

Ala Wai Watershed Inquiry Workshop (2001) Evaluation

**Respectfully submitted by Robert E Landsman, Ph.D.,
March 13, 2002**

**ANOVA Science Education Consulting
615 Kuliouou Place
Honolulu, HI 96821**

The Ala Wai Watershed Inquiry (AWI) teacher-development workshop consisted of eight daylong meetings spanning the period between March 1, 2001 and May 12, 2001. This workshop served as one in a series of workshops designed to equip teachers with skills necessary to promote inquiry and critical thinking in their classrooms. The main purpose of the AWI Workshop was to strengthen teacher confidence and skills in standards-based teaching through inquiry, problem solving, and critical thinking centered on the concepts of the watershed and environmental stewardship. Specifically, the AWI was designed to address the concept of watershed stewardship in relationship to the Ala Wai Canal, to assist teachers in understanding how to use the Hawaii State Content Standards and Benchmarks in designing their curricula, to promote the understanding and use of the inquiry process in science and other fields of middle school education for addressing the content standards, to begin to increase teachers' understanding of how to develop critical thinking skills in students, and to encourage the use of the scientific research investigation to broaden the approach and scope of the current science curriculum used by teachers.

In addition to the goals mentioned above, the AWI Workshop was also designed to strengthen those teacher communication skills necessary to successfully engage in learning through inquiry. Teachers were required to deliver a group oral presentation of their groups' research investigations that were conducted over the course of the workshop. They were also required to submit a written research report of this investigation. Finally, teacher-participants were required to develop and submit a written outline of a plan for an inquiry, standards-based unit for future implementation in their classrooms. The workshop content was supported by the expertise of an Environmental Education Specialist, a Resource Teacher, three professional scientists (including two Environmental Biologists and a Neuroscientist/Science Research Education Specialist), and two spokespersons for the Ala Wai Watershed Association.

Teacher Demographics

Seven middle school teachers of science, social studies, math, english, and physical education participated in the workshop. Six of the teachers were from Stevenson Middle School and one was from Jarrett Middle School. The teachers spanned a wide range of ages and had 3 to 30 years of experience in the DOE system.

Assessment and Evaluation Techniques for the Workshop

The seven teacher-participants were asked to complete an attitude and knowledge Workshop Assessment prior to their participating in the workshop (Pre-Workshop Assessment), during their participation midway through the workshop (Day 4, Mid-Workshop Assessment), and following their participation in the workshop (Post-Workshop Assessment). Self-reported confidence items required teachers to place a vertical line on an 18 cm scale. These responses were then measured and quantified for

data analyses. Teachers were also asked to write occasional “temperature checks” and a “reflection” following each workshop. A brief questionnaire was given to the teachers after they engaged in research scenarios designed to provide them with experience and practice to select and use the correct research tools for testing particular hypotheses about Ala Wai Canal water. The questionnaire was used to assess the effectiveness of using this method of simulated research scenarios to increase teacher confidence in their understanding and ability to teach the process to others. Teacher and Program Expectation Surveys were administered to the seven teachers at the end of the workshop program to determine if, and to what extent, the original goals and expectations of the teachers and workshop program plan were addressed. Finally, a DOE-mandated PD-Credit Evaluation was filled out by each teacher to determine the extent to which the Elements of Professional Development were met by the AWI Workshop.

AWI Program Evaluation Methods

Teacher reflection and “temperature check” comments were placed into categories based on whether they addressed the workshop in general; Ala Wai Watershed, watersheds in general, and environmental stewardship; scientific inquiry and the research investigation process; or standards-based education, including content standards and the standards-based unit. (Note that all teacher comments are quoted exactly as expressed, but may include additions by the evaluator, indicated with brackets, for clarity.) The comments were then used, where appropriate, to support and clarify quantitative data from the Pre-, Mid-, and Post-Workshop Assessments, Program and Teacher Expectation Surveys, and PD-Credit Evaluations.

The data from the items in the Workshop Assessments (Pre-, Mid, and Post-Workshop Assessment), were summarized and graphed. Where appropriate, one-way ANOVAs with repeated measures were used to determine differences between the pre-, mid-, and post-workshop data. When the results were statistically significant, Neuman-Keuls multiple comparison tests were used to determine differences between pairs of means. The Teacher and Program Expectation Surveys used Likert-scale items requiring the teacher-participants to decide whether various expectations were not at all addressed, somewhat addressed, or completely addressed in the workshop. The data from these surveys were summarized and graphed as percent to determine the extent to which teachers felt that the expectations were met. Items from the research scenario questionnaires were analyzed using the dependent *t*-test. The PD-Credit Evaluation consisted of 10 elements of Quality Professional Development arranged as a Likert-like scale. The evaluation scale for each element ranged from 1=does not meet the standard, 2=partly meets the standard, 3=meets the standard, 4=more than meets the standard, to 5=meets the standard to a high degree. Teacher participant data from the PD-Credit Evaluation were summarized using the mean and range for each item.

Evaluation Overview and Summary of Findings

This evaluation focuses on the impact of the AWI workshop on enhancement of teacher confidence and knowledge in engaging students in standards-based learning about environmental stewardship through scientific inquiry. To this end, the evaluation specifically examines teacher-participant understanding of, and confidence in teaching about and/or through, the concepts of watershed and environmental stewardship, scientific inquiry and the research investigation process, and content standards and standards-based units.

General comments gathered from teacher reflections and “temperature checks,” as well as quantitative data from assessments, surveys, and evaluations indicate that the workshop engaged teachers in a successful professional development experience.

The major findings in this evaluation are that participation in the AWI Workshop resulted in overall increases in both teacher knowledge about, and teacher confidence to use in their teaching 1) the Ala Wai Watershed and environmental stewardship, 2) scientific inquiry and the research investigation process, and 3) content standards and standards-based units. General teacher-participant reflection comments made at the end of the workshop support the quantitative data obtained from assessments and surveys, indicating a gain in knowledge in the three focal areas of the workshop (see Tables 1-3 below).

Table 1. Teacher-participant general statements about the Ala Wai Watershed and environmental stewardship.

<i>“This workshop was completely successful at addressing the Ala Wai Watershed. It brought in speakers, provided background information, and involved us in doing field studies and our own research study on the Ala Wai.” - Teacher #5</i>
<i>“Learning about the Ala Wai Watershed was quite eye opening.”- Teacher #7</i>
<i>“For so many years I drove past the Ala Wai Canal and never knew its needs and dilemma.”</i>

Table 2. Teacher-participant general statements about Scientific Inquiry and the Research Investigation Process.

<i>"My knowledge/understanding of research design is refined because of this workshop." - Teacher #1</i>
<i>"I will definitely be able to use the research process in all of my classes." - Teacher #2</i>
<i>"I now know how to use the research investigation process." - Teacher #3</i>
<i>"Now I have some ideas of how I can use scientific inquiry in my math, language arts, and health classes. I am excited about teaching scientific inquiry."</i>
<i>"I understand the research process better than I did in college!"</i>
<i>"This workshop did well in helping the teachers to learn and to understand each step of the process in doing [a] research investigation." - Teacher #4</i>
<i>"I became acquainted with some of the tools scientists use in their investigations and the sequence of steps within the research investigation process." - Teacher #6</i>
<i>"I am grateful for this workshop for it has challenged me to expand my knowledge of inquiry process and the skills needed... ." - Teacher #7</i>
<i>"Research Investigation provides the teacher with an awesome instructional tool to help implement standards-based learning and support the emphasis on what is learned rather than what is taught."</i>

Table 3. Teacher-participant general statements about Standards and the Standards-Based Unit.

<i>"I finally understand what content standards, benchmarks, performance indicators, and performance standards are! It took this program to finally make sense of all of these terms." - Teacher #4</i>
<i>"I gained the following as a teacher from this workshop: Looking at standards and attempting to write performance indicators." - Teacher #5</i>
<i>"This area [of the workshop] really helped to relate the scientific process and the standards in my mind." - Teacher #7</i>

“I now fully understand and appreciate how engaging students in research can address a number of the HCPS II... .”

As teacher knowledge increased, so did overall teacher-participant confidence in the areas covered in the workshop, as indicated by the teachers’ self-reported confidence level in the accurateness of their responses on the Workshop Assessment questions (Figure 1). By the end of the workshop, general teacher confidence in understanding and being able to apply the concepts covered in the workshop more than doubled to a level above “confident,” which was a statistically significant increase over the substantially below “confident” level exhibited by teachers prior to participating in the workshop.

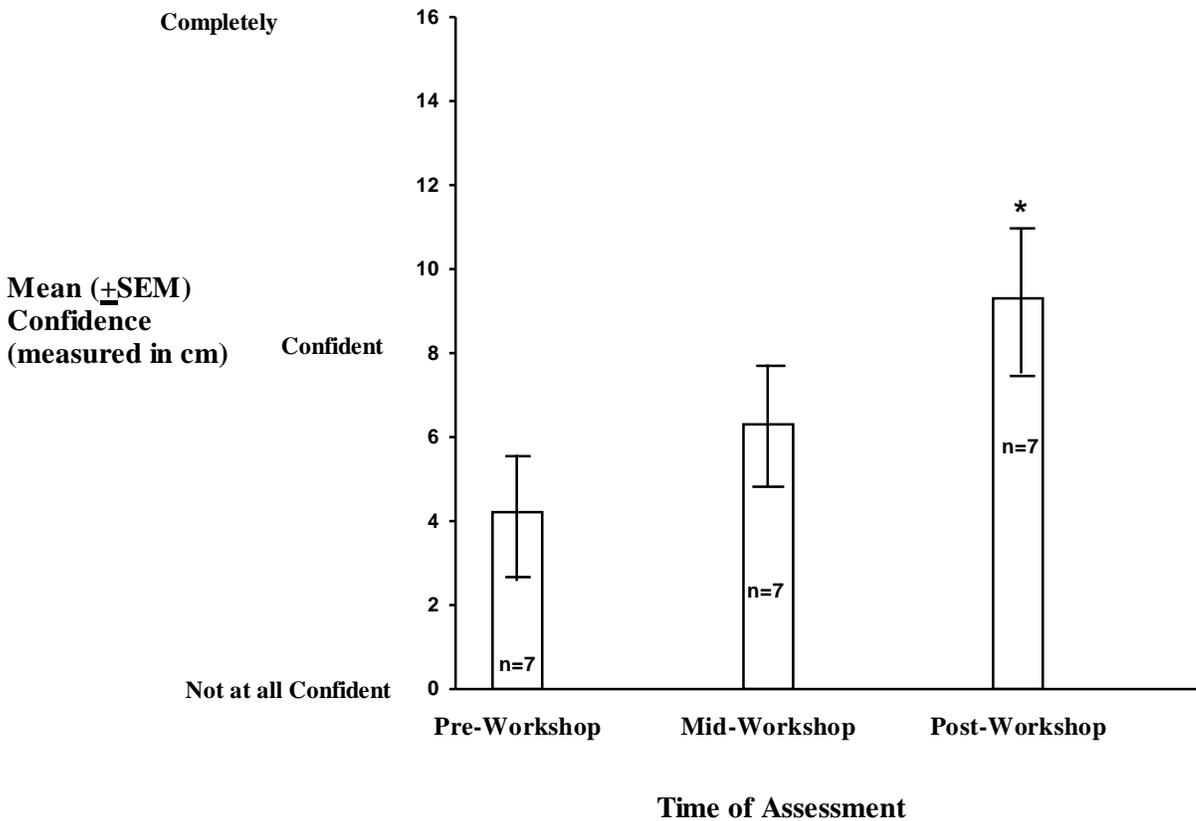


Figure 1. Teachers’ self-reported confidence in their answering all of the items on the Workshop Assessment accurately before (Pre), during (Mid), and after (Post) their participation in the workshop. Confidence ratings were made by teachers after they completed the items on the

assessment. A one-way repeated measures ANOVA indicated that teacher confidence in the accuracy of their responses to items on the assessment increased significantly by the end of the workshop ($F_{2,12} = 6.43, p < 0.02$). This indicated that teachers were becoming more comfortable with the concepts covered in the workshop.

*significantly different from Pre-Workshop ($p < 0.05$)

Teacher comments from reflections at the end of the workshop described this post-workshop increase in confidence: “In the area of addressing standards in the AWI program..., I personally feel a lot more confident about implementing it in my class; or, to be more specific, ‘I get it now!’” and “It [the workshop] has helped me feel a lot more confident about research investigation... .”

Ala Wai Watershed/Environmental Stewardship

A general goal of the AWI Workshop was to instill teacher confidence in the use of the concept of environmental stewardship applied to the Ala Wai Canal to engage students in learning through the process of inquiry. Specifically, it was hoped that through their participation in this workshop, teachers would develop confidence and the skills necessary to be able to engage their students in practical and relevant research investigation projects focused on the Ala Wai Watershed. To this end, teacher and program expectations included learning about and understanding watersheds, implementing and observing a watershed project in action, conducting a research investigation, and generating oral and written reports on the Ala Wai research investigation. The extent to which the workshop addressed these teacher and project expectations was assessed by items on the Teacher and Project Expectations Survey.

Responses from an overwhelming majority of the teachers indicated that the teacher expectation centering on learning and understanding watersheds was completely addressed (Figure 2). Teacher #4 reflected, “I understand what the Ala Wai Watershed is and what a watershed is.” However, one teacher (Teacher #6) indicated that this component of the workshop was not at all addressed (Figure 2). This teacher reflected, “What did this class teach us about a watershed? What did you want us to learn about a watershed? I have no idea.”

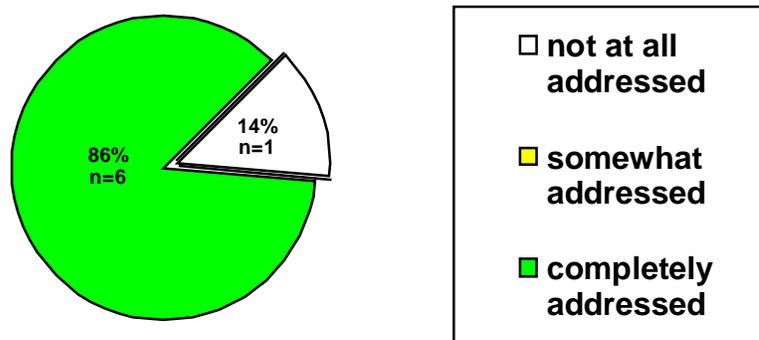


Figure 2. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to learn about and understand watersheds.

Five of seven of the workshop participants responded that the teacher expectation of implementing and observing a model of a watershed project was fully addressed, while one teacher felt that it was somewhat addressed (Figure 3). Teacher #7 reflected, "I feel that the AWI Program did address this portion of the [teacher] expectations." However, similar to how she felt about the previous teacher expectation, Teacher #6 responded that this expectation also was not at all addressed.

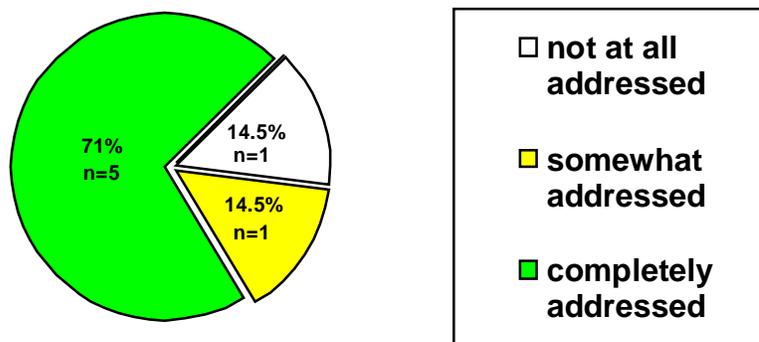


Figure 3. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to implement and observe a model of a watershed project in action.

As can be seen in Figures 4-6 below, there was unanimous agreement that the three project expectations related to the Ala Wai Watershed--conducting a research investigation, presenting an oral report and producing a written report-- were completely addressed in the workshop.

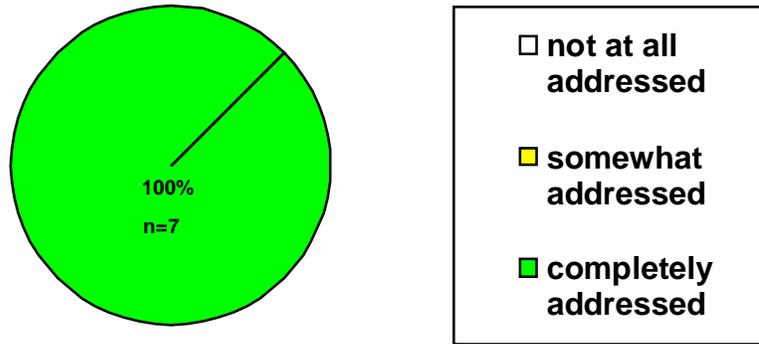


Figure 4. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to conduct a research study (with physical and social components), from beginning to end, that centers on the Ala Wai.

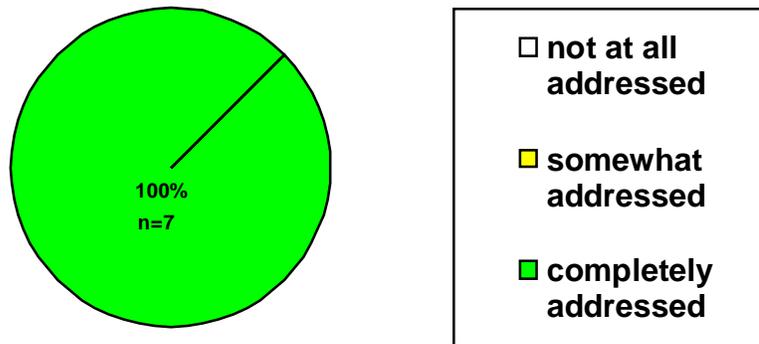


Figure 5. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation of teachers conducting an oral report on their research investigation of the Ala Wai.

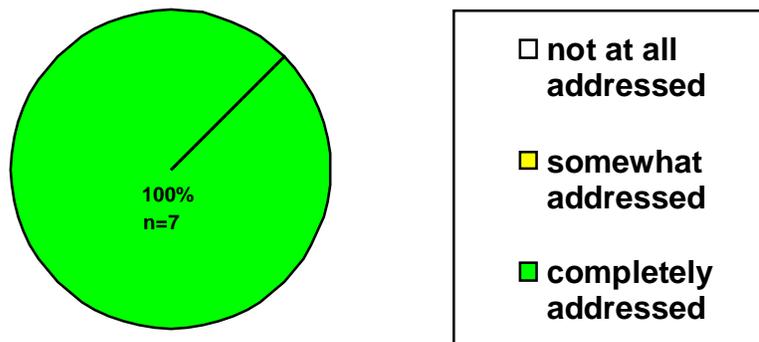


Figure 6. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation of teachers writing a research report on their research investigation of the Ala Wai.

Teachers' knowledge about watersheds and environmental stewardship were assessed in the Workshop Assessment (Figures 7 and 8). As shown in Figure 7, participation in the workshop resulted in a dramatic 70% increase in teachers able to demonstrate a good understanding and a decrease from 90 to 30% of the teachers having only a poor understanding of the term "watershed."

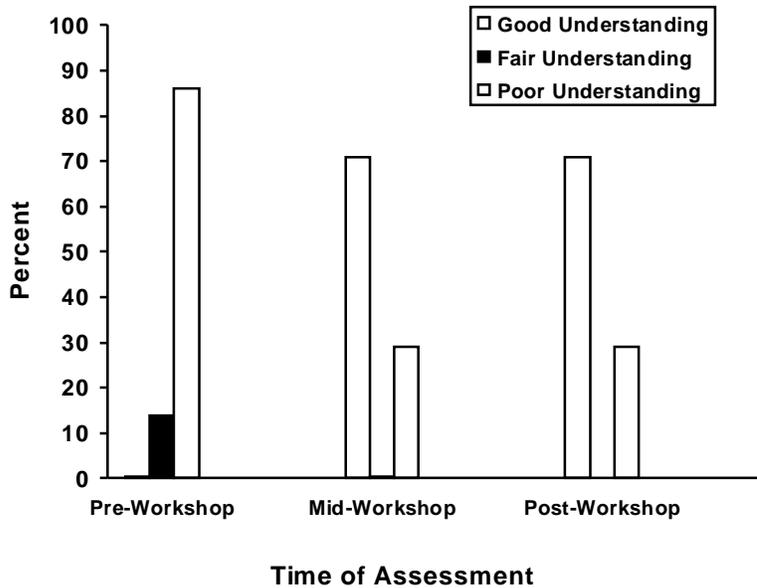


Figure 7. Percent of 7 teachers having a good, fair, and poor understanding of the term "watershed" before (Pre-), during (Mid-), and after completing (Post-) the workshop.

One teacher-participant (Teacher #7) reflected on her Ala Wai Watershed learning experience with, “Learning about the Ala Wai Watershed was quite eye-opening... .”

In contrast, the AWI Workshop did not appear to have a major influence on teacher understanding of environmental stewardship (Figure 8). By the end of the workshop, only one teacher (Teacher #7) increased her understanding of this concept (from poor to good). At the end of the workshop, Teacher #7 reflects her new knowledge about the Ala Wai Watershed in a statement emphasizing stewardship: “For so many years, I drive past the AW and never knew its needs and dilemma.”

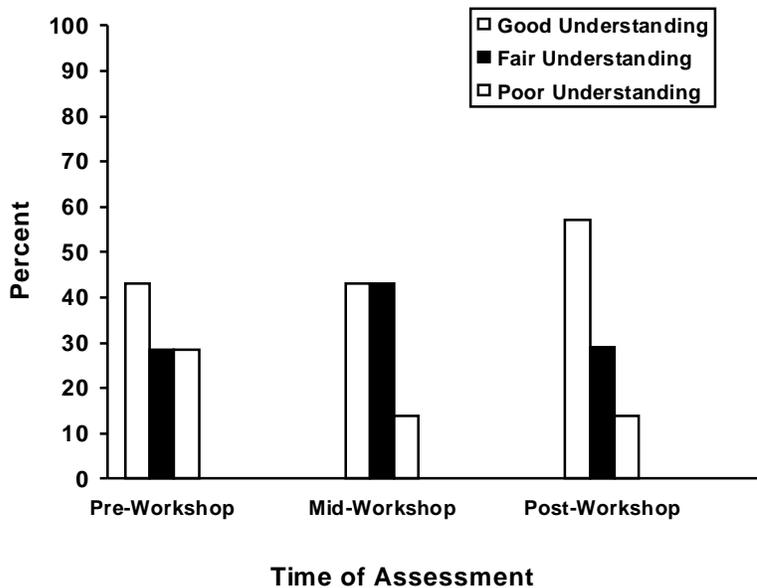


Figure 8. Percent of 7 teachers having a good, fair, and poor understanding of the term “environmental stewardship” before (Pre-), during (Mid-), and after completing (Post-) the workshop.

Although teachers' understanding of environmental stewardship did not appear to be greatly influenced by their participation in the AWI Workshop, teacher confidence in the ability to teach and engage students in environmental stewardship was dramatically changed. Figure 9 shows the mean teacher confidence in ability to teach and engage students in environmental stewardship before, during, and after participating in the workshop. Teacher confidence level increased significantly from near not at all confident before the workshop (mean \pm SEM = 2.63 ± 0.71) to confident by the end of the workshop (7.43 ± 1.92) [Figure 9].

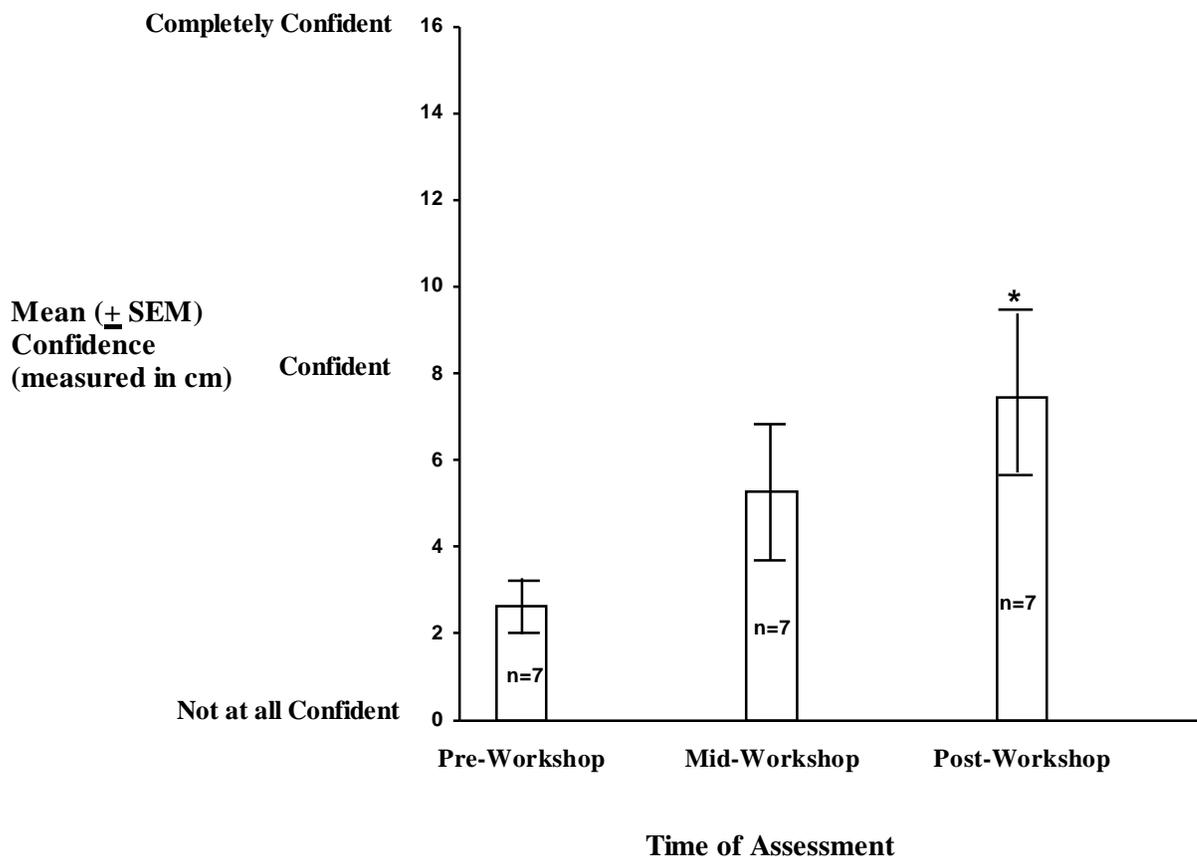


Figure 9. Teachers' self-reported confidence in their ability to teach and engage their students in environmental stewardship before (Pre), during (Mid), and after (Post) their participation in the workshop. A one-way repeated measures ANOVA indicated that participation in the workshop significantly influenced teacher confidence in their ability to teach and engage their students in environmental stewardship by the end of the workshop ($F_{2,12} = 4.22, p = 0.04$).

*significantly different from Pre-Workshop ($p < 0.05$)

Scientific Inquiry and the Scientific Research Investigation (RIP) Process

One primary goal of this workshop was to assist teachers in learning about and developing skills in the research investigation process so that teachers could begin using scientific inquiry in standards-based science teaching. Specifically, it was expected that teacher-participants would become familiar with and be able to begin to guide their students in the steps necessary to conduct scientific research to gain an understanding of the world around them. It was also expected that teachers would gain an appreciation for

how the inquiry process used in science can be generalized to other academic courses. Increasing teacher comfort level in emphasizing the use of statistics in data analyses and decision-making by their students was a primary goal of the research investigation/inquiry content of the workshop.

The teacher-participants unanimously indicated on the Program and Teacher Expectation Surveys that all workshop expectations related to scientific inquiry and the research investigation process were at least somewhat addressed, with a majority of teachers indicating that five of these six expectations were fully addressed (see Figures 10-14 below).

All seven teachers responded on the Program Expectation Survey that they had engaged in research investigations which generated new knowledge (Figure 10).

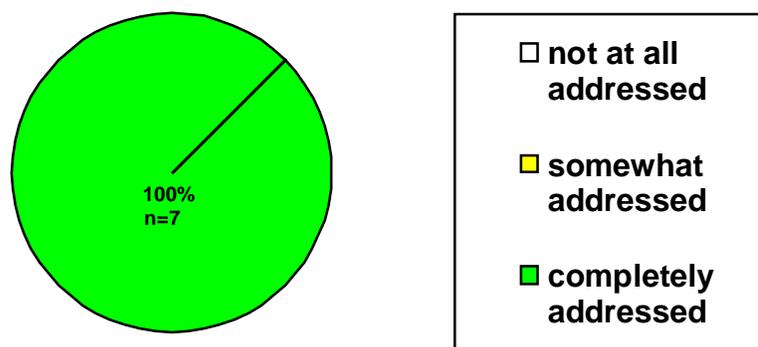


Figure 10. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop engaged them in research investigations which generate new knowledge.

The teachers were also unanimous that the program expectation for teachers to understand how the parts of a research investigation relate to each other was fully addressed in the workshop (Figure 11). For example, Teacher #5 stated, “I have learned the step-by-step process of research investigation. I now know how each part is connected;” and Teacher #6 claimed, “Our teachers did a good job in teaching us the interrelationship between the parts of a research investigation.”

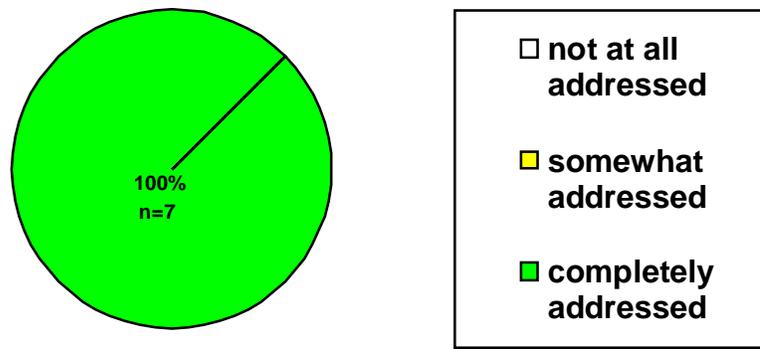


Figure 11. Teacher-participants’ responses (shown as percent) regarding the extent to which the AWI Workshop helped them to understand the interrelationship between the parts of a research investigation (introduction, methods, results, discussion and conclusion, and action plan).

The majority of the participants expressed that the program expectation of understanding the interrelationship between research design and data analysis was completely covered in the workshop; however, three of the seven teachers also felt that this expectation was only partially addressed (Figure 12).

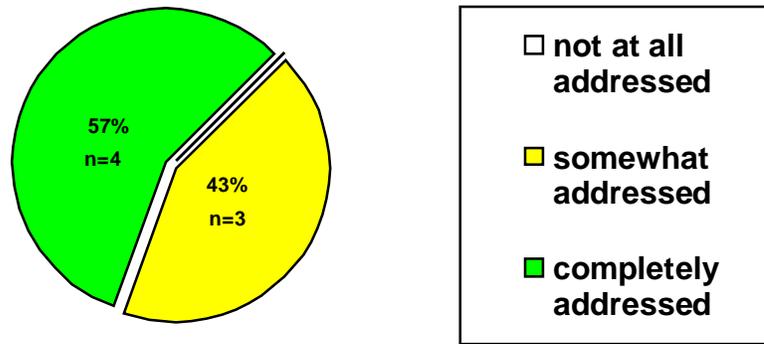


Figure 12. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the understanding of the interrelationship between research design and data analysis.

All participants felt that the strengthening of communication skills necessary for researchers was addressed in the workshop, with three out of seven indicating that this program expectation was addressed completely (Figure 13).

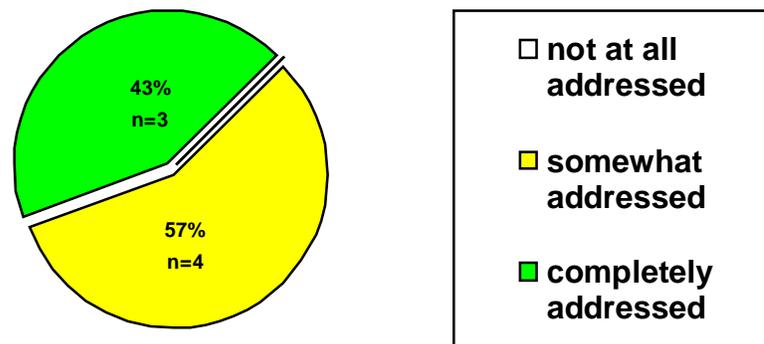


Figure 13. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the strengthening of all communication skills that are necessary for researchers.

Five of the seven teacher-participant responses on the Teacher Expectation Survey indicated that the learning of statistics for use in the scientific inquiry process was completely addressed in the workshop (Figure 14). Teacher #1 claimed, "Standard deviation [is]...among the most valued things that I gained;" and Teacher # 7 reflected, "Regarding the area on statistics, I truly learned something new here..." and "I [had] often wondered how scientists came to the conclusions they came to using data." One teacher

(Teacher #7) stated, “Although understanding the null hypothesis is simple, it was confusing for my brain and I found it a fun and challenging concept to grasp.”

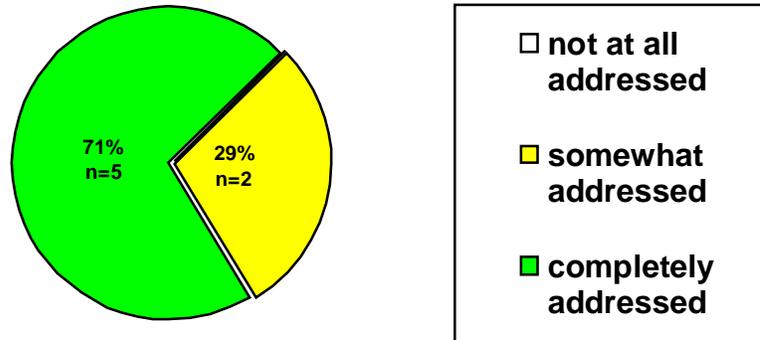


Figure 14. Teacher-participants’ responses (shown as percent) regarding the extent to which the AWI Workshop engaged them in the learning of statistics.

The Majority of the teachers also felt that their expectation for learning about specific statistical tests and directional and non-directional hypotheses (one- and two-tailed tests) was completely addressed (Figure 15). One teacher reflected, “How thrilling to learn [about] something like the ‘null’ [hypothesis].”

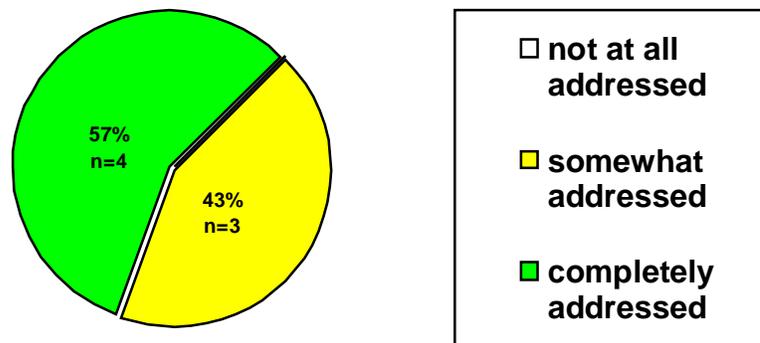


Figure 15. Teacher-participants’ responses (shown as percent) regarding the extent to which the AWI Workshop engaged them in learning about correlation and *t*-tests and using different tailed tests.

The percent of teachers demonstrating a good understanding of the role statistics play in the research process increased from 0 % to 60 % by the end of the workshop, with

a corresponding six-fold decrease in the percent of teachers with poor understanding (Figure 16).

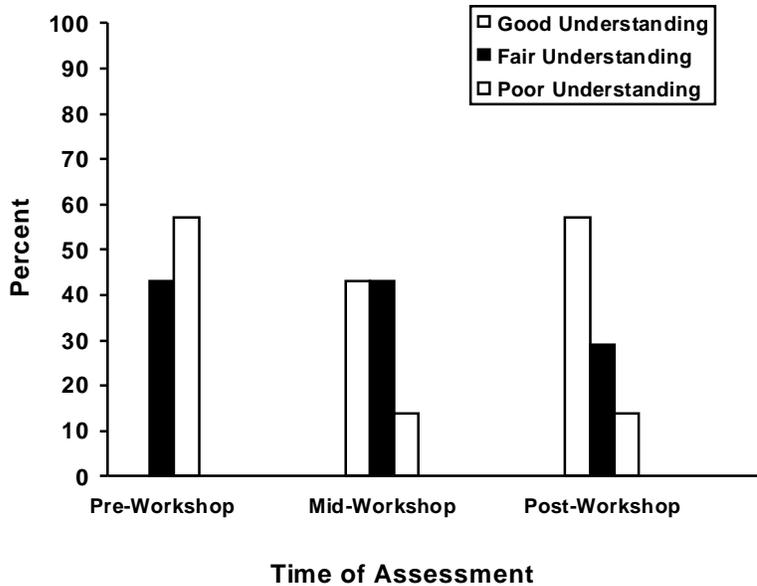


Figure 16. Percent of 7 teachers having a good, fair, and poor understanding of the role statistics play in research before (Pre-), during (Mid-), and after completing (Post-) the workshop.

For decision-making based on data collected in the research investigation, the AWI Workshop emphasized graphing and interpretation of experimental and correlational data, covering the bar graph (histogram), line graph, and scatterplot. The Workshop Assessment examined the impact of the workshop on the teachers' ability to describe, understand and interpret graphs for making decisions based on research investigation data. The assessment data indicate that teacher understanding and interpretation of the graphs increased substantially over the course of the AWI Workshop. For example, as shown below in Figures 17-19, teacher-participants' abilities to describe and interpret bar graphs were dramatically improved over the course of the workshop. The percent of teachers able to provide excellent descriptions of the data presented in a bar graph increased from zero to sixty percent, while poor descriptions decreased from 70% (Pre-Workshop) to 0% (Post-Workshop) [Figure 17].

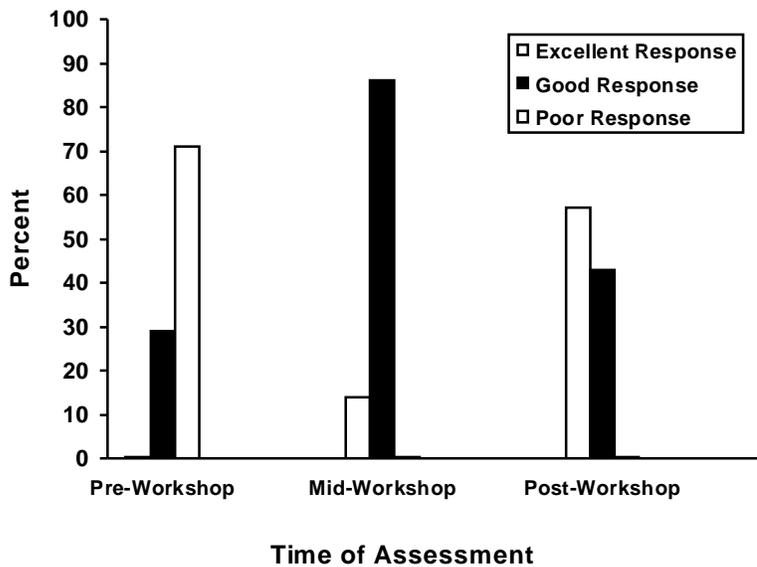


Figure 17. Percent excellent, good, and poor responses for 7 teachers describing a bar graph (histogram) comparing plant growth under different fertilizer conditions before (Pre-), during (Mid-), and after completing (Post-) the workshop.

By the end of the workshop, teachers also exhibited a large increase (0 % Pre-Workshop to 55 % Post-Workshop) in ability to correctly interpret the data presented in a bar graph (Figure 18). This large percent increase in interpretation ability corresponded with a dramatic percent increase (from 0 % to 70 %) in understanding of the concept of error in decision making and a dramatic decrease (from 100 % Pre-Workshop to 10 % Post-Workshop) in lack of understanding of error (Figure 19).

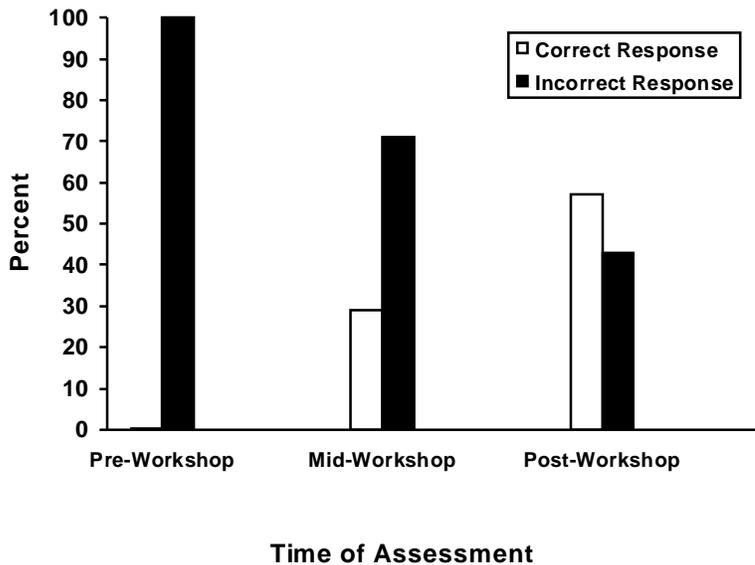


Figure 18. Percent Correct and incorrect responses for 7 teachers interpreting data presented in a bar graph (histogram) comparing plant growth under different fertilizer conditions speed before (Pre-), during (Mid-), and after completing (Post-) the workshop.

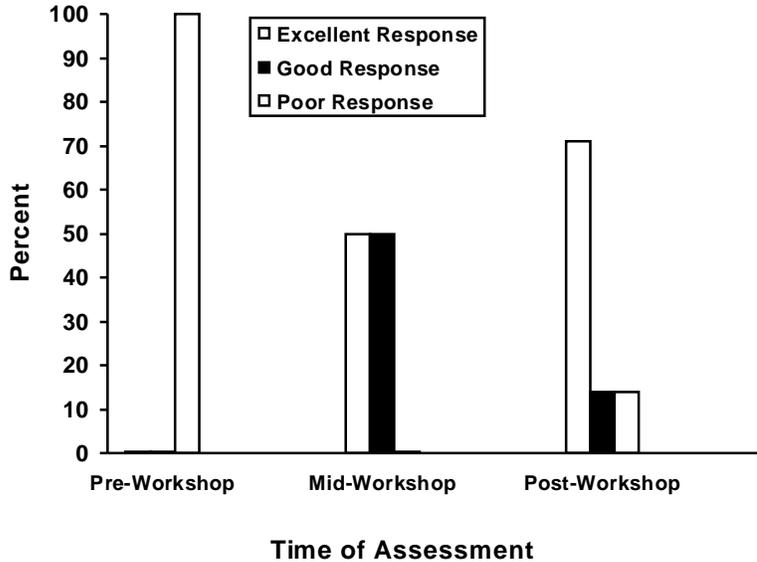


Figure 19. Percent excellent, good, and poor responses for 7 teachers recognizing the role (importance) of variability (error bars) in interpreting the data presented in a bar graph (histogram) comparing plant growth under different fertilizer conditions speed before (Pre-), during (Mid-), and after completing (Post-) the workshop.

Figure 20 shows the mean confidence of the teachers in their ability to successfully engage students in research in their subject area before, during, and after their

participation in the AWI workshop. As can be seen in the figure, prior to the workshop, teachers rated themselves as being slightly less than confident (mean \pm SEM = 7.01 ± 1.11 compared to 8.25), while after their participation in the workshop, they felt slightly more than confident (9.24 ± 1.43 compared to 8.25). A repeated measures ANOVA indicated that mean teacher confidence for engaging their students in research did not differ across the three workshop periods. However, because of the small sample size ($n=7$) and relatively small variation among the means, the ability for the ANOVA to detect a significant workshop effect on teacher confidence was very weak. Thus, the negative statistical finding on workshop influence on teacher confidence level in successfully engaging students in research should be cautiously interpreted. (See Figure 20 caption for further explanation of the power issue.)

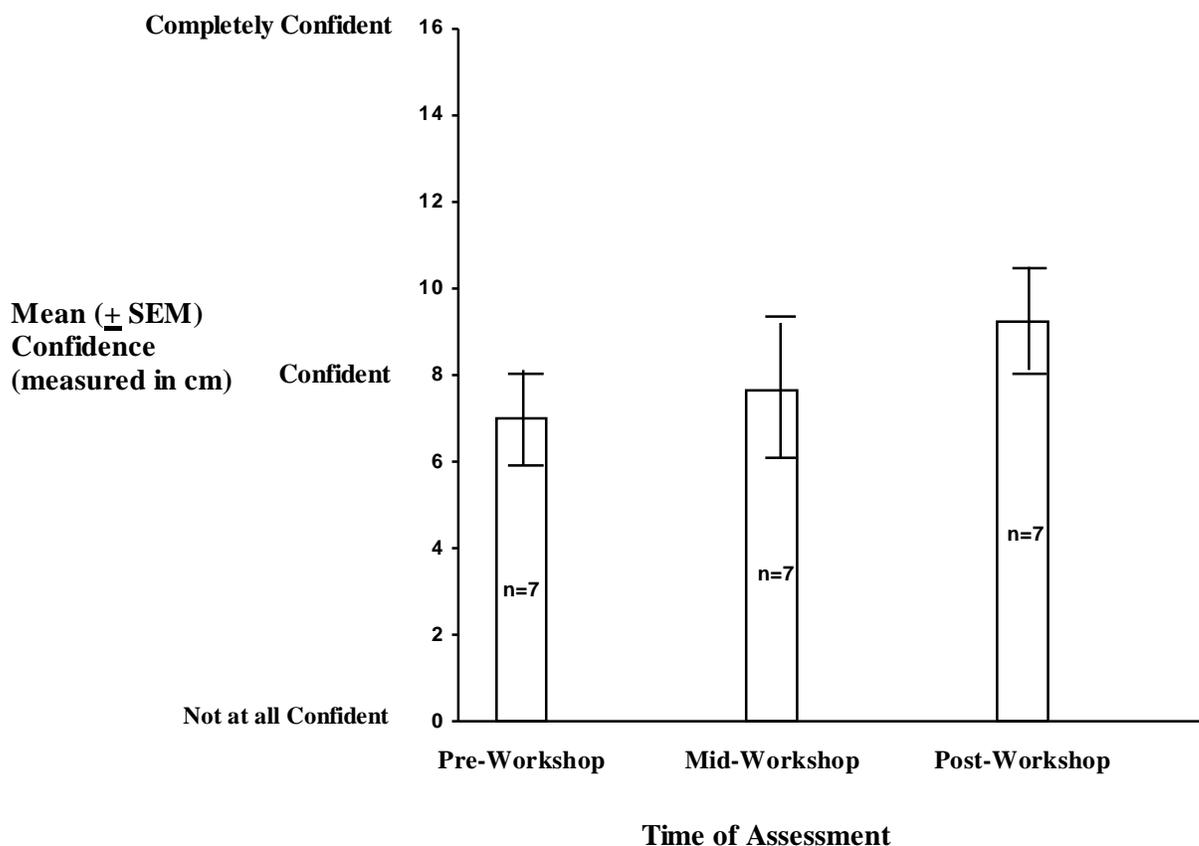


Figure 20. Teachers' self-reported confidence in their ability to successfully engage students in research in their subject area before (Pre), during (Mid), and after (Post) their participation in the workshop. A one-way repeated measures ANOVA indicated that the teachers' confidence was not significantly different across the three workshop assessment periods ($F_{2,12} = 1.75, p > 0.05$). Due to the small sample size and relatively small variation among the means, the power of this test to detect a significant workshop effect on teacher confidence was very low (power of performed test with $\alpha = 0.05$: 0.14) compared to the desired power of 0.80. Thus, the negative statistical finding should be interpreted cautiously (see text for additional discussion).

Figure 21 below presents confidence values plotted for each teacher-participant. At the end of the workshop, four of the seven teacher-participants showed clear, steep increases and two (Teachers #1 and #5) showed very slight increases in confidence in this ability compared to their confidence before participating in the workshop. In contrast, one teacher (Teacher #6) showed a drop in confidence, from confident to somewhat less than confident, between the Pre- and Post-Workshop assessments (see Figure 21).

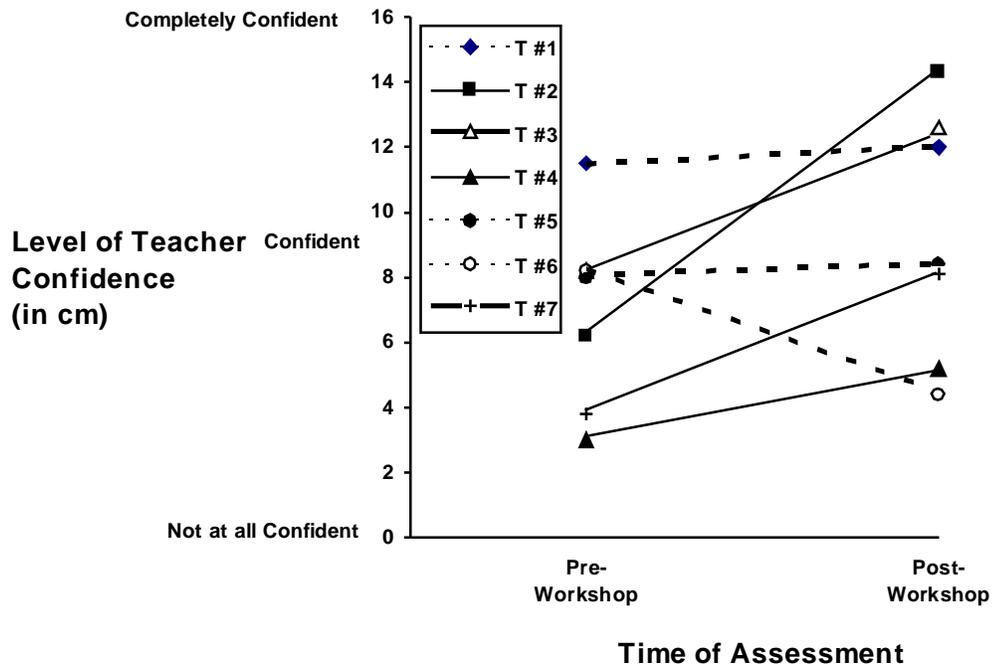


Figure 21. Individual teacher (T) Pre- and Post-Workshop confidence level in ability to successfully engage students in research in their subject area.

Teacher #7, whose confidence in her ability to successfully engage students in research increased from less than confident to confident (see Figure 21 above), actually engaged her students in the scientific inquiry process that she was learning while the workshop was still in progress. She described her experiences with her students with, “You know it amazed me that when given the opportunity students came up with ‘better research’ questions than I could think of,” and “The students then used the ‘If...then...’ form to come up with a hypothesis. With each hypothesis they generated, we went through the criteria list- testable, materials, subjects available and stated as an answer to a question- and I believe that the students felt successful and at ease with this.”

According to their Workshop Assessment responses, teachers revised and refined their understanding of “research” over the course of the workshop. Although the percentage of teachers who had a poor understanding of the meaning of research, as it pertained to what was covered in the workshop, did not change by the end of the workshop, the percentage of teachers with a fair understanding decreased six-fold and those with a good understanding increased by fifteen percent (see Figure 22).

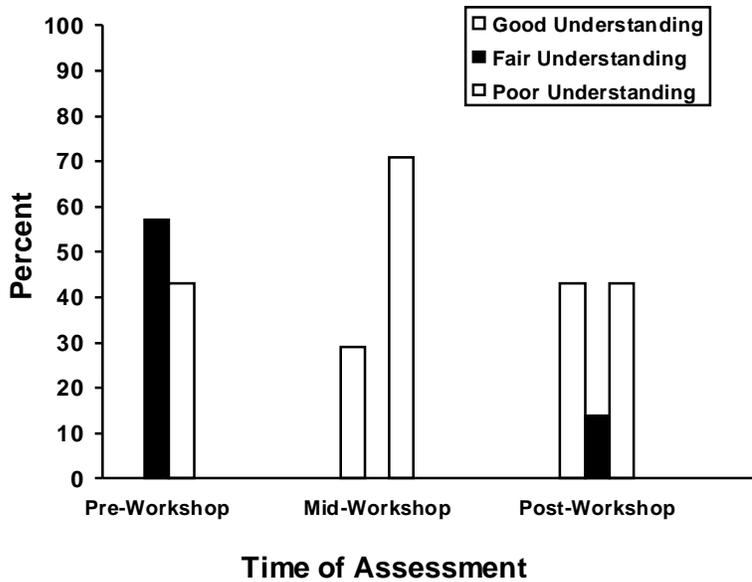


Figure 22. Percent of 7 teachers having a good, fair, and poor understanding of the word “research” before (Pre-), during (Mid-), and after completing (Post-) the workshop.

A variety of strategies and tools were used in the AWI Workshop to enhance teacher learning of the research investigation process and to facilitate the development of doable lessons. Specifically, sample inquiry lessons, a research investigation flowchart developed by the workshop instructors, storyboards, practice research scenarios, and a statistics manual written by the Science Research Education Specialist were used to teach the process of scientific inquiry and its application to the Ala Wai Canal Watershed. The impact of these teaching strategies on learning was assessed through the evaluation of the Teacher Expectations Survey and teacher reflection statements. The success of the practice research scenarios as a strategy was also determined through analysis of teacher responses on a brief questionnaire.

The teacher expectations for teacher strategies encompassed six of the items on the Teacher Expectations Survey (see Figures 23-27 below). Almost three quarters of the teachers felt that the workshop partially addressed their expectation for providing them with skills to create doable units (Figure 23). In addition, one teacher responded that this teacher expectation was completely addressed, while another responded that it was not at all addressed.

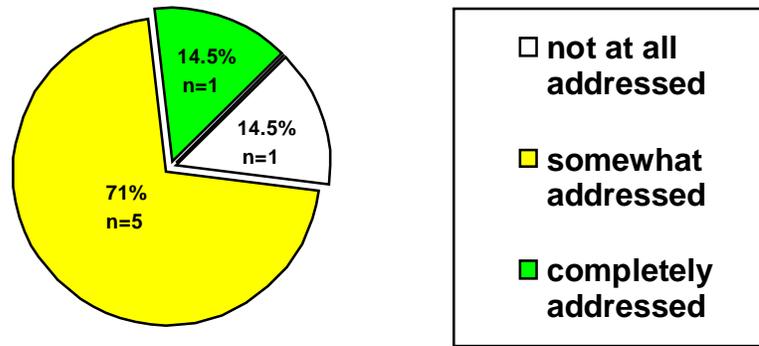


Figure 23. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to be able to create doable lessons/units.

All but of one of the workshop participants also felt that the expectation for learning classroom-friendly inquiry activities was at least partially addressed, with one teacher responding that they were completely addressed (Figure 24). Teacher #6 stated, "The observation and pulse rate activities were very good in teaching the scientific inquiry process." "These....two activities....were classroom friendly." One teacher, however, indicated that this expectation was not at all addressed.

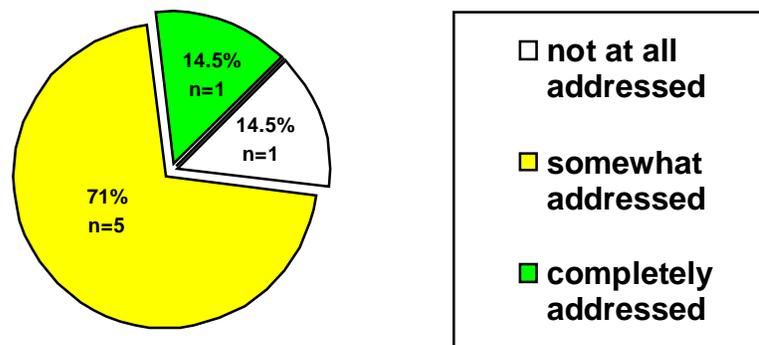


Figure 24. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to learn inquiry activities that are classroom friendly.

Six of the seven teacher-participants responded that the expectation for them to learn more hands-on inquiry-based lessons was somewhat addressed (Figure 25). Teacher #3 stated that "The research investigation flowchart was a big help." "[The research

investigation] flowchart allowed us to go through the [research investigation] process-hands on,” and Teacher #7 stated that “the research investigation flowchart combines ‘hands-on’ activities and ‘thinking’ activities quite well.” In contrast, one teacher indicated that this expectation was not at all addressed (Figure 25).

One teacher (Teacher #7) was actually putting science inquiry techniques she was learning in the workshop into practice in her classroom. She reflected, “You know it amazed me that when given the opportunity students came up with ‘better research’ questions than I could think of,” and “The students then used the “If...then...form to come up with a hypothesis. With each hypothesis they generated, we went through the criteria list...testable...materials and subjects available...stated as an answer to research question and I believe the students felt successful and at ease with this.”

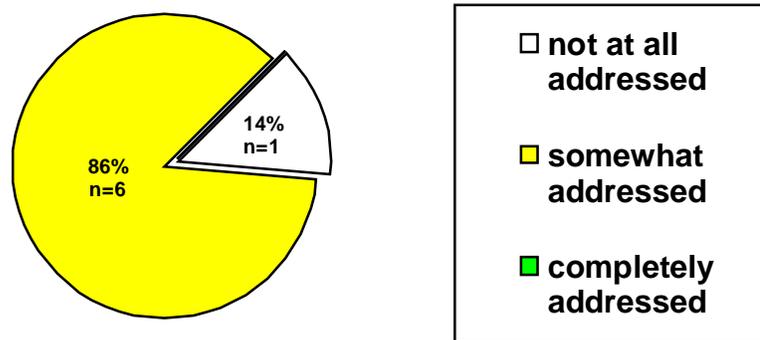


Figure 25. Teacher-participants’ responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to be able to learn more “hands-on” activities to take back and use with their students.

One set of activities within the AWI Workshop were four practice research scenarios involving contrived observations made on the Ala Wai Watershed accompanied by real and laboratory-doctored water samples. These scenarios were designed so that each would suggest a potential water quality problem that could be studied in the laboratory using available research instruments such as conductivity meters, hydrometers, pH indicators, and kits for measuring dissolved oxygen, copper, nitrate, nitrite, phosphate and ammonia. The purpose of these scenarios was to engage teachers in activities that would force them to begin to problem solve issues surrounding a watershed using critical thinking and the research investigation process. Post-scenario questionnaires administered after completion of the first and third scenarios were used to assess whether teachers’ confidence in guiding themselves through the water quality research investigation process was influenced by this activity.

Figures 26 and 27 present self-reported confidence values for teachers following their participation in the first and then the third research scenarios. As can be seen in Figure 26, practice with the research scenarios did not affect teacher confidence regarding their ability to successfully conduct research in water quality issues. Similarly, teacher confidence in their ability to explain to others the research process they used was unchanged (Figure 27).

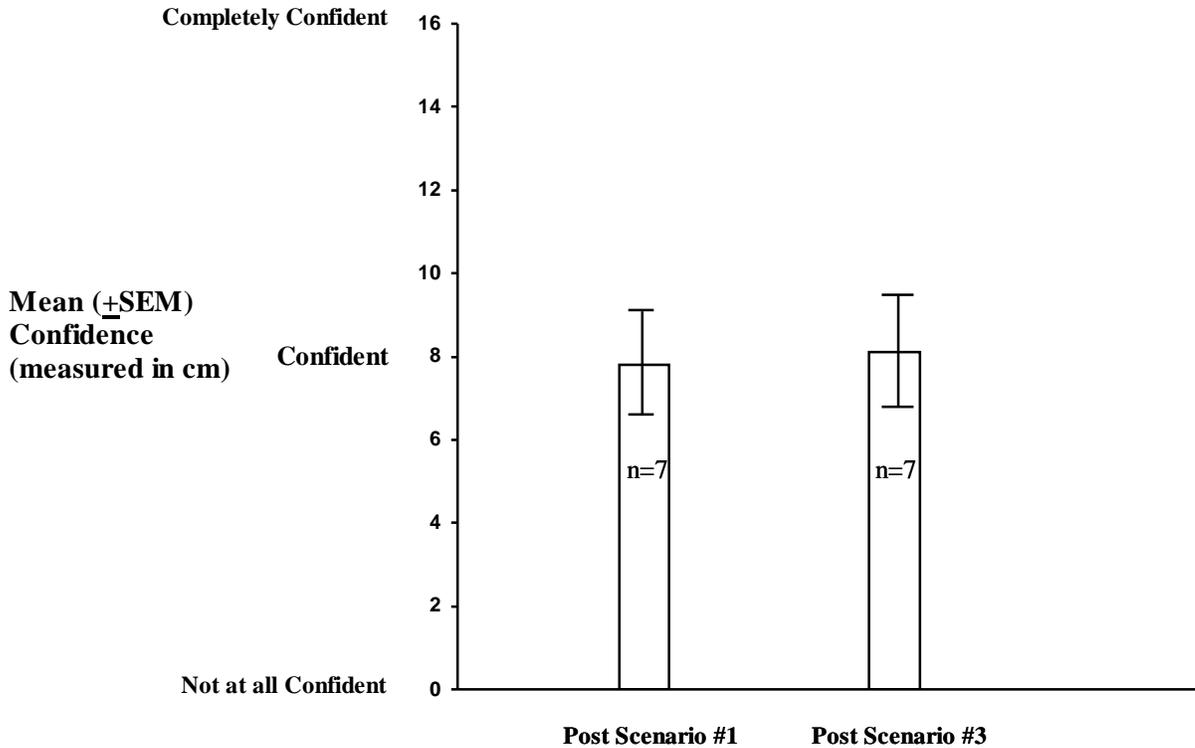


Figure 26. Teachers’ self-reported confidence in their ability to successfully engage in water quality testing research following participation in one and three practice research scenarios. A dependent *t*-test indicated that there was no difference in mean teacher confidence measured by the two research scenario questionnaires ($t_{df=6} = -0.27, p = 0.80$).

Comments from teachers revealed that they felt that not enough time was given for them to fully benefit from this practice activity. As discussed at the end of this evaluation, a teacher strike necessitated the abbreviation of time permitted for certain activities such as these. Teacher #3 said, “Some of the meetings seemed very rushed (data collection/practice [four research scenarios]),” and Teacher #6 stated, “I felt cheated

when our time was cut short on the day we were to do four labs [research scenarios]. I would have liked to experience using all of the tools available... ”

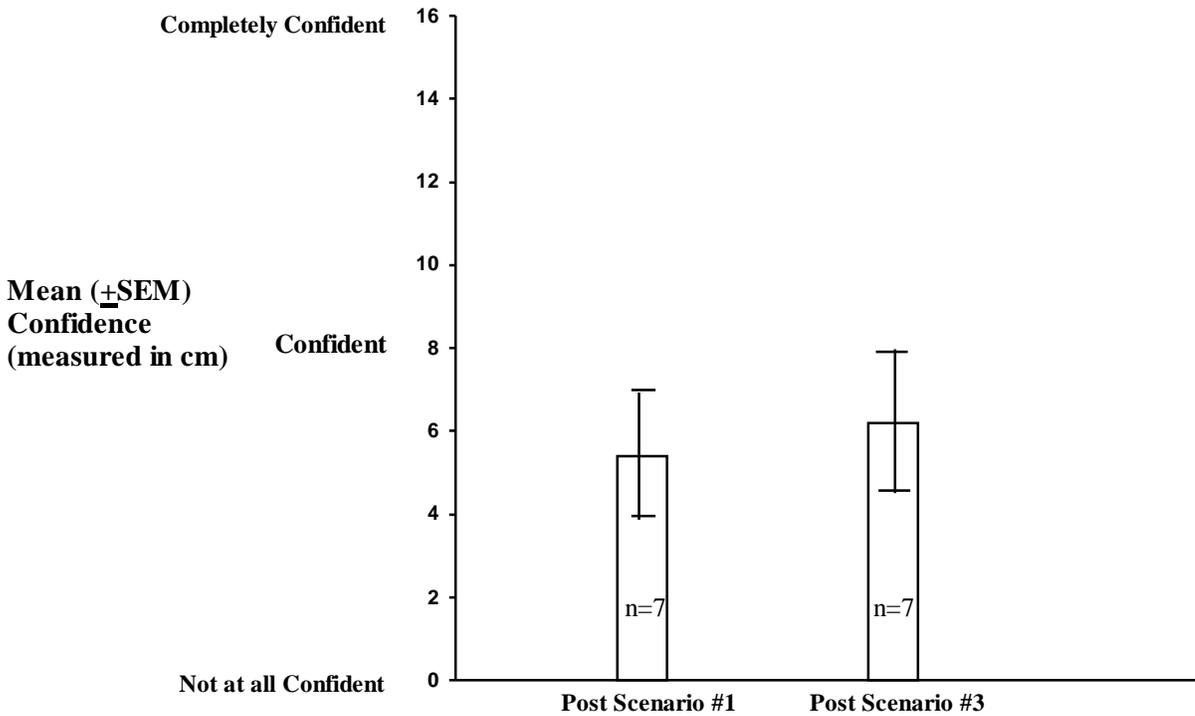


Figure 27. Teachers’ self-reported confidence in their ability to explain the water quality testing research process to another person following participation in one and three practice research scenarios. A dependent *t*-test indicated that there was no difference in mean teacher confidence measured by the two research scenario questionnaires ($t_{df=6} = -1.23, p = 0.26$).

All of the participants indicated that their expectation for the workshop to enable them to be able to use activities/ideas to teach scientific inquiry was at least partially addressed, with almost three-quarters of them indicating that this expectation was completely addressed (Figure 28).

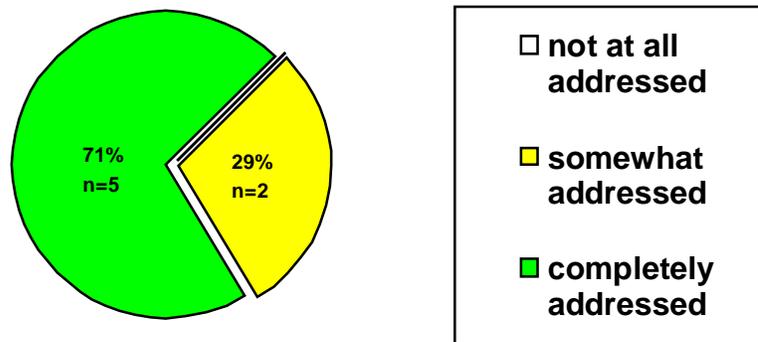


Figure 28. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to be able to use activities/ideas to teach scientific inquiry.

Most of the teachers, in their reflections and temperature checks, mentioned the value of the Research Investigation Storyboard and the Research Investigation Flowchart for teaching scientific inquiry. Some comments were: “The Research Investigation Flowchart will encourage students when they visually see how organized and sequential[ly] the Research Investigation Process flows along,” “The techniques shown in the chart provide a map for learners to see what successful learning looks like,” [using the flowchart to] “go over the parts of the research investigation process step-by-step helped me to understand what I was looking for. The flowchart is very helpful and can be adjusted to fit most types of research.” Teacher #6 expressed, “The Research Investigation Flowchart is a mode of delivery I can use to teach any content in science.” It is a tool I can use to meet all the scientific inquiry skills in the science content standards.” “I fully understand and appreciate how the Research Investigation Flowchart can cover more than half of the science standards in HCPS II.”

Teacher-participants also consistently reflected positively about the value of the storyboard for the planning of student research investigations. For example, Teacher #4 commented, “Because we did a complete storyboard for both the physical and social investigations, the data collection/analysis portion of our investigation was a piece of cake,” and Teacher #6 explained the value of using the storyboard: “The storyboard is very important in helping our students to design and conduct a research investigation study because it helps to clarify and elaborate step-by-step the process of the investigation. With the scrutinizing eyes of peers and teachers, this will eventually save them from making unforeseen mistakes, not to mention the waste of time and costly supplies and materials.” Finally, Teacher #7 stated, “I love the idea of the storyboard. I think this is an excellent way to help me assess where the students are at, offer assistance to those who are not progressing, and to give encouragement to those who are progressing.”

Teachers were almost equally split as to how much the workshop addressed their expectation to be able to use the research investigation inquiry process to devise and implement a School-Wide 6-8 grade Theme Connection (Scope and Sequence)

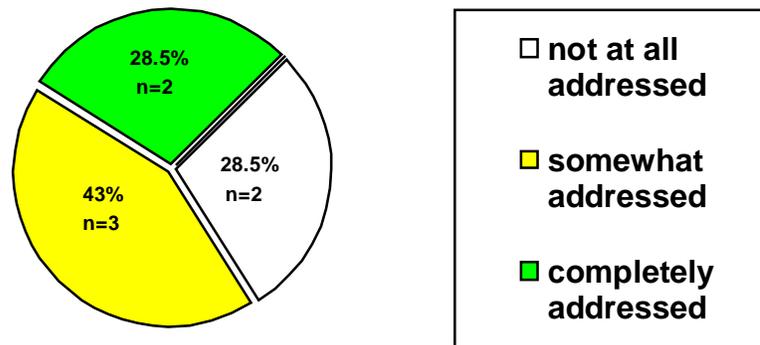


Figure 29. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to be able to use the research investigation inquiry process in order to devise and implement a School-Wide 6-8 Theme Connection (Scope and Sequence).

[Figure 29]. However, they all indicated that their expectation of being able to develop project-based and interdisciplinary units was addressed, with one-third responding that it was completely addressed (Figure 30).

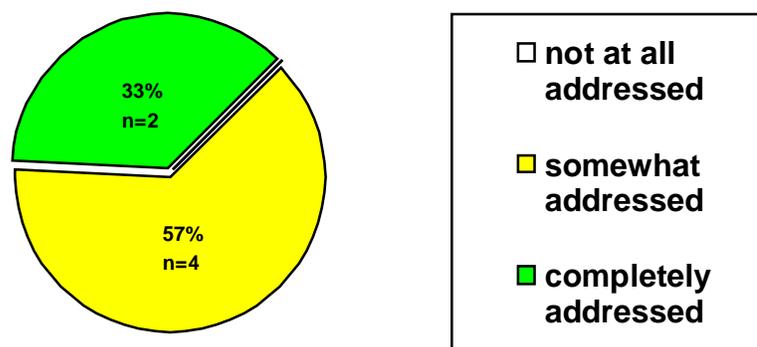


Figure 30. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed the expectation for teachers to be able to develop project-based and interdisciplinary units. (One workshop participant did not respond to this item.)

The seven AWI teachers unanimously agreed that the standard for the five Elements of Quality Professional Development relating to inquiry and actively engaging workshop participants in research were either met or exceeded. All seven teacher participants agreed that the workshop content at least met the standard for an on-going and sustained process (PD-Credit Evaluation: mean = 4.57, range = 2.0), with all but one teacher claiming that the standard was more than met or met to a high degree. Teachers were also in overwhelming agreement that the standard for active engagement was exceeded (PD-Credit Evaluation: mean = 4.0, range = 2.0). This element includes modeling what needs to occur in the classroom, inquiry-based instruction/learning, and the modeling of practices by the facilitator. Teacher #7 stated “Research investigation embraces goals that are critical for a successful learning environment.” The practice of the scientific research process is commonly a collegial effort and, according to the teachers, this standard was met or exceeded in the workshop (PD-Credit Evaluation: mean = 4.57, range = 2.0). The teachers also felt that the use of the inquiry approach, using the research investigation process to learn science, as demonstrated in the workshop, focused on the element of result-oriented instruction and student learning (PD-Credit Evaluation: mean = 4.43, range = 1.0). For example, Teacher #7 stated “Research investigation...provides opportunity for individual self-direction, provides opportunity for each individual to perform well and to take pride in learning...and provides out-of-school learning experiences.” Finally, six of the seven teacher-participants expressed their view that the workshop met the reflection standard (mean = 4.14, range = 3.0). The research investigation process itself involves continual reflection, analysis, refinement, and improvement. Instruction of the research investigation process to the teacher-participants was challenging, enhanced learning, and connected with practice.

Standards/Standards-Based Unit

A major goal of this workshop was for teachers to become more comfortable with the use of standards in their classroom instruction. Specifically, through the workshop, it was hoped that teachers would develop a greater understanding of content standards, make connections between content standards and classroom activities, and learn about and learn how to develop a standards-based unit plan.

According to the results of the Teacher Expectation Survey, the majority of teacher-participants felt that all four of their expectations regarding the standards component of the AWI Workshop were at least somewhat addressed (see Figures 31-34 below). The seven workshop participants felt that the meaning of “standards” was either partially or fully addressed (Figure 31).

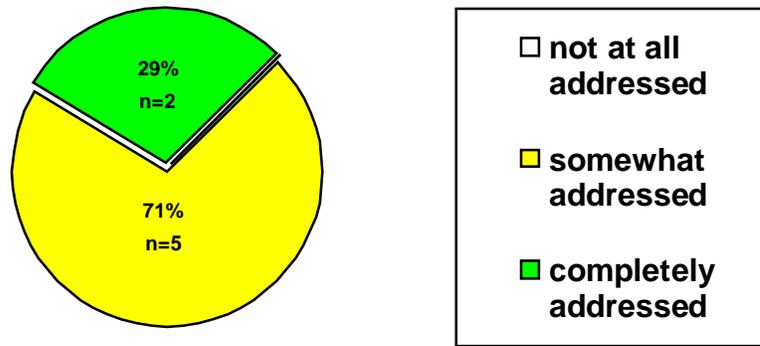


Figure 31. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop addressed what "standards" really mean.

Two-thirds of the teachers felt that their expectation for reflecting on content standards and making connections between them and the classroom was somewhat covered in the workshop, while one-third felt it was not at all addressed (Figure 32).

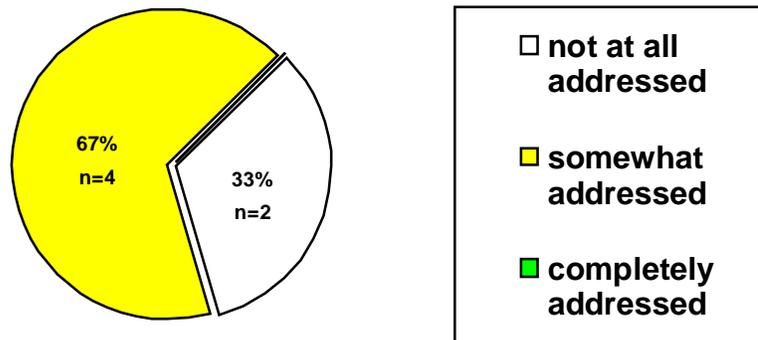


Figure 32. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop engaged them in reflecting on content standards, and learning how to make connections between standards and classroom activities. (One of the seven workshop participants did not respond to this item on the survey.)

The majority (85%) of the workshop participants indicated that their expectation of achieving a better understanding of content standards (Figure 33) was at least somewhat addressed, with two teachers feeling that it was completely addressed. In contrast, one teacher (Teacher #2) responded that this expectation was not at all addressed in the workshop. However, in her reflection on content standards, she stated, "Although we were unable to cover much on content standards, I feel that enough information was disbursed to give me a better understanding of what is expected."

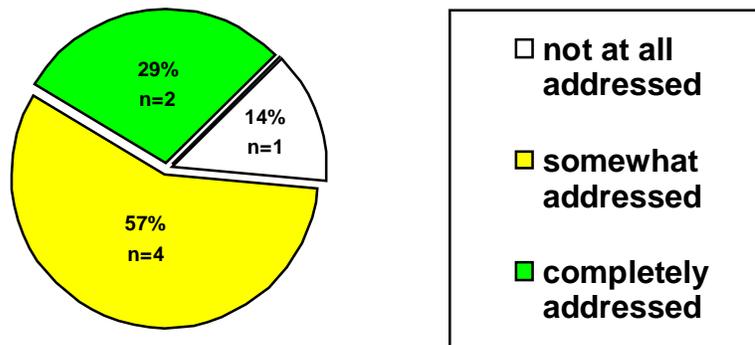


Figure 33. Teacher-participants' responses (shown as percent) regarding the extent to which the AWI Workshop helped them to gain a better understanding of content standards.

Slightly more than half of the participants indicated that the teacher expectation of learning about, and how to develop, a standards-based unit was at least somewhat addressed, with one teacher indicating that she thought that these aspects of the standards-based unit were completely addressed in the workshop (Figure 34). However, this is in contrast to 43% of the teachers who felt that this component was not at all addressed in the workshop. One reason for teachers feeling that this element of the standards component of the workshop was not addressed was expressed in a reflection from Teacher #3: "I am still not clear on how to develop a standards-based unit plan incorporating research investigation based on the Social Studies standards because the SS standards were not addressed."

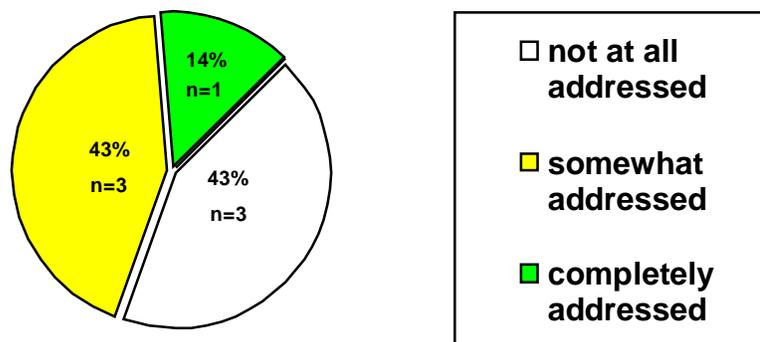


Figure 34. Teacher-participants' responses (shown as percent) regarding the extent to which learning about the standards-based unit plan, and how to develop one, were addressed in the AWI Workshop.

Based on their responses on the AWI Program Expectation Survey, all seven of the workshop participants felt that the program expectations regarding standards were at least somewhat addressed (see Figures 35 and 36 below). Six of the seven teachers responded that the workshop completely addressed teachers' understanding and appreciation for how engaging students in research can address a number of the Hawaii Content and Performance Standards (HCPS II) [Figure 35]. One teacher-participant (Teacher #7) stated that "this area really helped to relate the scientific process and the standards in my mind." However, only two of the seven teachers felt that the workshop completely addressed teachers knowing, understanding, and implementing HCPS II in their class (Figure 36).

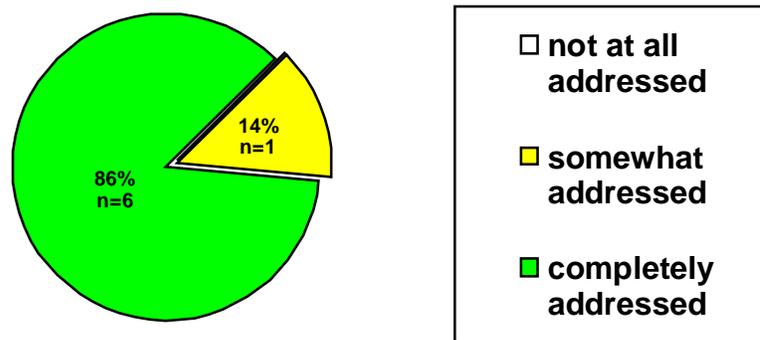


Figure 35. Teacher Participants' responses (shown as percent) regarding the extent to which the AWI Workshop helped teachers to understand and appreciate how engaging students in research can address a number of HCPS II.

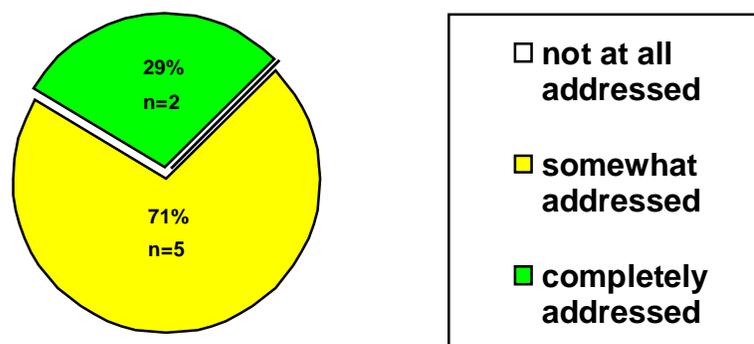


Figure 36. Teacher Participants' responses (shown as percent) regarding the extent to which the AWI Workshop helped teachers to know, understand, and implement HCPS II in their class.

Prior to taking the workshop, teachers reported that they were not confident in addressing standards in their classroom (see Figure 37 below). However, the teachers' confidence in their ability to address content standards in their classrooms significantly increased by the end of the workshop, compared to their confidence before and midway through the workshop.

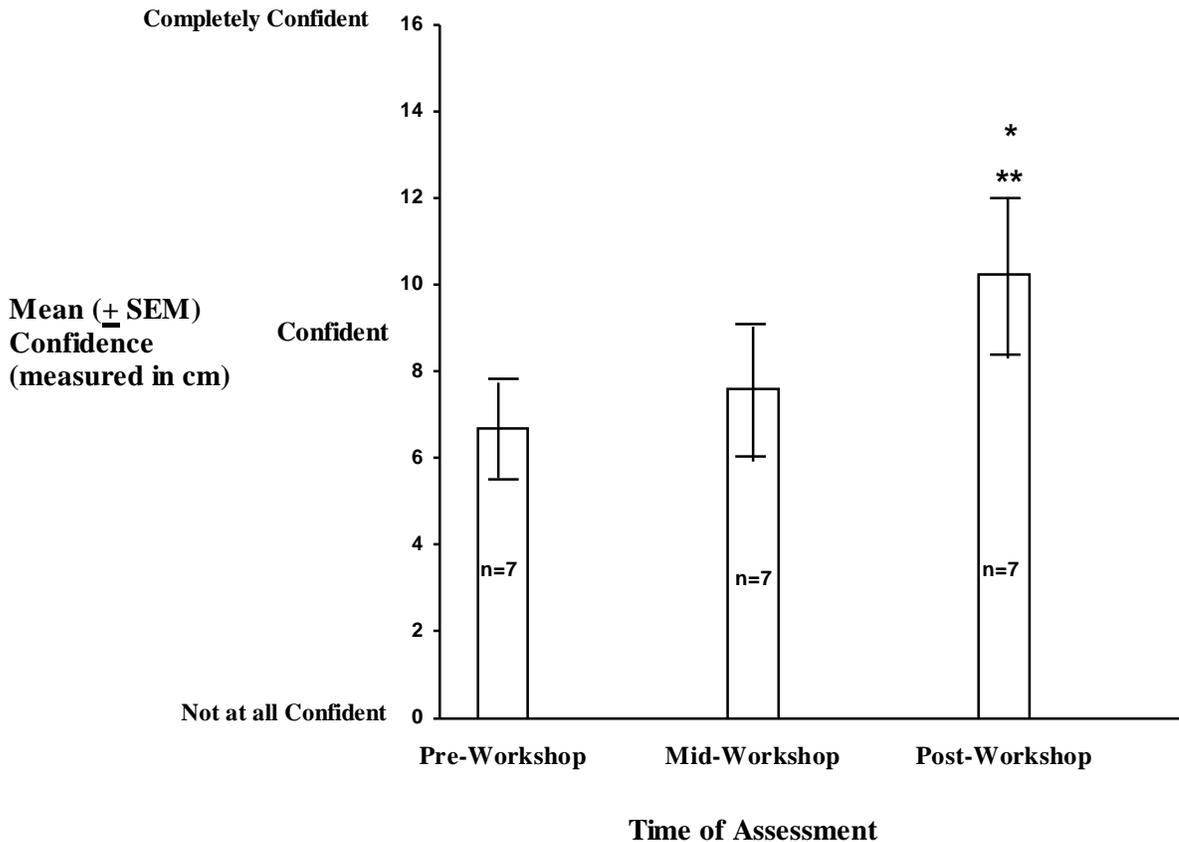


Figure 37. Teachers' self-reported confidence in their ability to address content standards in their classroom before (Pre), during (Mid), and after (Post) their participation in the workshop. A one-way repeated measures ANOVA indicated that participation in the workshop significantly influenced teacher confidence in their ability to address content standards in their classrooms by the end of the workshop ($F_{2,12} = 5.51, p = 0.02$).

*significantly different from Pre-Workshop ($p < 0.05$) **significantly different from Mid-Workshop ($p < 0.05$).

All seven teacher participants felt that the standard was met for focus on the Hawaii Content and Performance Standards (PD Credit Evaluation: mean = 4.14, range = 2), with five of them expressing that the standard was exceeded. According to one teacher’s reflection, “[The Research Investigation Process] ties into science standards,” and “I feel confident that I can address certain standards with research investigation.” However, three of the seven participants expressed dissatisfaction with coverage of material related to development of a standards-based unit plan. For example, Teacher #5 stated, “I think we should have taken more time to learn how to write standards-based units and lessons,” while Teacher #6 said she “would like to see what a standards-based unit plan looks like” and “...we were never taught how to put a plan together.” Finally, one participant (Teacher #4) reflected, “I ...am still not 100% clear about performance indicators.”

Additional Evaluation Findings and Conclusions

In addition to the quantitative data and specific comments supporting the interpretation of a positive professional learning outcome from the AWI Workshop, general teacher reflection and “temperature check” comments made throughout the workshop illustrate the overall positive impact of the workshop on teacher-participants (Table 4).

Table 4. General AWI Workshop teacher-participant comments.

<i>“This workshop did well in helping the teachers to learn and to understand each step of the process in doing [a] research investigation.” - Teacher #2</i>
<i>I have learned a lot from this class [workshop] and enjoyed myself as well.” - Teacher #4</i>
<i>“It took another 3-credit class on standards and \$270. for me to appreciate this workshop and what it can offer to help me deliver the standards to my students.” - Teacher #6</i>
<i>“The inquiry process we learned was excellent... .”</i>
<i>“I definitely saw the treasure of the Research Investigation Process and how it could be applied to anything taught in the classroom.”</i>
<i>“This was a most rewarding workshop and I’m glad I stuck with it. Best of all, it [the workshop] makes the standards so much more user-friendly.” - Teacher #7</i>

A number of teacher reflection statements also made it clear that teachers found this workshop to be both interesting and challenging. For example, Teacher #1 stated that the workshop provided “high variety and challenging activities;” Teacher #4 claimed,

“Sometimes activities/concepts are challenging, but in a good way. Exercising my brain feels great!” and Teacher #7 commented, “Very, very challenging. You have forced me to use parts of my brain that [were] anorexic.”

Finally, the teacher-participants attributed the success of the workshop, in part, to the skills and attitudes of the instructors and facilitators (Table 5).

Table 5. AWI Workshop teacher-participant comments relating to workshop staff.

<i>“Knowledgeable and caring instructors.” - Teacher #1</i>
<i>“One of the most predominant [strengths] is the many ‘experts’ that are brought in to explain concepts. Because they are experts in their fields, we get the most detailed and thorough information available; and it is presented by people who are truly enthusiastic about what they are presenting. As a teacher,[I feel] just the enthusiasm alone is enough to catch an audiences attention. I also feel that the coordinators for the workshop have gone above and beyond to make sure that there are many opportunities for interesting and innovative things to happen.” - Teacher #2</i>
<i>“Instructors are knowledgeable and really want to help us understand material. Activities are varied and interesting.” - Teacher #4</i>
<i>“You [the workshop instructors] all worked well as a team.” - Teacher #7</i>

The AWI Workshop was conducted during what might be considered a “difficult” period of the 2001 academic year. The teachers were involved in a union-based job action, which included the planning and conducting of a teacher strike. The planning stages of the strike were very stressful, emotionally-draining, and time-consuming for the AWI teacher-participants. The strike itself had a major impact on the planning, and actual scheduling and completion of the workshop. During the period of time including April 5 through the first week of May, the teachers were out on-strike and previously scheduled workshop days could not be held. In addition, teachers had to play catch-up with their students at the end of the strike and could not attend in-service activities. The teachers expressed a high level of post-strike stress, which also interfered with workshop progression. As a result of the strike-caused disruption, six of the workshop days were crammed into a single month, and the originally-planned 10-day workshop was forced into eight days. Thus, the depth and breadth of a number of the previously planned workshop elements had to be abbreviated. One area that was particularly affected by this was the content standards and the standards-based unit. Also, the teacher expectation for the workshop to provide them with an understanding of how to use scientific inquiry to implement a school-wide 6-8 scope and sequence was not substantially covered. The expectations for teacher-generated end-products were adjusted to accommodate the changes in schedule. For example, rather than completing a ready to use standards-based unit plan, teachers

were asked to complete and submit only the outline for the plan. The re-planning, rescheduling, and changing of specific content and requirements as a consequence of this situation may have affected teachers' perceptions of their own accomplishments as well as the ability for the AWI Workshop to meet all of its initial goals and objectives.