear toward their own teaching situation.

One participant, teaching at the middle school level, felt that course content was almost irrelevant since the middle school curriculum was so fluid.

*At my level, for example, I am so flexible in what I can do. There is hardly any weather curriculum in my book. There is no hydrology hardly at all, very little, and yet I can do everything [from] all the [NTEN] classes that I've done. I can apply it. And I've got the flexibility to do it. At high school, they're a little bit more locked in. I can't see a physics teacher taking an earth science class unless it relates to studying the physics of something like mountain building. [Participant taking >4 courses]*

Five participants, all having taken more than four NTEN courses, felt strongly that course content should be geared above the level they taught so as to engage their own intellect and provide the necessary depth of background to teach their subject more effectively. As these participants explained:

*A lot of things that I studied were generally of a higher level than I would do at high school, but it was important to do those because it gave me the understanding that I can use so that I can apply that to my level. The actual activities in the course, I would like some of them, a part of it, to be directly applicable but more important is that I get a total understanding of the ideas and then I can make up my own activities that would be appropriate. [Participant taking >4 courses]*

*As far as the content goes...we can always improve our content and that's part of our job as teachers is to figure out a way we can benefit our students with it...It's always nice that instead of having straight tests, that [NTEN instructors] provide us with the opportunity to develop a lesson or a unit or something like that. Like my [NTEN course name] class, that was a really wonderful class. It was one of the hardest courses I've ever taken in my entire life. And so much of the content itself was so deep and so far above anything I could take into my classroom directly, but the background information it provided me helped me teach immunology and microbiology to my students more effectively. [MSSE Participant]*

- ***Underlying expectations about course content and how it would be used appeared to play a role in influencing some participants' viewpoints on the importance of fit between course content and classroom practice.***

The outlined box below presents two participants' reactions to course content from the same NTEN offering. The first participant, a middle school teacher, viewed the advanced content presented as a way to strengthen his own knowledge. The second participant, a high school teacher, viewed the advanced content as a barrier to transferring knowledge to his classroom.

**Middle School Teacher**

"[NTEN course content is] above grade level in most cases, and it should be. It's our job then to take it and make it applicable to our kids. Most of the courses I've taken have been open to anybody K-12 and I think the two astronomy courses were K-16. So it's our job to take the material and make it applicable. It's not their job to water it down so it can fit...The [course name] course was way, way above what I could ever give to my kids but it gave me the knowledge to be comfortable with the material I had to present to kids. I wasn't on their same academic level. I was superior to them. I knew more than them based upon [my NTEN-gained knowledge] and it made me comfortable." [Participant taking >4 courses]

**High School Teacher**

"I liked the idea of an on-line course, which is why I chose it, because it was convenient. However, the course itself proved to be difficult and actually was more advanced than what I'd hoped. I assumed it would be a basic course in [subject matter] and in fact it turned out to be a course that was more or less a college level course. Well, it was supposed to be a college level course, I don't mean it that way. I guess I mean the information that was covered in the course was what I would expect more along the lines of what you could use in college rather than at a middle school or high school level." [Participant taking 1-2 courses]

The majority of participants believed that the responsibility to make connections back to the classroom rested with themselves rather than with NTEN. At the same time, having course

assignments that required them to think about how their experience with NTEN could be translated to their own instructional situation was helpful. As illustrated below, successful courses were often defined as ones that asked participants to design a unit or lesson for use in the classroom or solicited their professional opinions about how various ideas, resources, or content could best be applied in a classroom situation.

*[NTEN courses] have to be open to how you would use this in a classroom because I think the intent of everything that I got...was that you really want to try and put this into a classroom and how would you do it? So there was an openness...one of the early comments I remember [an instructor] sending out was “I’m not the expert in the high school classroom. I need your assistance to describe to other teachers how do you implement this idea, or how would you approach this problem in a high school classroom?” And the fact that even though [the instructor] has a tremendous knowledge base and lots of years of experience, he was very open to our comments and to using us as a resource to tell other people how you would use this in your classroom. I thought that was a really spectacular approach to teaching, especially on-line which is without the face-to-face. You are really just getting a lot of suggestions [and] we could kind of cut through them and see what ones work and try different things out. I like that approach. [Participant taking >4 courses]*

- ***Participants had diverse viewpoints on whether NTEN courses should be directly applicable to their own teaching situation in terms of pedagogy.***

Interviewed participants were asked about the importance of being able to apply the teaching strategies modeled in NTEN courses. Several participants described being open to picking up any new ideas or methods presented during NTEN courses.

*I think that [NTEN] adds to your own teaching abilities and I think it keeps you current with new information and new teaching styles. So I think that it is important in that way. [Participant taking 1–2 courses]*

*I did learn from the way that the professor organized things and also I learned from the lesson designs from other teachers and how they would approach the topic from a different way than I would have. I learned quite a bit from that. [Participant taking 1–2 courses]*

*In my classroom [I often say,] “there was this great problem that was in one of my courses I am taking. We’ve got to try it.” In fact, in [one NTEN course] I did that several times in part because it was required and part because there were these cool problems that kept cropping up that I had to try out and let the students do it. And to be honest with you, I never would have seen that in a regular classroom. In a regular college class I would have had a professor telling me “here is what particle physics does. Here’s some of the equations. Here’s how it works. Now go home and do these 10 homework problems.” It would have been a 10 homework problem assignment and I turned it in. Here, it was like I’m reading this that morning and that afternoon I’m putting it into my classroom and trying it out. And not because I was lectured on how to do it, but because*

*someone said “well, I did this with my class” and the professor said “this is what we ought to try and you give me some examples of feedback on how it worked for you.” Oh man, there are no college courses that were like that. None that I ever took. [Participant taking >4 courses]*

Six of the 20 participants interviewed specifically noted the importance of experiencing data collection and analysis through NTEN and being able, in turn, to apply strategies learned in this area to their own classrooms:

*I know that in the [NTEN course name], for example, we worked our way very carefully through the data so we could see how it actually, what the results ended up. And I now have a really good basis to use in my classroom because I knew what the results meant. I knew where they came out, and I knew what mistakes would be typically made. So it was really useful in that respect. [Participant taking >4 courses]*

*[The NTEN course] was excellent for data gathering...I have been using those strategies now with my students, so I found that very valuable. In the [NTEN course name] class that I took, we went out and collected field data. Actually jumped into marshes and had to sample them and dig around a little bit. And that’s been helpful as well. I generated a plant list for local marshes and grasslands that I could use as a bit of perspective when I talk about what’s in our local area with the kids, because we do talk about wetlands. So that facet of it is invaluable. I think that is one of the most important elements that they ought to have. [MSSE Participant]*

*Well, the [NTEN course name] class was one of those where you were able to access data from the various sources to make spectra or plot spectra and analyze it and so on. I found that very interesting. I could also [make it] available to students if I could work something of that into my class. So from that point of view it was helpful. [Participant taking >4 courses]*

- ***Interviewed participants appeared to think about NTEN more in terms of providing content as opposed to teaching strategies, although several expressed appreciation for the opportunity to be exposed to a greater variety of instructional strategies.***

During interviews, participants were able to respond more readily to questions focusing on content. Questions about NTEN teaching strategies at times needed to be rephrased or participants needed more time to think before responding. For some participants, making a clear connection between teaching strategies used in their own classrooms and those used in an on-line setting was challenging. For example, one participant felt that the NTEN course audience, being teachers, necessarily led to different teaching strategies than what would be possible in a classroom with students.

*I don’t think my teaching strategy can be anywhere close to what [NTEN’s] was because of the people you were working with. First of all, they assumed that the person knew what they were doing, that they had some expertise in the class. When we teach, you have to go through everything from day one from scratch. When we get junior high kids,*

*some of them can't read. A few years ago some of these kids couldn't do long division. They don't even know how to put it on a calculator. So the teaching strategies have to be totally different. [Participant taking >4 courses]*

Another participant felt that “some of the strategies that were in [the NTEN] courses...naturally don't apply to a classroom where you are face to face with the students.” In particular, this participant felt the flexible and independent format of NTEN, while suitable for graduate level students who were motivated to learn, study, and generate discussion, was not practical for high school students who needed more traditional types of incentives to engage in learning, such as tests. From another participant's perspective:

*Well, [applicability of teaching strategies is] not as important as the content, but definitely very important. That is to the extent that I have been teaching a lot of years and I get pretty locked into my own strategies for reaching the kids. And if I can be exposed to fresh ones, which is at least one of the nice things about this kind of course is that you do. That is good. [Participant taking >4 courses]*

At the other end of the spectrum, three participants came to recognize the full extent of applicability of the teaching strategies they were exposed to through NTEN only after the course had ended. As two of these teachers reported:

*At the time I took this course [related to graphic calculators], I didn't realize that it was going to have an incredible impact on my career because the job that I was [recently] hired to do was—actually, one of the reasons that I was hired so quickly was because I had had the experience with graphing calculators. So a lot of what I saw, and what I did, and what I used in the course was applicable, after the fact. So I would take other NTEN courses that were courses I was interested in and not necessarily automatically assume that I was going to be able to use them in the classroom the next academic period. In other words, some of the work that I did this summer I will probably use for a long time. [Participant taking 1–2 courses]*

*In the case of my [NTEN subject matter] classes that had that fieldwork component, my math teaching partner and I have developed an entire unit based around field techniques that came from those ecology classes. I wouldn't have said at the onset that that was important, but it was at the end of the course and going through the course I realized how I could take this right into my classroom. So it was useful but I wouldn't have said at the beginning that it was an important component. [MSSE Participant]*

- ***Pointing to the many of the same factors contributing to an ideal NTEN experience, survey and interview data both provide insight into participant dissatisfaction with NTEN and why some participants chose not to complete courses.***

While the majority of study participants felt that they had a quality experience overall with NTEN, a variety of concerns were expressed. Participants with significant concerns chose not to finish a NTEN course; others may have chosen not to sign up again for another course in the future. It is important to understand why participants choose not to complete a course.

Table 6 shows the percent of respondents rating each of a number of factors a 4 or 5 on a five-point scale from 1 “not at all important” to 5 “very important,” in terms of its contribution to dropping out of a course. HRI also conducted a similar survey of dropouts in 1996; these results are shown for comparison.

**Table 6**  
**Respondents Rating Various Factors 4 or 5\***  
**in Their Decision Not to Complete a Course (N=90)**

<b>Factors for not completing NTEN Course</b>	<b>Percent</b>	
	<b>1996</b>	<b>1999</b>
Lack of time to complete course requirements	55	63
Technical difficulties other than those associated with connecting to MSUlink	N/A	19
Problems connecting to MSUlink	44	18
Lack of structure in the course (e.g., not clear about expectations, directions, deadlines, assignments, etc.)	11	17
Subject matter too challenging	14	14
Lack of interactions with instructor(s)	7	13
Too much structure in the course (e.g., lack of flexibility to explore topics of interest, too many deadlines)	7	12
Lack of relevancy/application to my teaching assignment	N/A	9
Lack of access to computers or the Internet at convenient times	N/A	8
Lack of quality interactions with other participants	7	6
Lack on interest in the subject matter	11	5
Not enough on-line interaction with other participants	7	3
Subject matter not challenging enough	0	1

\* Five-point scale ranging from 1 “not at all important” to 5 “very important.”

In 1999, as in 1996, the most important factor is clearly a lack of time. In 1996, HRI found a large overlap between the lack-of-time factor and the problems participants had connecting to MSUlink (in 1996, the system had a different name); i.e., some participants spent so much time resolving technical difficulties that they did not have adequate time to complete course requirements. In the time between the two surveys, the project appears largely to have resolved the issues with technical difficulties, meaning participants can spend more of their time learning subject matter.

Interview data support this finding. Several participants spoke about “electronic frustrations,” issues with technology and telecommunications that impacted their NTEN experience, but these were usually presented within the context of an improvement over time as NTEN worked through a variety of software and network server platforms:

*As the technology improved, the interaction between the classes, the professors, the teacher’s assistants, and of course students themselves and their peers has improved. It’s gone from a very, very rough, almost-impossible-to-get-on type system to one where the last class that I had was no problem at all. [Participant taking >4 courses]*



*I was very intimidated at first by [working on-line], but they made me feel comfortable very, very quickly. The improvement in the software really was the big thing. They were using [name of software] originally and it was very, very difficult to make any kind of—there was just no flow to it. And then the new program they used, the new e-mail program they used was very, very efficient. [Participant taking >4 courses]*

- ***Lack of interaction with instructors and lack of course structure were factors most strongly supported by interview data to account for participant dissatisfaction with NTEN courses.***

While course instructors were generally identified as contributing to a quality NTEN experience (by the majority of both interviewed participants and survey respondents), two participants in the interview sub-sample described a lack of interaction with instructors that led to dissatisfaction. From one participant's experience:

*The instructor was a professor but I spoke with him about once, kind of an introductory thing, and then the teaching assistant took over. And all the rest of the class, basically, I was dealing with a teaching assistant. And I didn't think that was right. [More than four courses participant]*

Another participant noted that the contrast in quality between the two NTEN courses she had taken hinged on the instructor. While finding the content of both courses inherently interesting, the instructors' presence in one course was almost non-existent while the other course offered a much richer instructor-student interaction. As the participant explained:

*My biggest objection [to one NTEN course] was that I never got any feedback from the instructor. And never once did I hear [about] my assignments, whether they were correct, what I needed to do better, or anything. I just got a grade which was a B. No justification. No comments or anything out of the course. The other course, however, I can't say enough good things about the instructor. He even picked the phone up and called me personally to say, "How are you doing? Do you need any help? What can I do for you? Anything?" He was willing to help you, which I felt was a personal touch that probably influenced me to take the course because it was only a 1 credit course...that one professor I felt was very concerned about his class and he got in there and gave not only a personal touch but every time you sent in an assignment you immediately got feedback on them. But he wasn't strict as far as deadlines, even though they were set. He eased his requirements and said "Okay, if you didn't get them in I'm not going to penalize you for it." Which I thought was very human. I think he realized that we are out here teaching as well as trying to take classes, so he added that element to it. [Participant taking 1–2 courses]*

Another participant felt that NTEN instructors who were not used to working outside of the university realm had a particular set of assumptions about secondary school teachers, such as the level of content knowledge they should have and the amount of time they should be able to commit to NTEN course work. Instructors' expectations were not always realistic given the diversity of teachers' educational backgrounds and school schedules and workloads.

Some participants reported that they had had a negative experience in their first on-line course which deterred them from further involvement with NTEN. One of these participants described the lack of participation from other teachers taking the class as being a main factor in his decision to withdraw from an NTEN course. As he explained:

*For the first three weeks, everything was running real smoothly and I found myself putting a lot of time in because it was a pleasure to do so. And then [other participants] stopped helping, stopped participating. It was just very frustrating for me and I found myself not finishing the class. [Participant taking 1–2 courses]*

A second participant experienced difficulties with an NTEN course that was at too advanced a level, and when he logged on to ask a question of the instructor after the course was over, did not feel “welcomed.”

Participants who had taken only one or two courses also identified a need for NTEN to more clearly outline course requirements in terms of workload and time expectations, assignment instructions, and course content. Some participants talked about the need to make course credit designations more accurately reflect the relative amount of work required. Others noted that they were surprised with the level of content provided in that it was too advanced given what they had expected from the course description. These individuals suggested that pre-requisites be listed for certain courses in the future. In some cases, a combination of advanced content and a time crunch proved overwhelming. As several participants commented:

*I think if you are going to take the course, you should know what they are getting into to. So kind of spell it out to teachers that this course deals with this. [Participant taking 1–2 courses]*

*I think on-line courses are great. I really do think there is a future for that. But people will have to be more careful than I was in what they choose. I think course descriptions are going to have to be written better than [the one I took] was. I think course descriptions, to make sure that people don't have a bad experience, are pretty important. Based on my experience I'd think twice about taking another course from the school I took the course from because I felt the course description didn't do a good job describing what I underwent. [Participant taking 1–2 courses]*

*[The NTEN course] really wasn't, in my opinion, geared toward teachers. It was geared toward engineers. And it really didn't apply to what I was doing and that's not what I expected...The content and the way assignments were handled, and the assignments that were given, they were definitely geared toward being an engineer instead of being a science teacher. [Participant taking >4 courses]*

*It was so time consuming, and it was only a two-credit course. I felt they needed to add more credits. You've really earned more credits than just two...[also] the aspect of not being so stringent with time and deadlines, particularly with teachers who are teaching. I teach a full load with four preps [and I'm the] technology coordinator and site manager. So in order to keep all of that going and take graduate courses on-line and*

*meeting the deadlines—it got very hectic. I'd like to see them ease that requirement.*  
[Participant taking 1–2 courses]

Repeat participants tended to describe such difficulties with course descriptions or requirements from a different perspective. Having taken multiple NTEN courses, they had the ability to place a given course along a continuum of experiences and see the possibilities for improvement given time.

*The weakest [NTEN course] probably was the [NTEN course name] and that was simply because it was the first time it was being offered. And I'd love to take that one again. They were just trying all sorts of different things and they had a tremendous amount of difficulty establishing criteria for the course and due dates. [The instructor] went way too far the other way as far as getting stuff in on time and how highly structured the course had to be. And I would think that that's a great course now. It was in its formative stages. Most of the others that I had taken had been going on for two or three years and they knew what they were doing.* [Participant taking >4 courses]

In terms of course offerings, 4 of the 20 participants interviewed noted that they felt NTEN needed to broaden the range of courses they offered. For example, two participants talked about the need for more secondary mathematics courses at the graduate level, and in particular, mathematics methods courses. Another participant talked about the need for more courses that addressed content at a level suitable for middle school and elementary school teachers (i.e., courses that did not require as much mathematics background). A fourth participant felt that courses which addressed a wider geographic emphasis were needed (i.e., NTEN needed to broaden its perspective out from Montana's mountain geography into other regions). One participant was deterred from taking more NTEN courses by the difficulty encountered trying to sign up for new offerings which were sold out almost instantaneously. This particular issue was echoed by others during the site visit interview.

Despite concerns with particular aspects of the NTEN experience, participants often worked through a less-than-desirable course, or put the memory of it to rest, with the expectation that a more fulfilling and positive experience could be had in the future. From the perspective of a repeat participant who took part in the study's observation sub-sample, the challenges presented to himself and other colleagues while taking NTEN courses could be surmounted. (See Vignette 2.) In the long-run, positive impacts on one's teaching practice made efforts to work through frustrations with time and technology worth it.

## Vignette 2

### Surmounting Challenges Presented by NTEN Courses

Mr. Green had some concerns with taking courses on-line. Foremost was the time that such courses required, particularly if you were not a proficient typist or technology savvy. As Mr. Green described, other colleagues in his middle school taking the NTEN courses had similar frustrations:

*I keep thinking about how much time I had to put in because [the courses] were on the computer. In taking the class you're learning computing and that was a real frustration. I work with people who quit who were frustrated. I think just because they got [annoyed] with the way things were. I felt the same sometimes because I was putting a lot of time into these courses...and that changed, but it still is a factor. I know I wouldn't pay for these classes. It's a lot of time. It's a lot of work. And some times I take something else because it's easier or quicker.*

Mr. Green, like his colleagues, felt that NTEN needed to more closely consider the amount of time required to take on-line courses. His persistence in sticking with NTEN, however, paid off. Having taken several NTEN courses, Mr. Green is now much more technically adept than he was at the onset of his on-line adventure. Learning how to integrate technology into his classroom, well ahead of others in his district, was also an advantage afforded him by NTEN:

*Getting on the computer and starting back when we did, in 1994 or whenever it was, this was all new. This technology was fairly new in education. It required the Internet and downloading and uploading information. This has made a big impact on me and in teaching because of the technology especially...because I'm sure that I use technology a lot more because of learning it in the NTEN classes. Learning where I could find resources [by] going onto the Internet more...[Without NTEN] I probably wouldn't use the Internet near as much as I do or e-mail, because if you don't learn it and have to use it, it becomes a hassle. It's second nature now, especially now that I have it in the classroom. Originally, I didn't.*

Part of Mr. Green's frustration early on in his NTEN career, was that he did not have access to the Internet in his classroom. While the school library had a connection, Mr. Green explained that "it wasn't any use to me because it wasn't easily accessible so anything that was Internet related, at first, it was out there, but I couldn't use it. But now, that's changed." For the last few years, Mr. Green has had access to one Internet-connected computer in his science classroom. The computer is hooked-up to a television monitor so all students can see what is on the screen. He reported that middle school science doesn't really use computers for data collection activities, but rather, for connecting to the information available on the Internet and for word processing and creating spreadsheets, and graphs. HRI observed Mr. Green's use of the Internet in his Earth Science class during the site visit. During the post-observation interview, Mr. Green reported that he integrates the Internet into his curriculum several times a week. Reflecting on the lesson HRI observed, he stated that, "definitely with the Earth Science [class], using the Internet for that, finding the site and figuring out how to use it in the classroom, that's definitely NTEN...my first exposure to it was taking the NTEN classes."

While Mr. Green recognizes a number of benefits NTEN has afforded his teaching practice, he still thinks about the time versus reward factor of taking NTEN courses:

*There have been some classes where I've looked at what was offered and what I had coming up and I thought, "I can't do this while I'm teaching." It's that intense sometimes that I can't commit the time I need to for the class and still do a good job teaching.*

As Mr. Green explained, NTEN courses are challenging, requiring more time than typical professional development offerings:

*[With NTEN,] you are required to think a lot more. You are required to do research. You are required to participate in tough discussions, all of that. Typically in the other professional development classes that I've taken have been quick workshops that you are there for long hours and they are more concerned about the amount of hours that you put in and the time that you are there. And I guess they are geared to be easier all the way around. Most of the time they are pass/fail classes that they don't have a lot of requirements. And the NTEN classes have been just the opposite. There have been a few pass/fail, but they've all had pretty tough requirements. Equivalent to actually going to university and sitting there and taking a class. They made sure that you had enough homework that you are putting in the specified amount of time for homework and then some.*

Mr. Green suggested that NTEN should consider offering courses of shorter duration than the typical 10 weeks. Despite the challenges the on-line format has presented him, however, he still thinks "it's a really good opportunity for teachers, having [NTEN] out there providing that, because not everyone can run all over the country and take classes. If you're isolated, this is perfect and you have the same opportunity as everyone else to access high-quality graduate and undergraduate level classes." Mr. Green believes that NTEN, given the competition it faces from the growing number of other universities offering on-line courses, will only continue to improve the distance-learning experience. "In the end," Mr. Green projected, "I hope it makes continuing education more accessible to everyone...resulting in a better educated population of teachers."

## C. NTEN as Part of a Wider Portfolio of Professional Development Experiences

Based on interview data, there is no doubt that NTEN has been a rewarding vehicle for participants' professional development. Below are just a few of the extremely positive comments participants had about their on-line professional development experience:

*I think it's the biggest jump in my professional career that I could have ever done. Economically, going back for a master's would have been more beneficial economically, but I think as far as knowing overall science, I think NTEN has given me a greater understanding of a lot more science than I could have ever gotten any place because I had to absorb it myself. I didn't have somebody lecturing to me. I had to go through and read it and do the activities and that's the best way to learn these things. Not sitting in front of a teacher. So I think it's been the greatest boost to my teaching ability than one single thing that I can think of in all my 28 years of teaching. [Participant taking >4 courses]*

*[NTEN] allows me continuous improvement. That's the most important aspect for me. I can continuously improve and learn new ideas, sharing. And of course learn new content. [MSSE Participant]*

*Just about every teacher has to take a certain number of courses. And I found [NTEN] an excellent vehicle for my professional development. It was accessible. It was rigorous. It was challenging, but yet it was very tuned into the needs of teachers. [Participant taking 1–2 courses]*

*All the [NTEN] classes that I've taken have added to my education. I think the more education I have, the more I can help my students. There are some things there that I am sure that I don't even notice that I probably am doing because of the NTEN classes that I've taken. [Participant taking >4 courses]*

*Honestly, it's been most of my professional development. There have been a few things locally here through the years that I've taught. NTEN has probably been about three-quarters if not more of my professional development. I am what I am today partly because of NTEN. [Participant taking >4 courses]*

- ***Fulfilling specific professional licensing requirements was the most common reason cited by participants for including NTEN in their professional development plans.***

Interviewed participants held a number of expectations when they signed up for NTEN courses, including enhancing their content background, gaining ideas for classroom activities, and improving their technology skills. By far the most commonly cited reason for seeking out NTEN courses, however, was to gain credit toward subject re-certification and/or for advancement on the salary scale. Having access to professional development on-line was particularly important to those individuals in more remote locations. Access combined with affordability was an irresistible combination as these participants outlined:

*It's been really good because I have to stay certified. Basically, I have taken the NTEN classes for a few reasons. Staying certified. Furthering my education. And last, but not least, I've gotten in on some quality classes that were pilot project and they were free. And to tell you the truth, I think every one I'd signed up for was a pilot because I couldn't afford to pay the whole amount for these classes. So that was good. So that has helped me a lot because I have been able to keep up and further my education in combination with other workshops that I've taken...Locally, sometimes I've had to drive a ways to take classes. The nearest university is over 40 miles away. I've driven up to 100 miles to take classes. So this fits in nicely because I've picked up five different classes at low cost and I haven't had to travel. [Participant taking >4 courses]*

*It's been satisfying my graduate hours. Where I am located, they don't offer graduate math classes. I'm located in a college town, but...they offer other programs, but no math. So if you want to work on a master's, or work on requirements to be adjunct at a community college, you need some graduate hours. So in my case, I would have had to travel 60 miles to have gotten a course and they are being taught at those times that are not really suitable for me. So an on-line course or correspondence course is the only way right now that I can actually fulfill a requirement to be re-certified by getting more hours, or by extending what I want to do and get graduate credit and work up hours possible towards a master's. [Participant taking 1–2 courses]*

➤ ***Participants identified a number of positive aspects and advantages in choosing NTEN as a professional development vehicle as compared to other options.***

Below is a list of advantages cited by participants for taking NTEN courses:

- ⌘ Allows you to work on a flexible schedule—time and location wise;
- ⌘ Provides a more substantive content focus;
- ⌘ Offers a wide range of course options, many of which are practical in nature;
- ⌘ Offers courses that are longer in length than typical in-services;
- ⌘ Engages you at a higher or more in-depth level;
- ⌘ Provides a link with educators across the country;
- ⌘ Presents excellent course materials; and
- ⌘ Provides an affordable option for professional development.

Participants' comments comparing NTEN to other experiences provide further insight into the advantages listed above.

*It was wonderful. The ability to do it when I had energy, not at the end of the day or on a weekend. At a time when I was ready to look at the material and do it and communicate with people was wonderful. One of the things about [typical] professional development that is very difficult—there isn't an appropriate time to gather a crowd of people together. [Participant taking 1–2 courses]*

*Well, the other ones mostly involved in-service days which are pretty much a waste of time, I consider. So [NTEN] is like light years ahead of that. Basically when I think about professional development things as being helpful, I want to come away with something that I can find useful. Either as an attitude or a concept or actually activities and so on...and basically all of the [NTEN] courses that I have taken I've always come away with something that is either directly or in some way been useful to me in the classroom. [Participant taking >4 courses]*

*Well, most of the professional development I've had beyond my graduate work was in-services and workshops. And if I were to rate a typical workshop I've been to on a scale of 1–10 they'd be somewhere between a two and three for the most part. And NTEN would be somewhere between a 20 and 30. I really thoroughly enjoyed the NTEN program because there was a lot of good expertise that was applied. There was a lot of classroom application. I never felt like I was sitting in a box listening to somebody tell me how I ought to teach. [Participant taking >4 courses]*

*Probably, of all the experiences I've ever had including workshops and seminars, I learned more from NTEN because it was more professionally based rather than just feely, touchy, feel-good hands-on things...[NTEN] was a total package. It wasn't just a little piece of the puzzle. That's what you get when you go to the seminars, you just get a little tiny bit here and a little tiny bit there. And it's probably the most expensive little tiny bit that any body in education ever made. [Participant taking >4 courses]*

*[NTEN] is comparable to college coursework that I've taken...It's legions ahead of a lot of the seminars and in-service that I have to go to. So it's invaluable...It's more content driven. It's more in depth...I even suspect there's as much idea gathering and sharing on the course work that you do over the Internet than even in a seminar. [MSSE Participant]*

➤ ***Participants who had taken multiple NTEN courses discovered additional benefits of choosing on-line courses as a professional development vehicle.***

Participants who had taken more than four NTEN courses were also those who commented most frequently on the benefits of the extended length of an on-line course, and the depth of learning possible, in comparison to shorter in-service offerings. As two MSSE participants noted:

*[NTEN] was by far the best I think...I usually go to a workshop or two during the year or summer and even though they are good, most of them, maybe they don't have the continued strength because I've taken NTEN classes now for a number of years. [MSSE Participant]*

*[NTEN] has probably been the best because it's been ongoing.* [MSSE Participant]

In contrast, two participants who had participated in only one or two courses commented on NTEN from the perspective of what it was not able to offer in terms of a professional development experience. One talked about NTEN as focusing on content rather than pedagogy, commenting:

*When I think of professional development I think of some of the in-service training we've had...[NTEN] really wasn't a course that helped me to develop my outlook on teaching per se. It was more of a concentrated effort to gain [content] knowledge.* [Participant taking 1–2 courses]

A second individual felt that more traditional professional development, off-line, allowed for “greater growth” because it allows for instantaneous discussion among participants rather than an asynchronous experience.

➤ ***Participants identified a number of impacts on their teaching and professional life that would not have been possible without NTEN.***

When asked about how their professional development life would be different without NTEN, participants again spoke plainly about the advantages of these on-line courses (e.g., convenience, practical and relevant content, affordability). One participant talked specifically about gaining connections to other teachers:

*I wouldn't know what I was missing out on with the networking with the other teachers. It's just been very enriching.* [MSSE Participant]

Others spoke about the high-quality instruction they received on-line, a level of quality they hadn't experienced outside of NTEN. In the words of one participant:

*I'd be more satisfied with what is going on in professional development now had I not participated in NTEN where I found out that so much more is possible.* [Participant taking 1–2 courses]

A quarter of the participants interviewed, mostly repeat participants, declared that without NTEN they would not have experienced a particular impact on their classroom teaching. Impacts discussed by these participants included: gaining depth in content and the ability to integrate it into practice, accelerating the process of development and change in the classroom in general, and using image processing. For another participant, NTEN afforded the opportunity to use the Internet in a concrete and educational way.

*[Without NTEN] it would lessen [my] use of the Internet. It's opportunities like [NTEN] that make the Internet useful. I don't believe I'd look at the Internet the same way. I think the Internet is made more powerful by opportunities that NTEN gives us to use.* [Participant taking 1–2 courses]



All participants in the MSSE program stated that they would not have pursued a master's degree if NTEN did not exist. One participant identified her NTEN experience as the catalyst for involvement in the MSSE.

*I wouldn't have ever heard of the MSSE program if it wouldn't have been for NTEN. I probably wouldn't have given it much thought because two-thirds of that program is Internet based. And because I'd had such a positive experience with those two or three NTEN classes that I had taken, I was eager to participate in a program that most of it was based on that same sort of format. [MSSE Participant]*

Three other, non-MSSE, participants also found NTEN an excellent avenue for pursuing graduate level credits, one of whom is now in the process of applying for the MSSE program. This participant's journey in making the decision to pursue a graduate degree through NTEN is documented in Vignette 3. Critical to her decisionmaking process was the influence of other colleagues who had obtained their Master's degrees through distance-learning programs. The identification of a number of positive elements of the NTEN learning environment during the two courses she has taken to date was also influential.

### Vignette 3

#### Choosing to Pursue a Graduate Experience On-line

Ms. Hall has observed first-hand the process of gaining an advanced degree through the on-line format. Having watched two of her colleagues pursue Master's degrees from distance-learning providers, she is now investigating this possibility for herself. Ms. Hall first became involved with NTEN because a colleague in her department shared information about NTEN and her own experiences in the MSSE program with fellow faculty. Intrigued, Ms. Hall and another teacher then signed up for NTEN courses. While Ms. Hall did not take any courses concurrent with her colleagues, she did gain a sense that others also found the convenience of the on-line format of primary benefit given teachers' schedules.

Talking further about the MSSE program with her colleague allowed Ms. Hall to broaden her perspective on the feasibility of pursuing a graduate degree. As she explained to HRI:

*A colleague of mine just finished the Master's program through NTEN and Montana State. And it's a program that fits into my teaching schedule and my workload and where I live very well because my opportunities for getting a Master's degree here in [city name] in an area that I am interested in are not very good without me taking a year off and going some place to do it. And so, this program is very convenient for me and it allows me to keep working while I am going through the program. And that's a huge burden off your shoulder when you can continue to work and then work on your degree at the same time.*

As Ms. Hall describes, having the opportunity to pursue further training in science was also an important factor in her decision to choose NTEN as a vehicle for her professional development:

*I would have to say a lot of the in-service classes that I've had and a lot of the other graduate classes that I've been involved in, I think NTEN is one of the best situations that I've dealt with as far as post-graduate education is concerned. I'm just really impressed with it...I think first off, it's in an area that I am interested in. Sometimes you wind up taking classes just because you need credits and there isn't anything else to take. But in this particular situation there are science classes. That's my field. That's what I'm interested in. They offer that. And so, that's probably the main reason why I think it's been such a good experience for me because it is directly related to the area that I am interested in.*

Interest was expressed by a few individuals for NTEN to consider offering a Ph.D. program on-line as well. For some participants, NTEN appears to have increased their awareness of general options for professional development on-line.

- *The majority of participants have, or would like to have, future professional development plans with NTEN.*

Fourteen of the 20 participants interviewed would take another NTEN course if a topic of personal interest, or one that suited their classroom needs, was offered. Many of these individuals reported that they have already taken most, if not all, of the courses NTEN offers in their particular field. Of the remaining 6 participants, 2 would consider taking another NTEN course if they could find the time, 3 are currently taking or are signed up for another NTEN class, and 1 is not interested in more professional development of any sort as he is nearing retirement. Cost was mentioned by three participants as a possible prohibitive factor in taking additional NTEN courses (even though their interest in doing so was high), particularly if they had already “maxed out” on the pilot course allowance.<sup>9</sup>

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<sup>9</sup> Some NTEN courses are subsidized and are essentially free to participants. Others cost roughly \$100 per credit. Participants are allowed to take only a limited number of subsidized courses.

## IV. CONCLUSIONS

Overall, study findings confirm the hypothesis that as participants take more NTEN courses they increase their knowledge of science content and make changes in their instruction. Participants who take multiple NTEN courses are more likely to report positive impacts in four main areas:

- ∞ Connectedness to other teachers;
- ∞ Range of teaching strategies;
- ∞ Enthusiasm for teaching; and
- ∞ Content knowledge.

Given the diversity of study participants in terms of their geographic location, teaching situation, available resources, and prior experiences, the cumulative impact of NTEN course taking seems generalizable. Participants located in particularly remote communities tended to attach more importance to certain impacts, however.

Below, specific impacts identified by this study are placed in one of two categories: general impacts or cumulative impacts. In the first category, impacts reported by the majority of study participants are listed. These impacts were in evidence regardless of the number of courses taken. Under the cumulative heading, impacts that were most frequently reported by those who had taken more than four NTEN courses are identified.

### A. General Impacts

- The greatest impact of the NTEN experience on participants' pedagogy was related to technology, in general; and use of the Internet, in particular.
- The majority of participants gained ideas for new projects or avenues to extend investigations on a particular topic through NTEN. Exposure to a variety of websites was a common factor across courses that attributed to impact in this area.
- NTEN had an influence on participants' use of lecture by either: (1) providing new content to enhance this teaching strategy, or (2) introducing alternative teaching strategies whose use in turn decreased the amount of time spent on lecture.
- Regardless of number of courses taken, NTEN did not generally have an impact on participants' use of discussion, group/collaborative work, or fieldwork. These strategies tended to be ones participants either used regularly prior to their participation in NTEN or had chosen not to use for specific reasons.

- Taking an NTEN course contributes to an increase in one's content knowledge. Expanded knowledge, for many participants, led to changes in the content they presented in their classrooms.
- Required use of the Internet in many NTEN courses provided the necessary motivation and skills through which participants could obtain new content knowledge.
- Opportunity to gain access to other educators on-line was of particular importance to those in more isolated teaching situations.

## **B. Cumulative Impacts**

- Participants who had taken multiple NTEN courses reported the most interaction with other teachers on-line. Some interactions developed into lasting professional connections.
- Making connections with other teachers on-line provided a unique avenue for participants to reflect on their own practice. Those who repeatedly returned to the NTEN environment indicated the greatest growth in terms of their ability to be reflective practitioners.
- Participants who had taken a number of different NTEN courses provided the most concrete evidence of impact on their use of computers. Experienced NTEN participants are using computers in new ways and finding a variety of avenues through which to incorporate this technology into their teaching.
- Increased use of real data in the classroom was typically attributed by participants to the technology-based knowledge and skills they gained through NTEN. This impact was reported most frequently by those who had taken more than four courses.
- Impact of NTEN on the use of hands-on and exploratory type activities was most evident in those participants who had taken multiple NTEN courses.
- Taking more than four NTEN courses can rejuvenate teachers in a number of different ways, including: boosting confidence level in the subject they teach and classroom strategies they employ; providing avenues for new explorations; creating excitement to try new things in the classroom; and affording the chance to follow-up on areas of personal interest.
- Participants with experience taking multiple NTEN courses described broader changes in their content knowledge compared to those who had taken only one or two courses (e.g., implementing a whole new content unit versus gaining some up-to-date knowledge to add to a particular lecture). For repeat participants, increased depth of content knowledge was often linked to a change in accuracy of content delivered.
- The MSSE experience appeared to have a greater overall impact on participants' classroom teaching strategies than did the NTEN courses.

Across study participants, satisfaction with the NTEN experience was high. Participants identified a number of different factors, such as interaction with course instructors and a coherent course structure, that contributed to a quality experience. Many of these same factors, however, were also identified by others as elements that could detract from participant satisfaction (i.e., low level of interaction with course instructors, lack of coherence in course structure). In general, participants felt more comfortable thinking about NTEN in terms of providing content as opposed to teaching strategies. Interviewed participants had diverse views about whether NTEN courses should be directly applicable to their own teaching situation in terms of pedagogy.

NTEN was typically considered a positive part of participants' portfolio of professional development experiences. Fulfilling specific professional licensing requirements was the most common reason cited for including NTEN as part of one's professional development plans. Participants identified a number of advantages in choosing NTEN as a learning vehicle as opposed to other available options, including: flexibility, strong content focus, practicality of course offerings, and networking potential. Participants noted a number of specific impacts on their teaching and professional life that would not have been possible without the benefit of their NTEN experiences. The majority of participants have, or would like to have, future professional development plans with NTEN.

# Appendix

## National Teacher Enhancement Network (NTEN) Participant Questionnaire

**Instructions:** Only group results will be reported from this questionnaire, and all responses will be kept confidential, so please be candid.

1. The National Teacher Enhancement Network (NTEN) at Montana State University has been providing on-line courses since 1993. Since 1993, how many *science and mathematics* courses have you *completed through NTEN*? Please do not include education courses offered as part of the Master of Science in Science Education (MSSE) program.

\_\_\_\_\_

2. During the 1999-2000 school year, are you teaching science in any of grades K-12?

Yes (continue with question 3)

No (skip to question 4)

3. About how often do your science students do each of the following? Select one on each line. (We realize your science teaching may vary based on the type of science class and the particular group of students. Please base your answer on a “typical” science class.)

STATEMENT	Never	Once a semester	Once a month	Once a week	2 or 3	Daily
					times a week	
a. Listen to a lecture by the teacher.	1	2	3	4	5	6
b. Participate in a class discussion where the teacher primarily facilitates.	1	2	3	4	5	6
c. Work in cooperative learning groups.	1	2	3	4	5	6
d. Make formal presentations to the class.	1	2	3	4	5	6
e. Read from a science textbook in class.	1	2	3	4	5	6
f. Answer textbook/worksheet questions.	1	2	3	4	5	6
g. Work on solving a real-world problem.	1	2	3	4	5	6
h. Share ideas or solve problems with each other in small groups.	1	2	3	4	5	6
i. Engage in hands-on science activities.	1	2	3	4	5	6
j. Follow prescribed steps in an activity or investigation.	1	2	3	4	5	6
k. Design or implement their <i>own</i> investigation.	1	2	3	4	5	6
l. Work on models or simulations.	1	2	3	4	5	6
m. Work on extended science investigations or projects ( a week or more in duration).	1	2	3	4	5	6
n. Participate in field work.	1	2	3	4	5	6
o. Record, represent, and/or analyze data.	1	2	3	4	5	6
p. Retrieve and use existing data and/or images (e.g., from the Internet) in an investigation	1	2	3	4	5	6
q. Write reflections in a notebook or journal.	1	2	3	4	5	6
r. Prepare written science reports.	1	2	3	4	5	6
s. Use computers.	1	2	3	4	5	6

4. Considering the cumulative impact of all your NTEN courses, please rate the extent to which each of the following occurred.

STATEMENT	N/A	Not at all									To a great extent
		1	2	3	4	5	6	7	8	9	
a. increased my knowledge of subject matter content	0	1	2	3	4	5	6	7	8	9	10
b. furthered my knowledge of resources for my teaching	0	1	2	3	4	5	6	7	8	9	10
c. expanded the range of teaching strategies I use	0	1	2	3	4	5	6	7	8	9	10
d. gave me the content knowledge to teach courses I was previously unprepared to teach	0	1	2	3	4	5	6	7	8	9	10
e. renewed my enthusiasm for teaching	0										
f. initiated conversations with teachers around the nation that continued beyond the course(s)	0	1	2	3	4	5	6	7	8	9	10
g. learned about telecommunications	0	1	2	3	4	5	6	7	8	9	10
h. became an active user of the Internet/World Wide Web	0	1	2	3	4	5	6	7	8	9	10

5. Again considering the cumulative impact of all your NTEN courses, please describe the single greatest impact on you.

6. Have you ever decided not to complete an NTEN course for which you registered?

Yes (continue with question 7)

No (skip to question 9)

7. How important was each of the following factors in your decision not to complete an NTEN course?

STATEMENT	Not at all		Somewhat		Very
	<u>important</u>		<u>important</u>		<u>important</u>
a. Lack of time to complete course requirements	1	2	3	4	5
b. Problems connecting to MSUlink	1	2	3	4	5
c. Technical difficulties other than those associated with connecting to MSUlink					
d. Lack of structure in the course (e.g., not clear about expectations, direction, deadlines, assignments, etc.)	1	2	3	4	5
e. Too much structure in the course (e.g., lack of flexibility to explore topics of interest, too many deadlines)	1	2	3	4	5
f. Lack of access to computers or the Internet at convenient times	1	2	3	4	5
g. Not enough on-line interaction with other participants	1	2	3	4	5
h. Lack of relevancy/application to my teaching assignment	1	2	3	4	5



STATEMENT	Not at all <u>important</u>		Somewhat <u>important</u>		Very <u>important</u>
a. Lack of quality interactions with other participants	1	2	3	4	5
b. Lack of interaction with instructor(s)					
c. Lack of interest in the subject matter	1	2	3	4	5
d. Subject matter too challenging	1	2	3	4	5
e. Subject matter not challenging enough	1	2	3	4	5
f. Other (please specify): _____	1	2	3	4	5

8. Responses to question 7 will give us quantitative data on reasons why you chose not to complete a course, but we'd really like to know "the rest of the story." Please explain in your own words why you decided not to complete an NTEN course.

### Demographics

9. Are you involved in, or a graduate of, the Master of Science in Science Education (MSSE) program?

Yes

No

10. Please indicate your race/ethnicity.

- American Indian or Alaska Native 1
- Asian 2
- Black or African American 3
- Hispanic or Latino 4
- Native Hawaiian or Other Pacific Islander 5
- White 6

11. Indicate your gender.

Male

Female

12. What grades are you teaching this year? Select all that apply.

Not currently teaching    K    1    2    3    4    5    6    7    8    9    10    11    12    college

13. Which of the following types of classes are you teaching this year? Darken all that apply.

Not currently teaching

Physical Science

Physics

Chemistry

Mathematics

Life Science/Biology

General or integrated science

Earth/Space Science

Other (please specify): \_\_\_\_\_

## **NTEN LONG-TERM IMPACT STUDY Spring 2000 Phone Interview Protocol**

Introduction: Thank you for choosing to talk with me over the phone about your experiences with NTEN. As you know, I work for Horizon Research, the external evaluator for the NTEN project. In our role as external evaluator, HRI collects data from NTEN course participants, through questionnaires and interviews, to give NTEN feedback on what is working well in the project, and what could work better. This spring, we are conducting phone interviews with a number of teachers who have taken NTEN courses over the past few years to discuss any impact their involvement with NTEN may have had on their teaching. Please know that our conversation today will be confidential. When HRI provides feedback to the NTEN project, we compile all of the information gathered from all of the interviews we conduct and report the results without identifying any specific individuals. Do you have any questions before we begin? Do you have any objection to my taping this discussion?

1. I'd like to start by getting a sense of your teaching situation this year.  
PROBES: What grades/subjects do you teach?  
What classes are you teaching this year?  
How is the schedule structured for your science classes (i.e., any longer lab periods during the week)?
  
2. Let's move onto your overall experiences with NTEN. In general, how would you describe your experience with NTEN?  
PROBES: When did you begin taking courses?  
Courses taken?  
Quality of experience?
  
3. Based on your experience taking on-line courses, what would you consider to be the elements of an ideal NTEN course?  
PROBES: How important is it to you that course content be directly applicable to your teaching situation? (grade level/regionally appropriate)  
Some courses have emphasized fieldwork, others data collection or using real data, for example,...how important is it to you that the teaching strategies presented in courses be directly applicable to your own teaching situation? (resources available, kinds of students you teach, location)
  
4. a) How does your NTEN experience fit into your overall professional development plans?  
b) How does NTEN compare to your other professional development experiences? (probe for differences)  
c) How do you see NTEN fitting into your plans for the future in terms of your teaching and professional development?

5. What impacts, if any, have NTEN courses had on your teaching?

PROBES: a) Content you teach

Are you teaching different content than you used to? If so, how is it different?

In terms of the accuracy of content delivered, do you feel there have been any changes in this aspect of your teaching?

Has your knowledge of available science teaching resources increased? If so, how?

Do you feel up-to-date on current science issues? If so, how has NTEN helped you achieve this?

b) Teaching Strategies

We are also trying to find out about any impacts NTEN has had on how you teach. How has your experience with NTEN affected your science teaching? Please describe.

PROBES: I'm going to mention a number of teaching strategies, and I'd like you to comment on the impact, if any, NTEN has had on each (\*probe for pre/post perspective on impacts):

Group work/collaborative work

Discussion

Field work

Long-term projects/extended science investigations

Collecting/using real data

Hands-on/laboratory activities

Use of computers

Use of Internet

Use of lecture

Other

6. What impact has NTEN had on your interactions with other teaching professionals and feeling of "connectedness" to a wider education community?

PROBES: Did you interact with course participants/instructors outside of the class discussions? If so, how?

Have any of these interactions continued once an NTEN course had ended?

Are there any impacts on your science teaching that you can attribute to your interactions with other teaching professionals through NTEN?

7. How would your teaching/professional development life be different if NTEN did not exist?

8. Before we conclude our interview, I have a quick series of demographic-type questions for you.

Where do you teach? (Rural/urban/suburban)

Describe school (re: location, size, grades taught, resources – esp technology)

Student body (Socio-economic status, race/ethnicity) vs. students you teach

How long have you been teaching?

How long have you been teaching at this school?

Are you enrolled in the MSSE program at Montana State?

9. Are there any other comments you would like to make about your experiences with NTEN?

## NTEN SITE VISIT INTERVIEW PROTOCOL Spring 2000

Introduction: As you know, I work for Horizon Research, the external evaluator for the NTEN project. This spring, we have been conducting a series of phone interviews and site visits with teachers who have taken NTEN courses over the past few years to discuss the impact NTEN has had on their teaching. The site visits are an important part of our data collection, and I'd like to thank you for agreeing to have me come and spend the day with you. I'd like you to know that the information HRI compiles from site visit observations and interviews with teachers is kept confidential. The project does not know who we are visiting or who we have interviewed over the telephone, and when HRI provides feedback to NTEN we do not identify any specific individuals or schools in our reports. Please also know that our focus is on the NTEN project as a whole and not on individual teachers and their classrooms. We are not evaluating you or your teaching, but rather, are interested in learning more about your teaching practice in regard to your NTEN experience. Do you have any questions before we begin? Do you have any objection to my taping this discussion?

1. I'd like to start by getting a sense of where this lesson(s) fits into the unit(s).  
PROBES: What came before this lesson?  
What is going to come next?  
What were you hoping the students would get out of this lesson?
2. How typical was [Y class] of your instruction? For example, I noticed that you used [X strategy]...  
PROBES: extent of use of various strategies observed in class(es)  
extent of use of various strategies across subjects/grades (if applicable)  
other strategies typically used
3. Were any aspects of the lesson(s) you presented today drawn from your NTEN experiences (probe for content, strategies, other)? Please describe.
4. Can you describe any other lessons or units in your science class(es) where you have *been able to incorporate your NTEN experiences? (ask for artifacts – lesson plans, handouts, etc... illustrating any impact described – use return envelope)*  
PROBE/REPHRASING:  
Is there anything that you do now that you wouldn't have done before taking NTEN courses?
5. Thinking back to when you began taking NTEN courses, what did you hope to gain from your involvement? Do you feel you have gained [this]?  
PROBE: Did you have any expectations for impact on your classroom teaching? Where these expectations met? If so, how? If not, why not?  
[If applicable: Did you notice any difference in your experience when you took a course alone versus when you took it along with someone else at your school?]

6. Has anything particularly helped, or hindered, your ability to apply any aspects of your NTEN experiences to your own classroom practice? Please describe.
- PROBES:     resources (esp technology)  
              other
7. (a) In our on-line course questionnaires we often ask people to respond to questions with *discrete ratings and numbers (e.g. on a scale of 1-5, how would you rate....)*. If you've completed our questionnaires in the past, the following question may sound familiar, but by interviewing participants we get the chance to hear what these ratings mean in words. Based on your experiences with NTEN, do you think these on-line courses are designed with teachers in mind? What leads you to think this?
- (b) Thinking about NTEN in terms of how it can best help you, as a teacher, do you have any *suggestions for improving on-line courses of this type, or the on-line experience in general, in the future?*
8. Thinking of the cumulative impact of all your NTEN courses, what do you think the single greatest impact has been on you?
9. Are there any other comments you would like to make about any aspect of your experience with NTEN?