Evaluation for the 2003 Honolulu District Professional Development Program: Teaching Science Literacy through Inquiry- The Research Investigation Process (RIP)

ANOVA Science Education Corporation
Honolulu, Hawaii

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The purpose of this professional development program was to introduce K-12 teachers to the teaching of science through true scientific inquiry, using the research investigation process (RIP ™) and to explore the RIP as a tool for addressing the Hawaii Science Content and Performance Domain I standards in the classroom. Specifically, it was designed to guide teachers in the use of the inquiry process; to have teachers learn how to design and conduct scientific research studies; to have them become familiar with techniques to assist in guiding students through the scientific inquiry process; to have them examine, practice, understand, and become competent in the ability to apply data analysis techniques to decision-making in science; to increase confidence in using scientific research in their approach to instructing students in science and in addressing the scientific inquiry benchmarks and science inquiry content standards; to have them implement the RIP as a tool for instruction in the classroom; and to increase student interest in learning science.

Over the course of the initial three-day workshop session, the research investigation process (RIP) was introduced and teachers were provided the opportunity to develop an understanding of each of the elements of the RIP through their participation in and development of actual research investigations. Teacher participants were guided through a number of activities related to making observations; posing research questions; obtaining, examining, and evaluating background information; constructing hypotheses; and designing the methods for a research investigation. Techniques in data summary, analysis and presentation were explored in the context of hypothesis testing and decision-making in science. Teachers were then expected to introduce workshop-related concepts and activities learned into their classroom and guide their students in conducting their first RIP over the subsequent three months. During the three-month implementation period, half-day individual teacher/small group follow-up sessions were available to the participating teachers upon request. The individual teacher/small group follow-up sessions involved modeling of instructional techniques and practices with students, assisting teachers on curriculum development, and/or clarifying concepts presented in the initial three-day workshop session. The participants met together again in a final follow-up session at the end of the three month implementation/individual teacher follow-up period to share their inquiry-based instructional experiences and student outcomes. All aspects of this workshop were aligned with the State of Hawaii Science Content and Performance Standards.

The data for this workshop evaluation were obtained from assessments of the 25 teacher-participants at the beginning of (Pre-Assessment) and again at the end (Post-Assessment) of the 3-day initial workshop, and from questionnaires administered along with the Post-Assessment (Post-Workshop Questionnaire) and during the follow-up session at the end of the program (Post-Follow-Up Questionnaire). Items on the assessments required demonstration of knowledge about the scientific inquiry process, data analyses procedures, and decision-making in science. A number of these items required teachers to demonstrate their knowledge through application. Self-report items measured teacher confidence levels in understanding and using scientific inquiry in the classroom and in comprehending and applying the scientific inquiry content standards to their instruction. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value). A concept inventory determined teachers' familiarity with and ability to teach elements of scientific inquiry and data summary and analysis techniques. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I am familiar with this concept , and have a fair understanding of what it means" (value = 3), "I am very familiar with this concept, but would have some difficulty teaching it to others" (value = 4), and "I am completely familiar with this concept and could easily teach it to others" (value = 5). The pre-workshop and post-workshop assessment items were the same. The Post-Workshop Questionnaire containing five items was also administered to assess the teachers' perceptions of how much their understanding of scientific inquiry and the research investigation process changed and improved as a result of participation in the workshop. Finally, the Post-Follow-Up Questionnaire, containing a number of the teacher confidence and perception items on the Pre- and Post-Assessments, as well as additional items related to the impact of the individual/small group teacher follow-up sessions and activities on teacher perceptions, was administered. Paired *t*-tests were used to determine significant differences (indicating change) between Pre- and Post-Assessment mean values and between Post-Workshop Questionnaire and Post-Follow-Up Questionnaire responses. One-way repeated measures ANOVAs were used to determine significant differences (indicating change) in responses on items from the common items on the Pre-Assessment, Post-Assessment, and Post-Follow-Up Questionnaire. In the latter cases, following a significant effect, Tukey's Tests were used for multiple comparisons. The criterion for statistical significance (α) for all tests was set at 0.05.

Teacher Knowledge and Understanding of the Scientific Research Investigation Process (RIP), and Confidence in Teaching Scientific Inquiry

Workshop participants demonstrated a large, statistically significant increase in their knowledge and understanding of the individual elements of the RIP by the end of the 3-day workshop (Figure 1, below). This included the logical order of the RIP elements, understanding of components involved in each element, and demonstration of the ability to construct testable hypotheses.

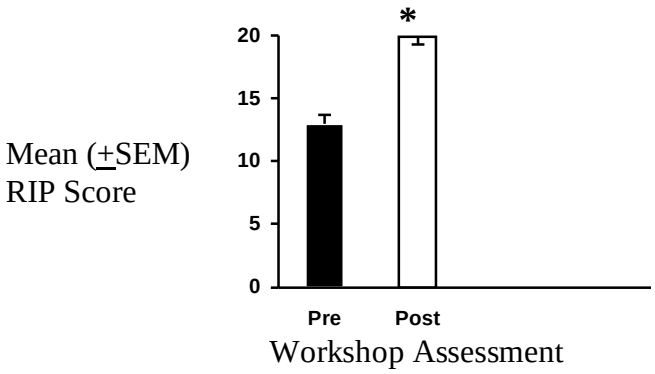

Figure 1. Demonstration of knowledge and understanding of the elements of the RIP. There were a total of 25 points available on this portion of the assessment.

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 8.56, $p<0.001$].

The post-workshop increase in teacher-participant knowledge and understanding of the research process was accompanied by a significant increase in teacher' self-reported familiarity and understanding of concepts related to the scientific research process in the concepts inventory (Figure 2, below). The average participant' response rose from "familiar with a fair understanding of the concept" to "very familiar with the concept with some difficulty in teaching it to others" by the end of the workshop. This showed that teachers recognized their increased knowledge and understanding.

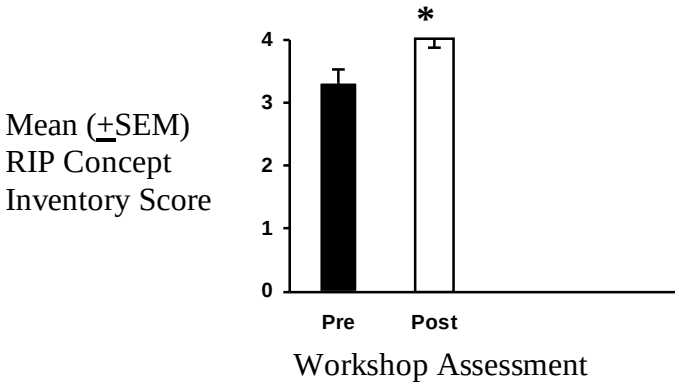

Figure 2. Familiarity and understanding of concepts related to elements of the RIP. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I am familiar with this concept, and have a fair understanding of what it means" (value = 3), "I am very familiar with this concept, but would have some difficulty teaching it to others" (value = 4), and "I am completely familiar with this concept and could easily teach it to others" (value = 5).

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 3.91, $p<0.001$].

By the end of the 3-day workshop, participants' self-reported confidence levels for their ability to use scientific inquiry, their understanding of teaching science through inquiry, and their ability to teach and engage students in scientific research activities all increased significantly f (Figures 3, 4 and 5, below) from less than "confident" to "confident" or higher.

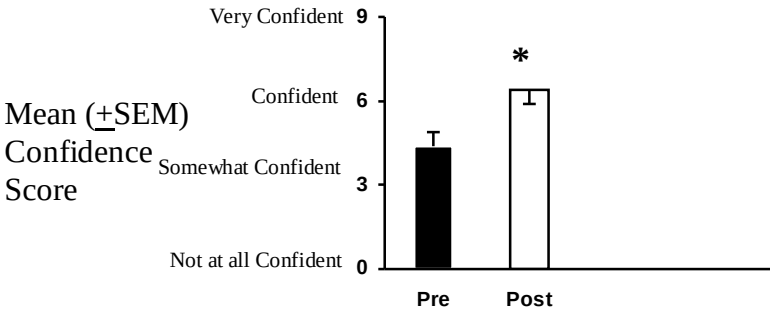

Figure 3. Self-reported confidence levels for ability to use scientific inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 5.20, $p<0.001$].

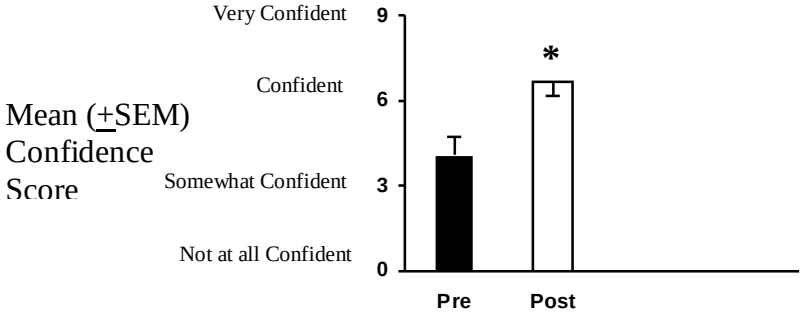

Figure 4. Self-reported confidence levels for understanding of teaching science through inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

*Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 4.81, $p<0.001$].

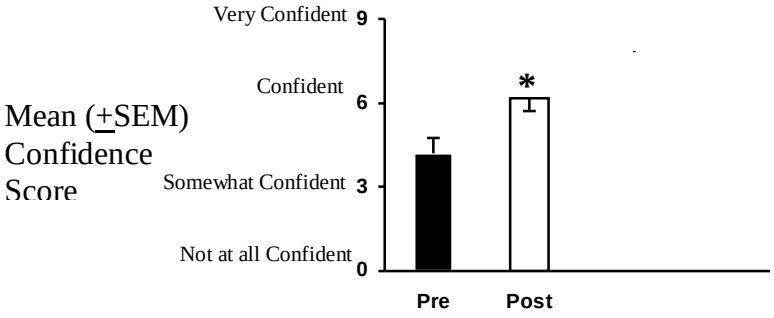

Figure 5. Self-reported confidence levels for ability to teach and engage students in scientific research activities. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 4.58, $p<0.001$].

Teacher Understanding of and Ability to Apply Data Summary, Presentation, and Analysis techniques to Decision-Making in Science

By the end of the workshop, participants demonstrated a large, statistically significant increase, almost doubling their Pre-Assessment score, in their knowledge and ability to correctly organize data into a summary table and to construct a bar graph for comparing the central tendency for two groups of data (Figure 6, below).

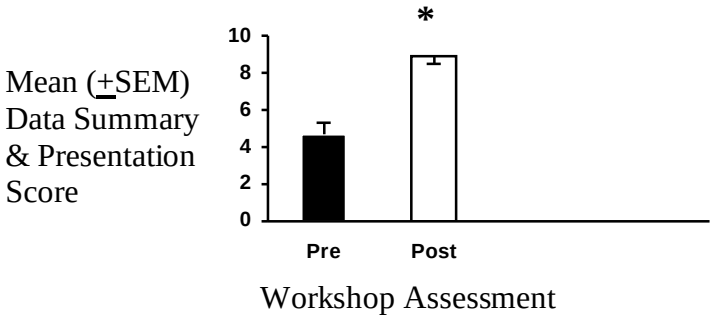

Figure 6. Demonstration of understanding and ability to apply data organization and presentation techniques to data. This section was worth a total of 10 points.

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 6.52, $p<0.001$].

Workshop participants also demonstrated a dramatic change in their knowledge and ability to apply data analysis techniques to research data. Comparison of the pre-and Post-Assessments revealed that by the end of the workshop, they significantly increased their understanding of how to calculate descriptive statistics and their ability to determine which measure of central tendency is most appropriate for a group of data (Figure 7, below).

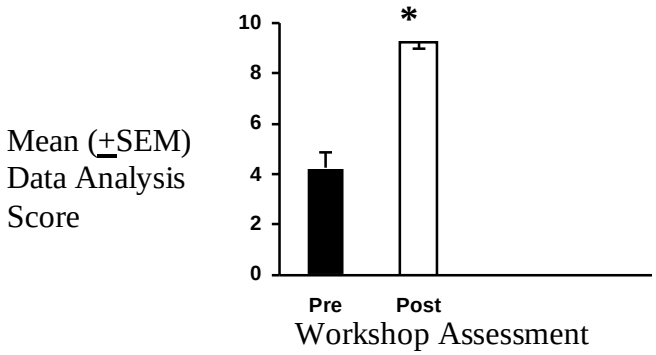

Figure 7. Demonstration of understanding of the calculations for descriptive statistics and ability to determine the most appropriate statistic to represent central tendency for a group of data. This section was worth a total of 10 points.

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 8.21, $p<0.001$].

Participants demonstrated a statistically significant increase in their ability to interpret data presented in scatterplots and summarized in bar graphs by the end of the workshop (Figure 8, below).

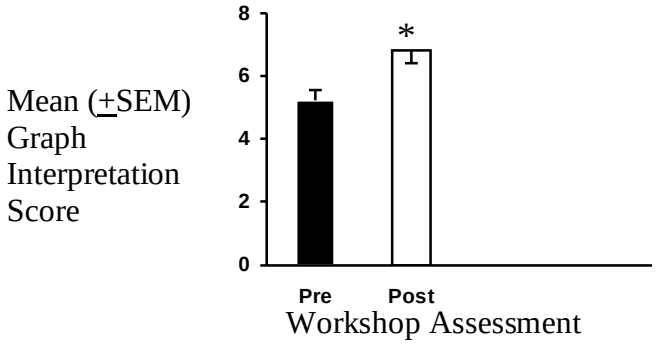

Figure 8. Demonstration of ability to interpret scatterplots and bar graphs. This section was worth a total of 10 points.

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 4.90, $p<0.001$].

The participant increase in knowledge of and ability to apply data presentation and analyses were accompanied by a significant increase in teacher' self-reported familiarity and understanding of concepts related to data presentation and analysis in the concepts inventory (Figures 9 and 10, below). By the end of the workshop, the average participant' response for the three measures of central tendency rose significantly from between "somewhat familiar with concept, but do not really understand what it means" and "I am familiar with this concept, and have a fair understanding of what it means" to between "I very familiar with this concept but would have some difficulty teaching it to others" and "I am completely familiar with this concept and could easily teach it to others (Figure 9).

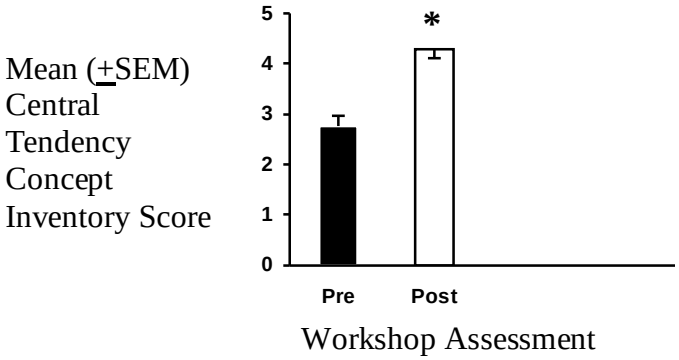

Figure 9. Familiarity and understanding of concepts related to measuring central tendency. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I am familiar with this concept, and have a fair understanding of what it means" (value = 3), "I am very familiar with this concept, but would have some difficulty teaching it to others" (value = 4), and "I am completely familiar with this concept and could easily teach it to others" (value = 5).

***** Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (23) = 7.11, $p<0.001$].

Similarly, the average participant' concept inventory response for tables and graphs rose significantly from "familiar with the concept with a fair understanding of what it means" to "very familiar with the concept, but would have some difficulty teaching it to others" (Figure 10).

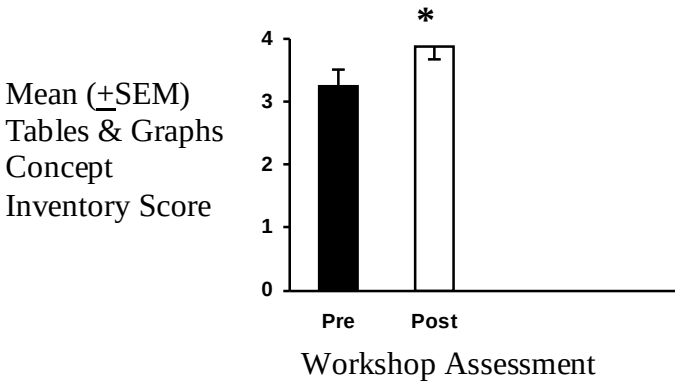

Figure 10. Familiarity and understanding of concepts related to tables and graphs. . The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I am familiar with this concept, and have a fair understanding of what it means" (value = 3), "I am very familiar with this concept, but would have some difficulty teaching it to others" (value = 4), and "I am completely familiar with this concept and could easily teach it to others" (value = 5).

*Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 4.57, $p<0.001$].

Benchmarks and Standards

General teacher confidence in and awareness of ability to understand and apply scientific inquiry to the teaching of science, and in ability to successfully address the scientific inquiry standards, was enhanced by their participation in the workshop. Participant self-reported confidence in ability to address content standards in the classroom rose significantly from less than "confident" to above "confident" by the end of the workshop (Figure 11, below).

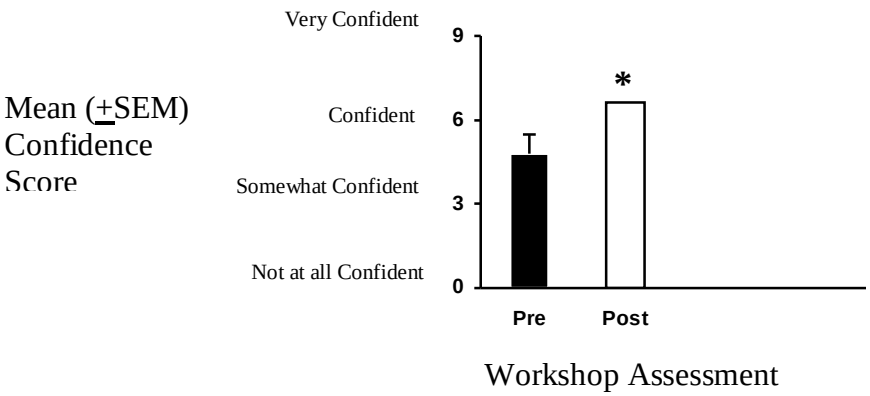

Figure 11. Self-reported confidence levels for ability to address content standards in the classroom. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

* Mean Post-Assessment score is significantly greater than mean Pre-Assessment score [t (24) = 3.71, $p<0.001$].

Similarly, by the end of the workshop, participant confidence about ability to accurately and completely address the scientific inquiry standards dramatically increased from "somewhat confident" to above "confident" (Figure 12, below).

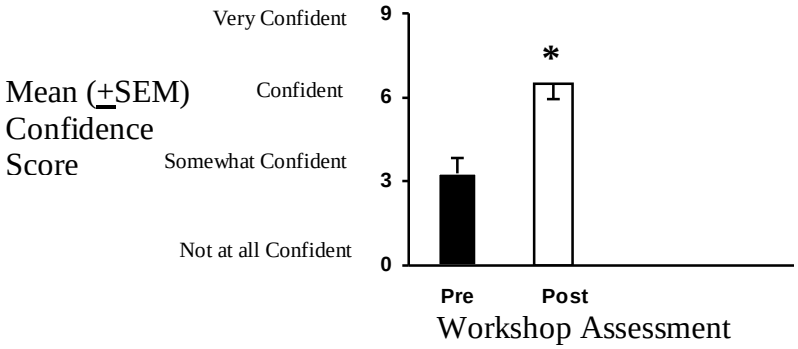

Figure 12. Self-reported confidence levels for ability to accurately and completely address the scientific inquiry benchmarks. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

* Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 7.05, $p<0.001$].

Finally, by the end of the 3-day workshop, teachers significantly increased their familiarity and understanding of inquiry standards from being "somewhat familiar with this concept," but not really understanding what it means to being between "familiar with this concept, with "a fair understanding of what it means" and "very familiar" with this concept, but with "would have some difficulty teaching it to others." This increase was statistically significant and was consistent with the increase in teacher-participant confidence regarding scientific inquiry and addressing the inquiry standards (Figure 13, below).

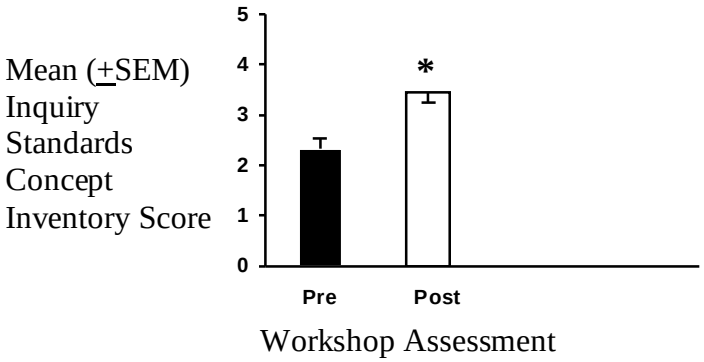

Figure 13. Familiarity and understanding of concept of inquiry standards. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I am familiar with this concept, and have a fair understanding of what it means" (value = 3), "I am very familiar with this concept, but would have some difficulty teaching it to others" (value = 4), and "I am completely familiar with this concept and could easily teach it to others" (value = 5).

*Mean Post-Assessment score is significantly greater than mean pre-assessment score [t (24) = 4.96, $p<0.001$].

Teacher Perceptions of Impact of their Participation in the Initial Three-Day Workshop

The Post-Workshop Questionnaire administered with the Post-Assessment contained five self-report items designed to assess how much teacher-participants believed their knowledge and abilities regarding the scientific research investigation process and scientific inquiry were impacted by their participation in this workshop. The results from these items are presented in Figures 14-19 below.

Seventy-percent (17 of 24) of the participants claimed that their understanding of the research investigation process was *changed* a "large amount" to "completely" as a result of their participation in this workshop, while seven of the participants claimed it changed a "moderate" to a "large amount" (Figure 14, below).

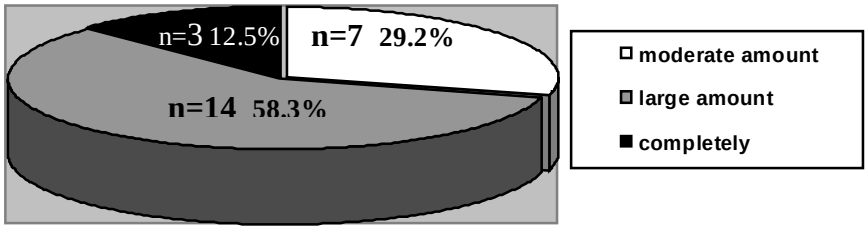

Figure 14. Pie chart representing 24 teacher-participants' responses to "what extent, if any, did your understanding of the research investigation process change as a result of your participation in this workshop?" The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely."

Two-thirds (16 of 24) of the workshop-participants claimed that their understanding of the research investigation process *improved* a "large amount" to "completely" as a result of their participation in the 3-day workshop (Figure 15, below). The remaining eight participants claimed it improved a "moderate" to a "large amount" as a result of their participation.

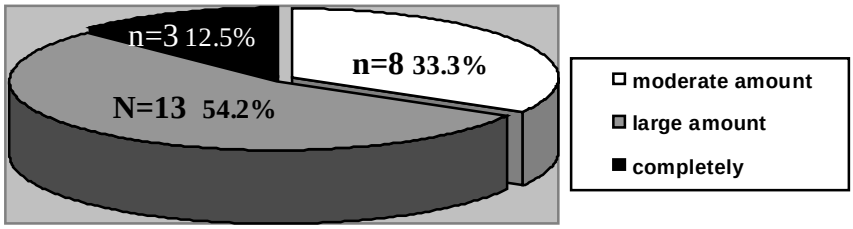

Figure 15. Pie chart representing 24 teacher-participants' responses to "what extent, if any, did your understanding of the research investigation process become clearer as a result of your participation in this workshop?" The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely."

Figure 16 presents a scatterplot of the teacher-reported increase in understanding of the research investigation process plotted as a function of change in understanding of the research investigation process, both as a result of participation in the workshop.

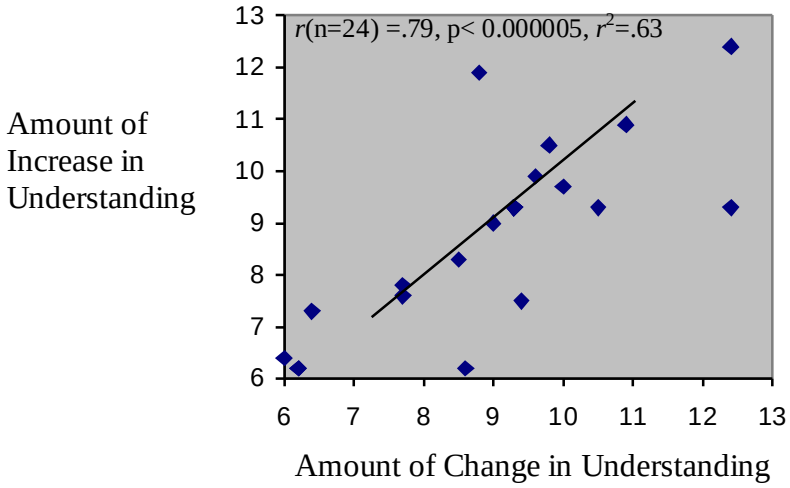

Figure 16. Scatterplot of increase in understanding as a function of change in understanding of the research investigation process, both resulting from participation in the workshop.

As can be seen in Figure 16 above, there was a moderate, statistically significant, positive relationship between the amount of change and the amount of increase in understanding of the scientific research investigation process. Approximately 63% of the increase in understanding was associated with the change in understanding.

More than half of the workshop-participants (14 of 24) claimed that their understanding of how to analyze research data was "substantially" or "dramatically" increased as a result of their participation in this workshop. One-third of the participants reported that their understanding increased "moderately" and the remaining eight-percent "slightly" (Figure 17, below).

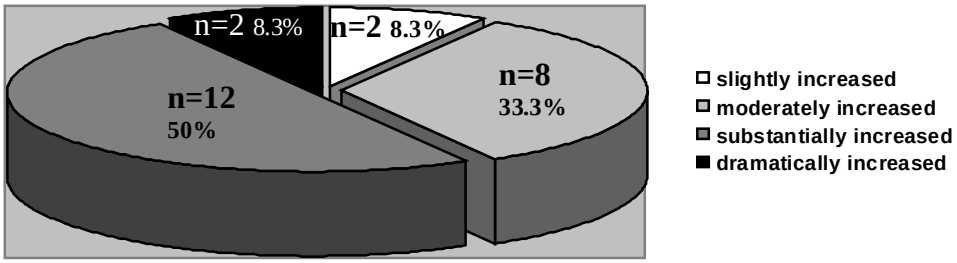

Figure 17. Pie chart representing 24 teacher-participants' responses to completion of, "as a result of my participation in this workshop, my understanding of how to analyze research data has _____." The scale for responses included "remained unchanged," "slightly increased," "a moderately increased," "substantially increased," "and "dramatically increased."

The majority of the workshop-participants (16 of 24 or 66%) "strongly" or "moderately" agreed that their involvement in the initial three-day workshop increased their ability to engage their students in standards-based science learning through scientific inquiry (Figure 18, below). Thirty-percent of the participants "slightly" agreed and one neither agreed nor disagreed that their involvement increased this ability.

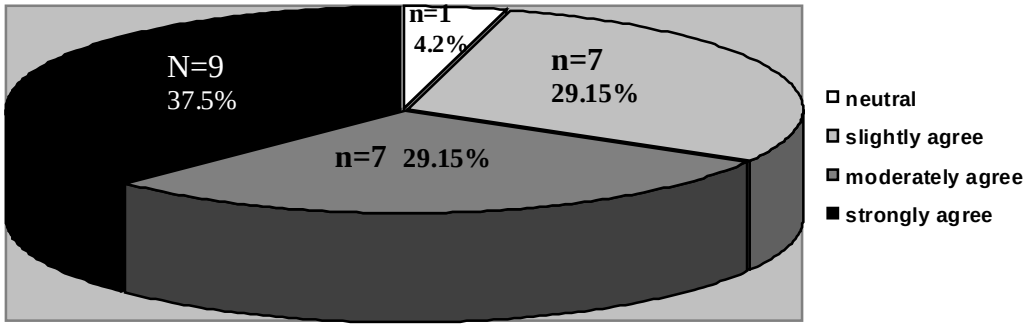

Figure 18. Pie chart representing teacher-participants' degree of agreement with "My involvement in this workshop has increased my ability to engage my students in standards-based science through scientific inquiry." The scale for responses included "strongly disagree," "moderately disagree," "slightly disagree," "neutral," "slightly agree," "moderately agree," "strongly agree."

Again, more than half of the workshop-participants (14 of 24) "strongly" or "moderately" agreed that their involvement in the initial three-day workshop increased their ability to develop a standards-based unit incorporating the research investigation process (Figure 19, below). However, almost 40% of the teachers only "slightly" agreed and one neither agreed nor disagreed that their participation increased this ability.

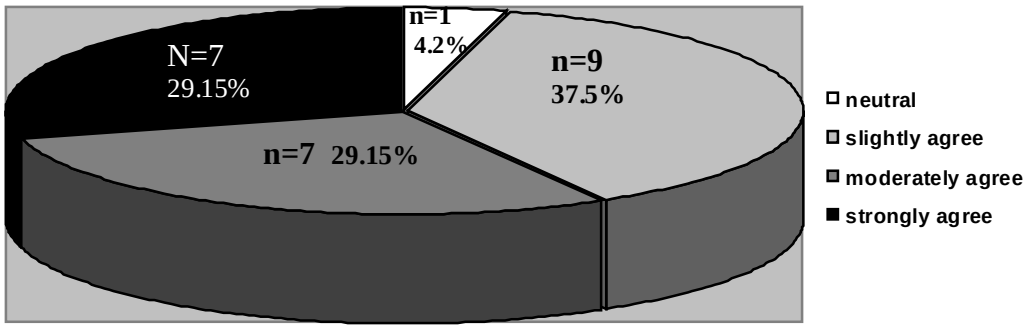

Figure 19. Pie chart representing teacher-participants' degree of agreement with "My involvement in this workshop has increased my ability to develop a standards-based unit incorporating the research investigation process." The scale for responses included "strongly disagree," "moderately disagree," "slightly disagree," "neutral," "slightly agree," "moderately agree," "strongly agree."

Impact of Implementation and Follow-Up Sessions

After the initial 3-day workshop, the teachers were expected to begin to introduce and implement the RIP into their teaching curriculum. There were two components of follow-up in this professional development program: 1) the in-school/classroom follow-up activities with the science literacy project director and individual teachers or small groups of teachers and 2) the final one-day follow-up session in which teachers had the opportunity to share the successes and challenges that they and their students encountered during implementing of the RIP into their classroom curricula. A Post-Follow-Up Questionnaire, administered during the final one-day follow-up session, was used to gather information related to the impact of the entire workshop on teacher understanding of, and ability and confidence in using the RIP as a tool to address science education standards, as well as for comparison with pre- and post-assessment values from the initial three-day workshop sessions and values from the Post-Workshop Questionnaire. Additional items were included on the Post-Follow-Up Questionnaire to directly assess the impact of the in-school/classroom follow-up activities on participant perceptions of achievement of the workshop objectives.

Pre- versus post-implementation and follow-up activities

Overall, although it is clear that substantial gains in teacher knowledge about and ability to use and implement scientific inquiry were achieved through the initial 3-day workshop, the implementation and follow-up experiences led to considerable additional gains in the participants' confidence and perceived ability to introduce the RIP to their students and successfully address the science content standards.

Teacher-confidence in ability to use scientific inquiry at the end of the program was significantly higher than before or after the initial 3-day workshop (Figure 20, below). Teachers were more than "confident" about their ability at the end of the implementation and follow-up activities compared to "confident" after, and slightly more than "somewhat confident" before the initial 3-day workshop. This suggests that the implementation of inquiry-based science instruction in the classroom and the individual follow-up activities positively impacted program-participants' confidence.

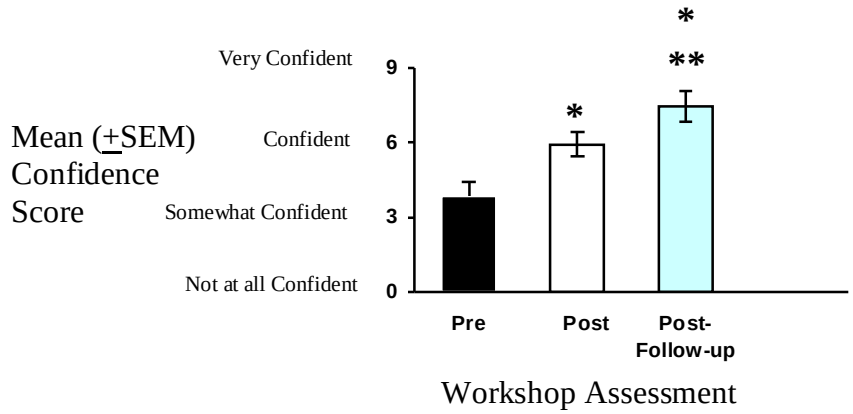

Figure 20. Teachers' self-reported confidence in their ability to use scientific inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value). N=9, two participants did not respond to this item.

One-way repeated measures ANOVA: $F(2,32) = 23.31$, $p<0.001$
*Mean post-workshop confidence is significantly greater than mean pre-workshop confidence; mean post-follow-up confidence is significantly greater than mean pre-workshop confidence; ** Mean post-follow-up confidence is significantly greater than mean post-workshop confidence

Program participants exhibited significantly higher confidence in their ability to teach and engage their students in scientific research activities following the implementation of the RIP into the classroom and participation in individual follow-up compared with pre-3-day workshop confidence levels (Figure 21, below). Although not statistically significant, implementation of the RIP into the classroom and individual follow-up activities resulted in a trend for increased self-reported confidence compared with confidence levels following the initial 3-day workshop (Figure 21, below).

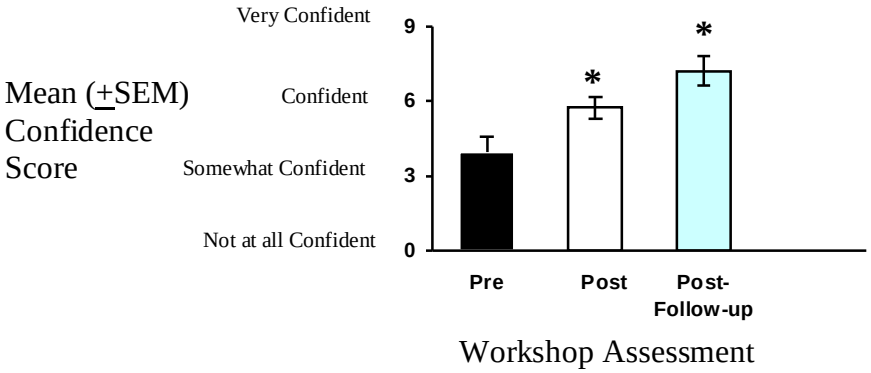

Figure 21. Teachers' self-reported confidence in their ability to teach and engage their students in scientific research activities.

One-way repeated measures ANOVA: $F(2,32) = 14.37$, $p<0.001$
*Mean post-workshop confidence is significantly greater than mean pre-workshop confidence; mean post-follow-up confidence is significantly greater than mean pre-workshop confidence
Although a statistically significant difference was not obtained, there was a trend for a difference between the mean post-follow-up confidence and mean post-workshop confidence levels.

Self-confidence in the participants' understanding of teaching science through inquiry was significantly higher following both the initial 3-day workshop and the classroom implementation and follow-up activities. However, the follow-up did not increase participant confidence above the post-3-day workshop confidence level (Figure 22, below).

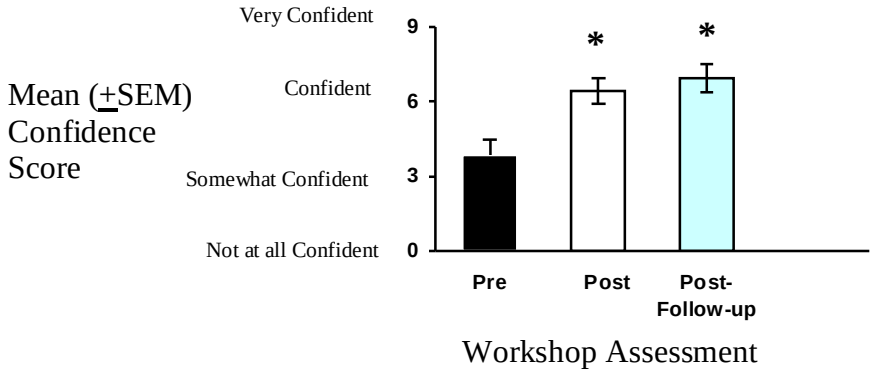

Figure 22. Teachers' self-reported confidence in their understanding of teaching science through inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

One-way repeated measures ANOVA: $F(2,32) = 11.73$, $p<0.001$
*Mean post-workshop confidence is significantly greater than mean pre-workshop confidence; mean post-follow-up confidence is significantly greater than mean pre-workshop confidence

Teacher confidence in ability to address content standards in the classroom was significantly higher than pre-workshop levels following the 3-day workshop and the implementation and follow-up. By the end of the classroom implementation and follow-up, confidence levels had significantly increased to between "confident" and "very confident" from a pre-initial workshop level of around less than "confident" (Figure 23, below).

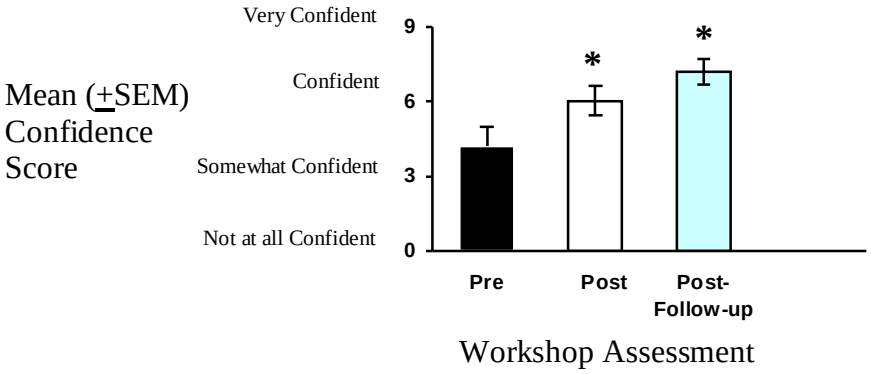

Figure 23. Teachers' self-reported confidence in their ability to address content standards in their classroom. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

One-way repeated measures ANOVA: $F(2,32) = 9.36$, $p<0.001$
*Mean post-workshop confidence is significantly greater than mean pre-workshop confidence; mean post-follow-up confidence is significantly greater than mean pre-workshop confidence

After implementation of the RIP into the classroom and individual follow-up, participant confidence in their ability to completely and accurately address the scientific inquiry benchmarks was higher compared with confidence levels at the end of the initial 3-day workshop (Figure 24, below). Self-reported confidence levels were raised significantly from "confident" after the 3-day workshop to between "confident" and "very confident" after the implementation and follow-up activities.

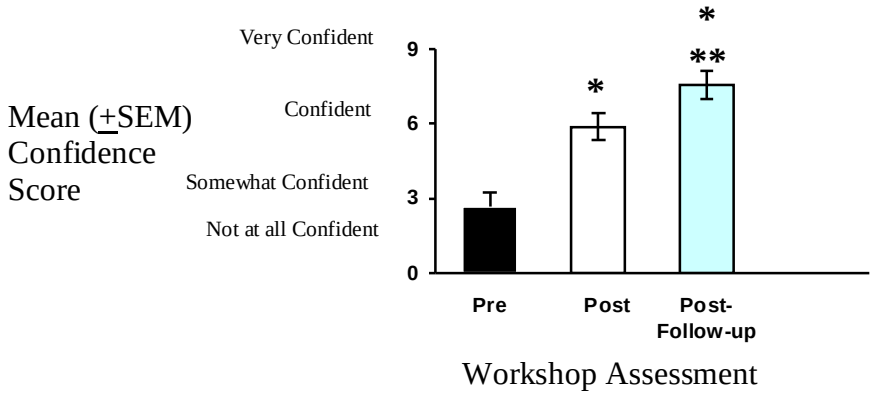

Figure 24. Teachers' self-reported confidence in their ability to accurately address the scientific inquiry benchmarks. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

One-way repeated measures ANOVA: $F(2,32) = 29.30$, $p<0.001$
*Mean post-workshop confidence is significantly greater than mean pre-workshop confidence; mean post-follow-up confidence is significantly greater than mean pre-workshop confidence; ** Mean post-follow-up confidence is significantly greater than mean post-workshop confidence

There was no difference in impact from implementation of the RIP into the classroom and individual follow-up compared with that of the initial 3-Day workshop on teachers' self-reported increases in their understanding of how to analyze research data (Figure 25, below). In each case, program participants reported "substantial" increases in understanding.

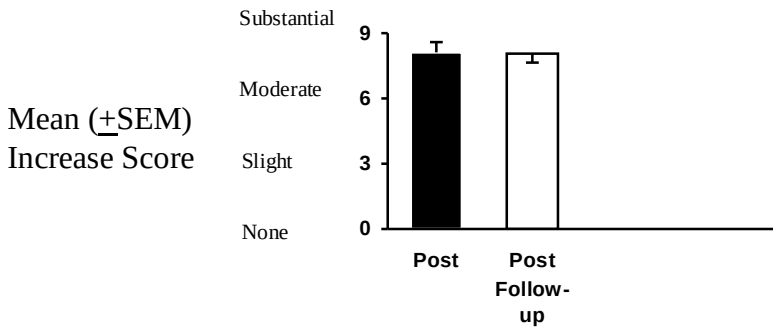

Figure 25. Teacher self-reported increase in understanding of how to analyze research data after the initial 3-day workshop session (Post) compared to after participating in the entire program (Post Follow-up).

* Mean post-follow-up assessment value was not statistically different from the mean post-3-day assessment value [t (26) = .63, $p>0.05$].

Compared to after the initial 3-day workshop, after participation in the implementation and follow-up activities, program participants reported a slightly greater, statistically significant, positive impact on their ability to engage their students in standards-based science learning through scientific inquiry (Figure 26, below).

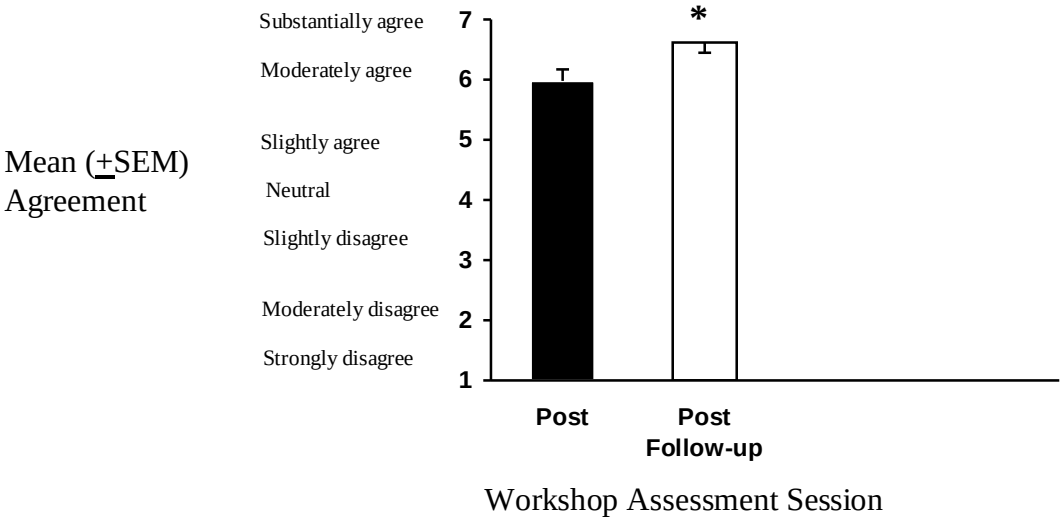

Figure 26. The extent to which teachers agreed with the statement, "My involvement in this workshop has increased my ability to engage my students in standards-based science learning through scientific inquiry," after the three-day workshop session (Post) compared to after the follow-up session.

*Mean post-follow-up assessment value was significantly greater than the mean post-3-day assessment value [t (15) = 2.45, $p<0.03$].

Teacher-participant perception of their ability to develop a standards-based unit incorporating the research investigation process was significantly higher after the implementation and follow-up activities compared to after the 3-day initial workshop participation (Figure 27, below).

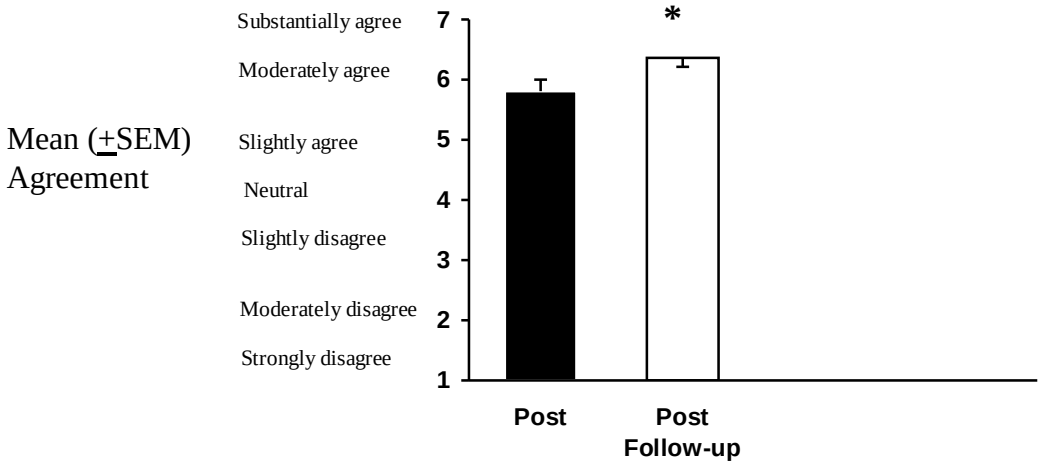

Figure 27. The extent to which teachers agreed with the statement, "My involvement in this workshop has increased my ability to develop a standards-based unit incorporating the research investigation process," after the three-day workshop session (Post) compared to after the follow-up session.

*Mean post-follow-up assessment value was significantly greater than the mean post-3-day assessment value [t (15) = 2.97, p=0.01].

All of the workshop-participants who attended the final follow-up session responded that their use of scientific inquiry in the classroom had "increased" or "greatly increased" since participating in the program (Figure 28, below).

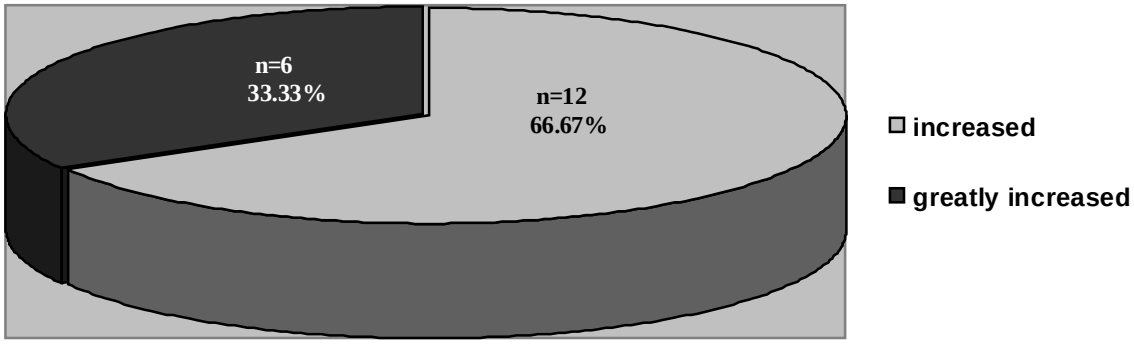

Figure 28. Pie chart representing teacher-participant responses in completing the following sentence: "Since participating in this inquiry workshop program, my use of scientific inquiry in the classroom _____." The scale for responses included "greatly decreased," "decreased," "remained unchanged," "increased," and "greatly increased."

All of the workshop-participants who attended the final follow-up session responded that engaging their students in learning science through inquiry "increased" or "greatly increased" their students' interest in learning science (Figure 29, below).

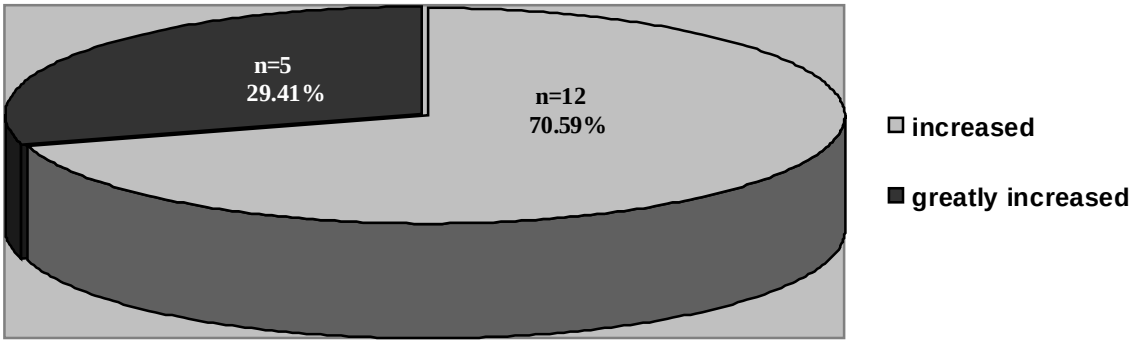

Figure 29. Pie chart representing teacher-participant responses in completing the following sentence: "Engaging my students in learning science through inquiry has _____ their interest in learning science." The scale for responses included "greatly decreased," "decreased," "remained unchanged," "increased," and "greatly increased." One of the eighteen participants who attended the follow-up session did not respond to this item.

Evaluation of in-school/classroom follow-up session impact

Almost three-quarters of the program-participants who participated in individual follow-up activities responded that their follow-up experience enhanced the quality of their classroom inquiry experiences with their students "a large amount" or "completely," while two reported a "moderate" and two a "small amount" of enhancement (Figure 30, below).

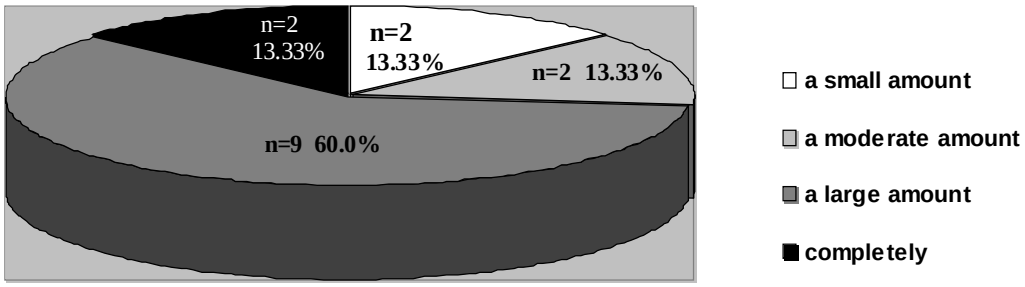

Figure 30. Pie chart representing teacher-participant responses to the question, "To what extent, if any, did the follow-up sessions enhance the quality of your classroom inquiry experiences with you students?" The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely." One of the 16 teachers who participated in the individual follow-up activities did not respond to this item.

Eleven of sixteen, or more than two-thirds, of the workshop-participants who participated in individual follow-up stated that their participation in the follow-up contributed "a large amount" or "completely" to their ability to implement the RIP with their students (Figure 31, below).

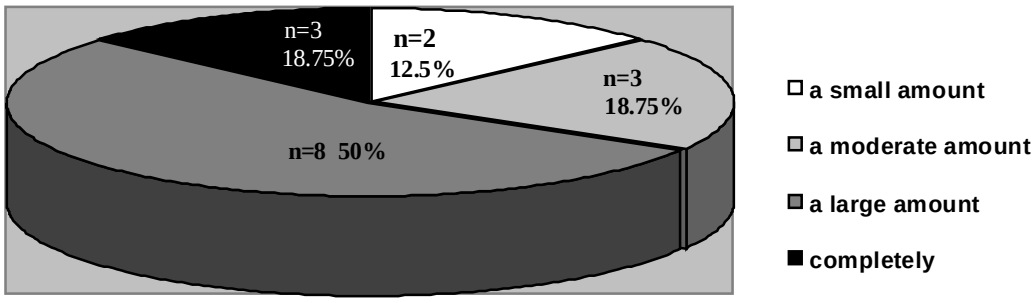

Figure 31. Pie chart representing teacher-participant responses about the extent to which the follow-up sessions contributed to their ability to implement the RIP with their students. The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely."

Three quarters of the workshop-participants who participated in individual follow-up responded that their participation contributed "a large amount" or "completely" to changes in their understanding of the research investigation (Figure 32, below).

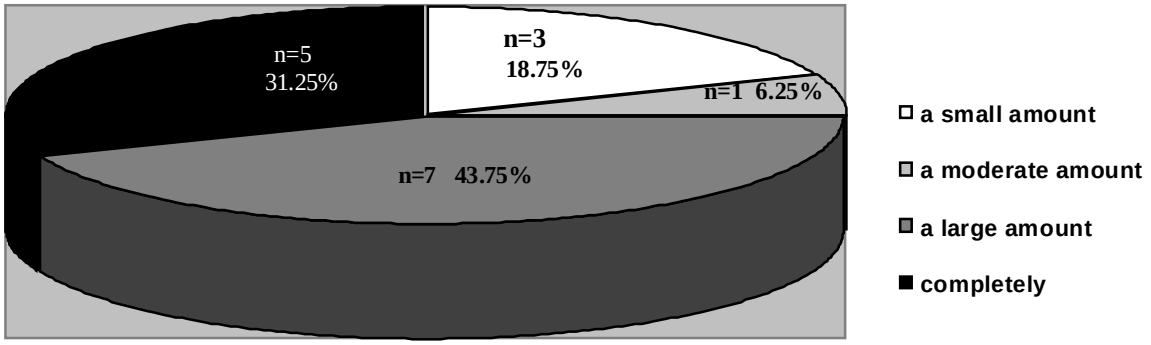

Figure 32. Pie chart representing teacher-participant responses as to the extent to which the follow-up sessions changed their understanding of a research investigation. The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely."

A majority (11 of 15) of the teachers who took part in individual follow-up responded that their participation resulted in a clearer understanding of the RIP (Figure 33, below).

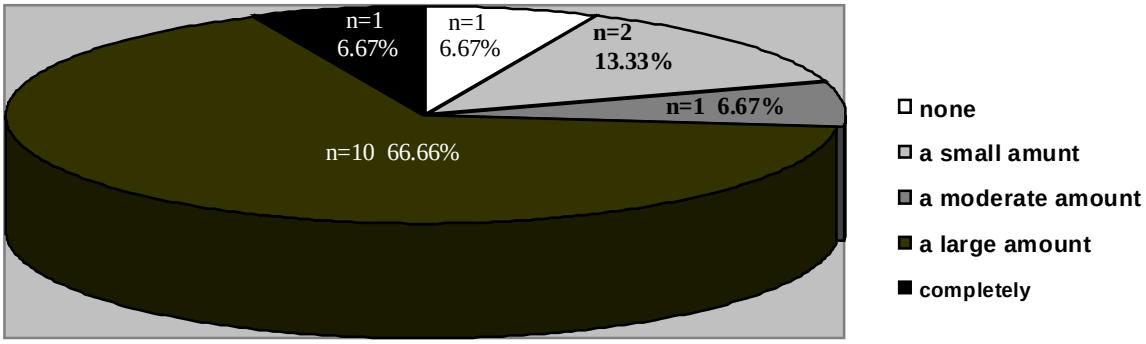

Figure 33. Pie chart representing teacher-participant responses as to the extent to which the follow-up sessions increased the clarity of their understanding of the RIP. The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely." One of the 16 teachers who participated in the individual follow-up activities did not respond to this item.

PD-Credit Evaluation Items

The Hawaii State DOE Professional Development (PD)-Credit Evaluation was administered to the 9 teachers who were taking this science literacy/inquiry program for credits. Figure 34 below presents then mean teacher responses for each of the ten items on the PD Evaluation. All of the ten PD-Credit items pertaining to this science literacy/inquiry program exceeded the "more than meets" the standard criterion, with five of those closely approaching "meets to a high degree."

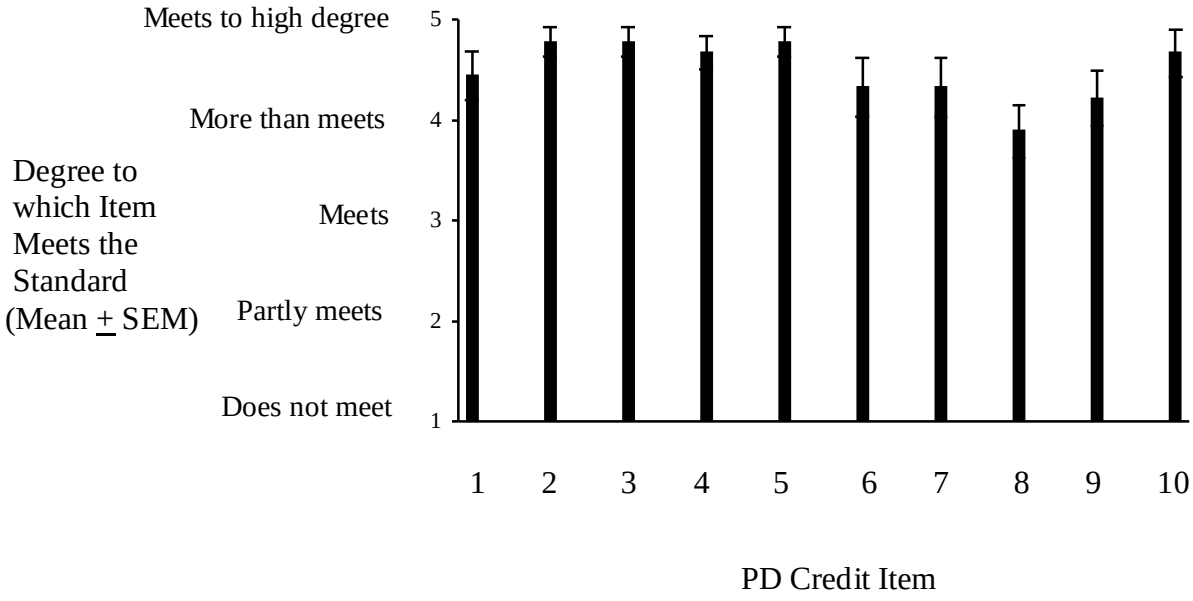

Figure 34. Honolulu District 2003 Science Literacy-Scientific Inquiry Professional Development Workshop.

Items: 1) focuses on Hawaii Content and Performance Standards, 2) focuses on student learning, 3) results-oriented, 4) appropriate content, on-going and sustained, 5) active engagement, 6) collegial, 7) job-embedded, 8) systemic perspective, 9) client-focused and adaptive, and 10) incorporates reflection

Program Evaluation Summary

Based on the findings from this evaluation, *Teaching Science Literacy through Inquiry-The Research Investigation Process (RIP)* successfully introduced K-12 teachers to the teaching of science through true scientific inquiry, meeting or exceeding the program's goals in all aspects of professional development assessed. The professional development program successfully instructed teachers in using the research investigation process (RIP) and afforded them the opportunity to explore the RIP as a tool for addressing the Hawaii Science Content and Performance Domain I standards. Teacher-participants learned to use the inquiry process and to design and conduct scientific research studies; became familiar with techniques to assist in guiding students through the scientific inquiry process; demonstrated understanding of, and competence in the ability to apply data

analysis techniques to decision-making in science; reported increased confidence in using scientific research in their approach to instructing students in science and in addressing the scientific inquiry benchmarks and science inquiry content standards; successfully implemented the RIP as a tool for instruction in the classroom; and reported increased student interest in the learning of science.

Although the implementation into the classroom and follow-up activities appeared to have had a strong impact on the success of this program, interpretation of these data should be made with caution. To ensure that measured effects from comparisons of measurements taken after the initial 3-day workshop and again after implementation and follow-up activities were caused by these activities and not the passage of time, control groups of teachers who did not participate in either one or both of these post initial 3-day workshop activities should be included. Inclusion of these control groups within this scientific literacy/inquiry project was not possible for both practical and ethical reasons.