ANOVA Science Education Corporation Professional Development Program for K-6 Teachers: Teaching Science Literacy through Inquiry- The Research Investigation Process (RIP™) , Program Evaluation.

RIP Implementation and In-Classroom Follow-up
Honolulu District, Honolulu, Hawaii
June 25, 2003

The purpose of this professional development program was to introduce K-6 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 program evaluation were obtained from assessments of 11 of the 12 elementary teacher-participants at the beginning of (Pre-Assessment) and again at the end (Post-Assessment) of the 3-day initial workshop, 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, N=7 participants). (One of the program participants was eliminated from the evaluation because they were unable to attend all of the workshop sessions and, therefore, did not complete both of the assessments.) 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. The Pre- and Post-Assessment data were statistically analyzed one-way repeated measures ANOVAs to determine significant differences (indicating change) between pre- and post-assessment mean values. ANOVAs were also used to compare responses on items from the Post-Workshop Questionnaire with the Post-Follow-Up Questionnaire, and were to compare responses from 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, almost doubling their assessment scores by the end of the initial 3-day workshop session (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.

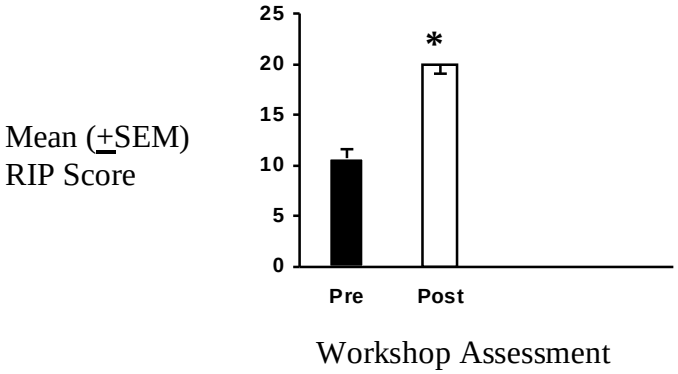

Figure 1. Demonstration of knowledge and understanding of the elements of the RIP. There were a total of 25 points available on this portion of the assessment.

*Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 67.13, p<0.001].

The post-3-day 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). By the end of the workshop, the average participant' response rose from "familiarity with fair understanding of concept" to "very familiar with concept and could teach it to others." This showed that teachers recognized their increased knowledge and understanding.

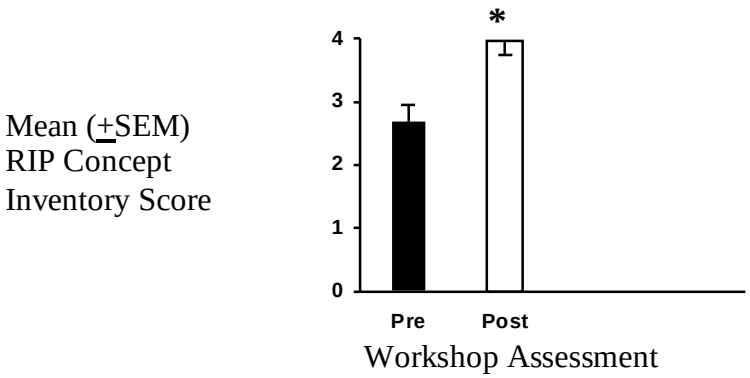

Figure 2. Familiarity and understanding of concepts related to elements of the RIP. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I 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 [F (1,10) = 32.74, p<0.001].

By the end of the initial 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 significantly increased, doubling compared to pre-workshop levels (Figures 3, 4, and 5, below).

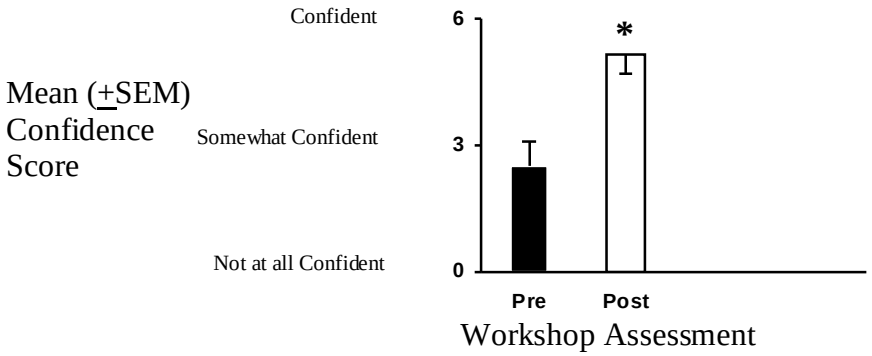

Figure 3. Self-reported confidence levels for participants' ability to use scientific inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

*Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 17.16, p=0.002].

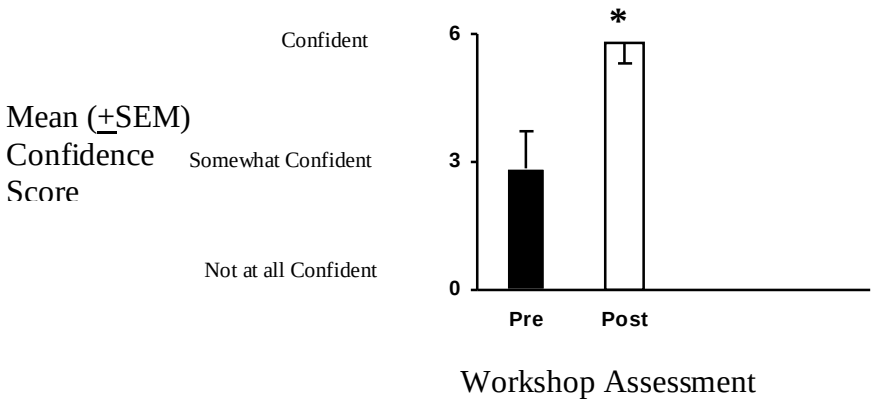

Figure 4. Self-reported confidence levels for understanding of teaching science through inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

*Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 15.75, p=0.003].

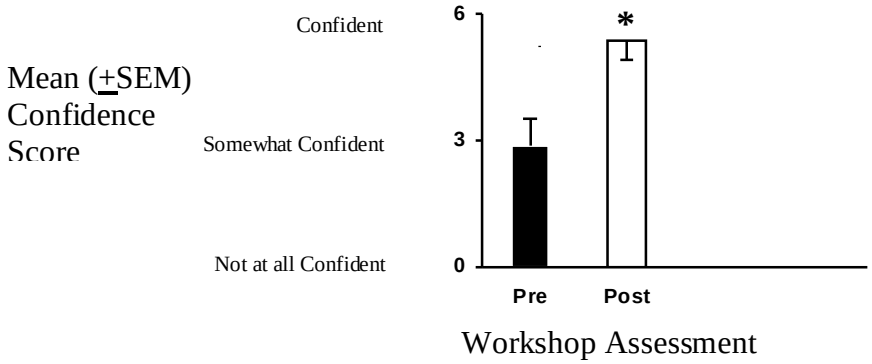

Figure 5. Self-reported confidence levels for ability to teach and engage students in scientific research activities. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

*****Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 15.80, p=0.003].

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

By the end of the initial 3-day workshop, participants demonstrated a dramatic, statistically significant increase in their knowledge and ability to correctly organize data into a summary table and to construct a bar graph for comparing the central tendency of two groups of data (Figure 6, below).

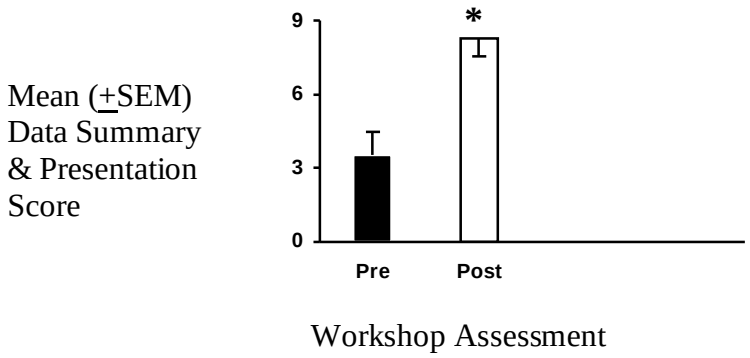

Figure 6. Demonstration of understanding and ability to apply data organization and presentation techniques to data. This section was worth a total of 10 points.

***** Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 18.47, p=0.002].

Workshop participants also demonstrated a very large 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 3-day workshop, participants 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).

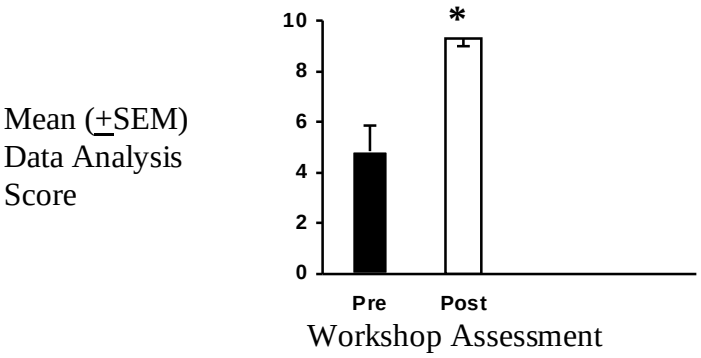

Figure 7. Demonstration of understanding the calculations for descriptive statistics and ability to determine the most appropriate statistic to represent central tendency for a group of data. This section was worth a total of 10 points.

***** Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 16.96, p=0.002].

Teacher-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 3-day workshop (Figure 8, below).

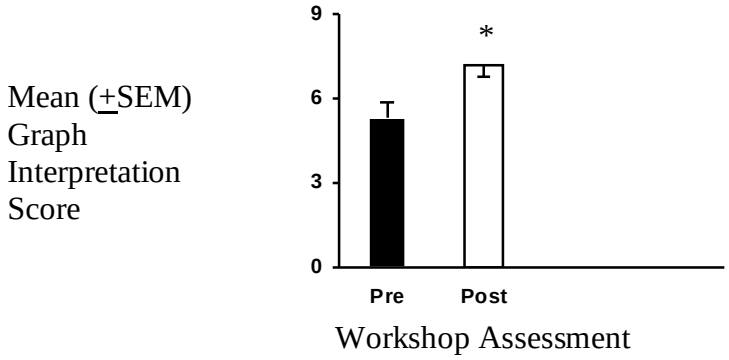

Figure 8. Demonstration of ability to interpret scatterplots and bar graphs. This section was worth a total of 10 points.

***** Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 19.17, p=0.001].

The post-3-day workshop increases in teacher-participant knowledge of and ability to apply data presentation and analyses were accompanied by significant increases in teacher' self-reported familiarity and understanding of concepts related to data presentation and analysis (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 "somewhat familiar with concept, but do not really understand what it means" to "very familiar with concept, but would have some difficulty teaching it to others" (Figure 9).

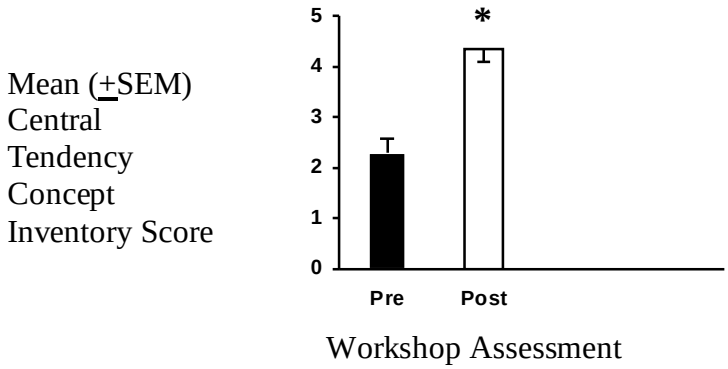

Figure 9. Familiarity and understanding of concepts related to measuring central tendency. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 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 [F (1,10) = 51.76, p<0.001].

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

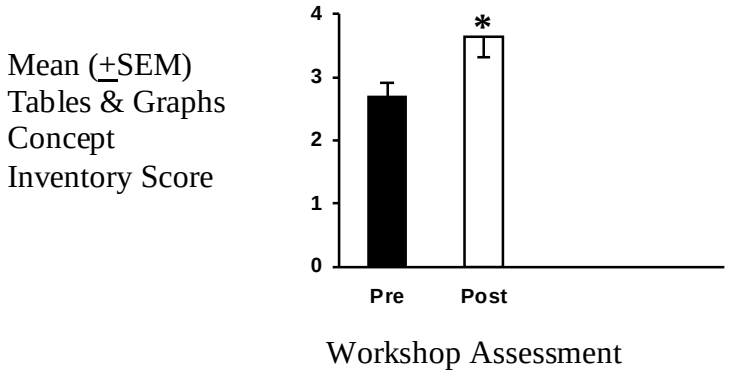

Figure 10. Familiarity and understanding of concepts related to tables and graphs. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I 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 [F (1,10) = 21.20, p<0.001].

Benchmarks and Standards

General teacher confidence 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 were also affected by participation in the initial 3-day workshop. Teacher-participant self-reported confidence in ability to address content standards in the classroom rose significantly, from "somewhat confident" to "confident" by the end of the workshop (Figure 11, below).

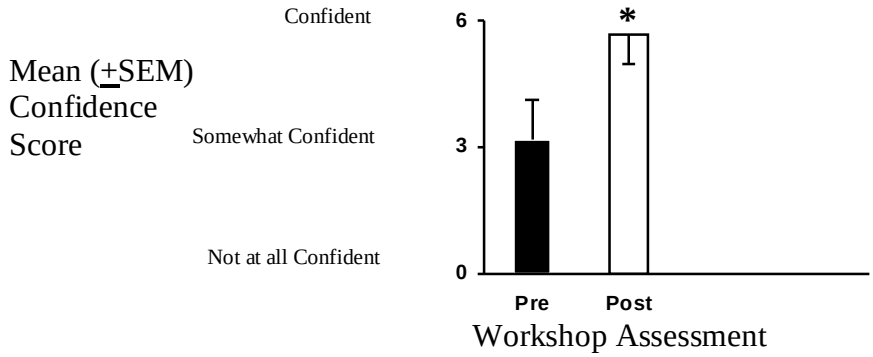

Figure 11. Self-reported confidence levels for ability to address content standards in the classroom. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

* Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 10.96, p=0.008].

Similarly, by the end of the workshop, participants' confidence scores in their ability to accurately and completely address the scientific inquiry benchmarks doubled, increasing from below "somewhat confident" to near "confident" (Figure 12, below).

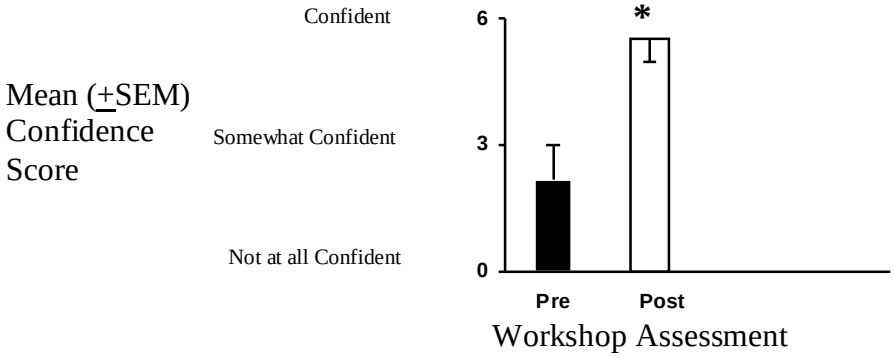

Figure 12. Self-reported confidence levels for ability to accurately and completely address the scientific inquiry benchmarks. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident"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

* Mean post-assessment score is significantly greater than mean pre-assessment score [F (1,10) = 18.51, p=0.002].

Finally, by the end of the 3-day initial 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 "very familiar with this concept, but would have some difficulty teaching it to others" (Figure 13, below). This increase was statistically significant and was consistent with the increase in teacher-participant confidence regarding addressing the scientific inquiry content standards and benchmarks (Figures 11 and 12, above).

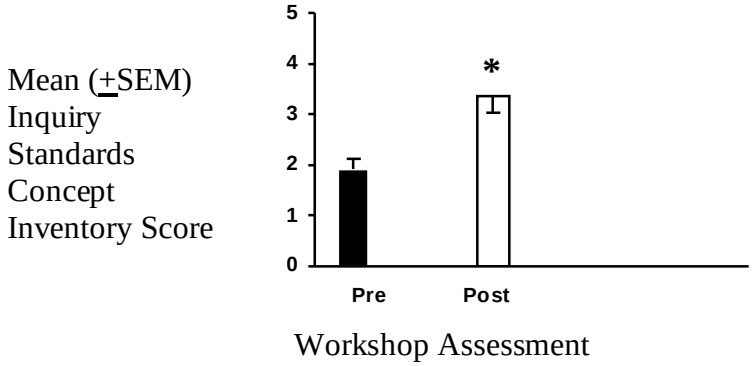

Figure 13. Familiarity and understanding of the inquiry standards concept. The answer scale for the concept inventory items included "I am completely unfamiliar with this concept" (value=1), "I am somewhat familiar with this concept, but do not really understand what it means" (value = 2), "I am familiar 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 [F (1,10) = 15.80, p=0.003].

Teacher Perceptions of Overall Impact of the Initial 3-Day Workshop on Understanding of and Ability to Implement Standards-Based Inquiry

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 (RIP) and scientific inquiry were impacted by their participation in the initial 3-day workshop. The results from these items are presented in Figures 14-19 below.

A majority of the workshop-participants (70%) claimed that their understanding of the RIP was changed a "large amount" to "completely" as a result of their participation in this workshop, while three participants claimed it was changed a "moderate amount" (Figure 14, below).

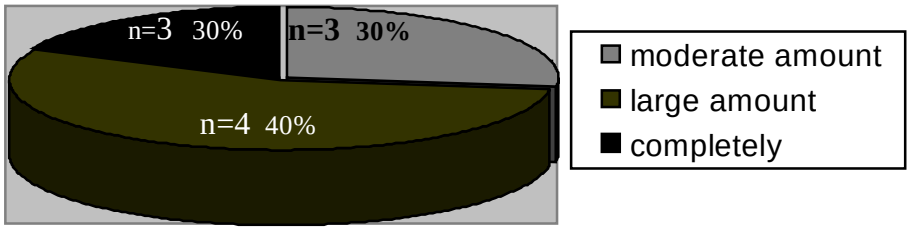

Figure 14. Pie chart representing 10 teacher-participants' responses to "what extent, if any, did your understanding of the research investigation process change as a result of your participation in this workshop?" The scale for responses included "none," "a small amount," " a moderate amount," "a large amount," and "completely." One participant did not respond to this item on the Post-Workshop Questionnaire.

Four-fifths of the workshop-participants (8 of 10) 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 other two participants claimed "moderate" improvement in their understanding of the RIP as a result of their participation.

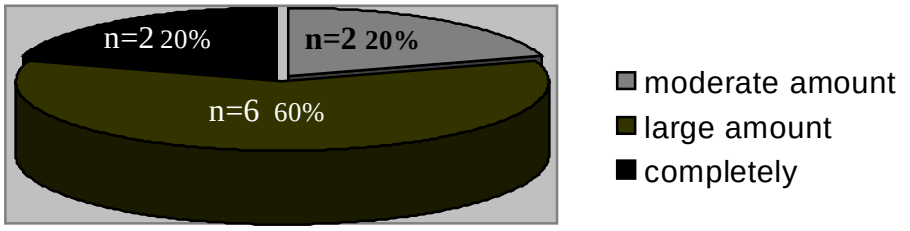

Figure 15. Pie chart representing 10 teacher-participants' responses to "what extent, if any, did your understanding of the research investigation process become clearer as a result of your participation in this workshop?" The scale for responses included "none," "a small amount," " a moderate amount," "a large amount," and "completely." One participant did not respond to this item on the Post-Workshop Questionnaire.

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

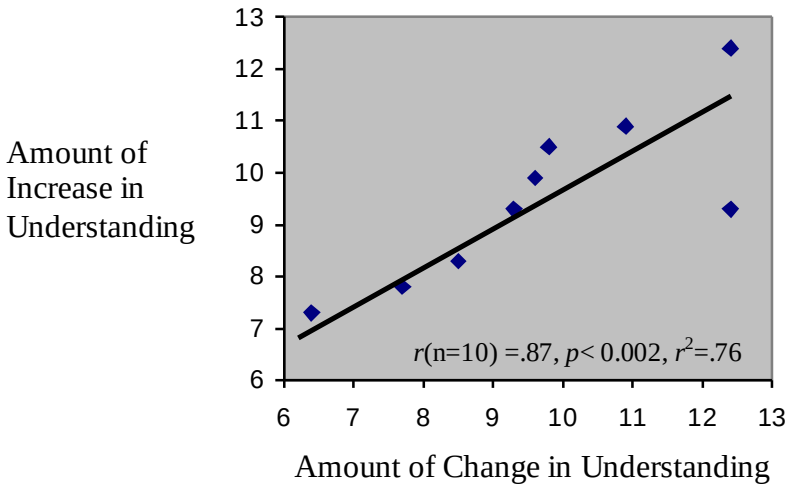

Figure 16. Scatterplot of increase in understanding as a function of change in understanding of the RIP, both resulting from participation in the workshop. One participant did not respond to both items and was eliminated from the analysis.

There was a high positive, statistically significant, relationship between the amount of change and the amount of increase in understanding of the scientific research investigation process (Figure 16): the greater the change in understanding, the clearer the understanding became. Approximately 76% of the increase in understanding was associated with the change in understanding.

All of the workshop-participants claimed that their understanding of how to analyze research data was either "moderately" or "substantially" increased as a result of their participation in this workshop (Figure 17, below).

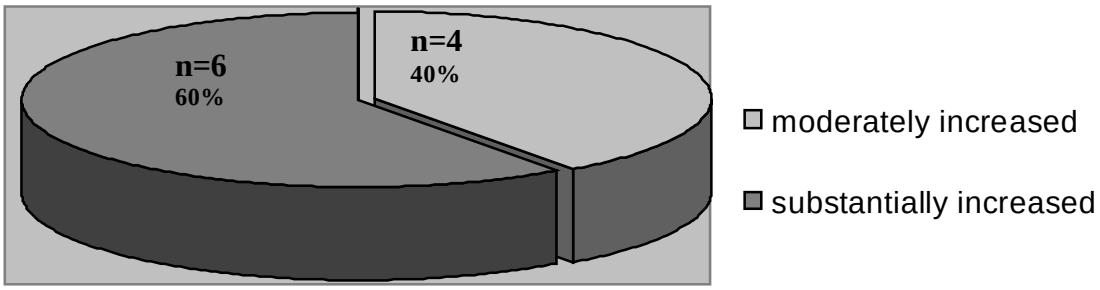

Figure 17. Pie chart representing 10 teacher-participants' responses to completion of the statement, "as a result of my participation in this workshop, my understanding of how to analyze research data has _____." The scale for responses included "remained unchanged," "slightly increased," "moderately increased," "substantially increased," "and "dramatically increased." One participant did not respond to this item.

Half of the participants "strongly" 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, while the other half "moderately" or "slightly" agreed (Figure 18, below).

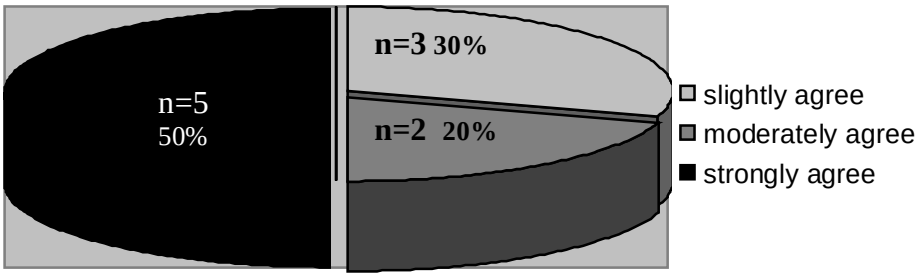

Figure 18. Pie chart representing teacher-participants' degree of agreement with "My involvement in this workshop has increased my ability to engage my students in standards-based science through scientific inquiry." The scale for responses included "strongly disagree," "moderately disagree," "slightly disagree," "neutral," "slightly agree," "moderately agree," and "strongly agree." One participant did not respond to this item.

A majority of the workshop-participants (6 of 10) "moderately" to "strongly" agreed, while four "slightly" agreed, that involvement in the initial three-day workshop increased their ability to develop a standards-based unit incorporating the research investigation process (Figure 19, below).

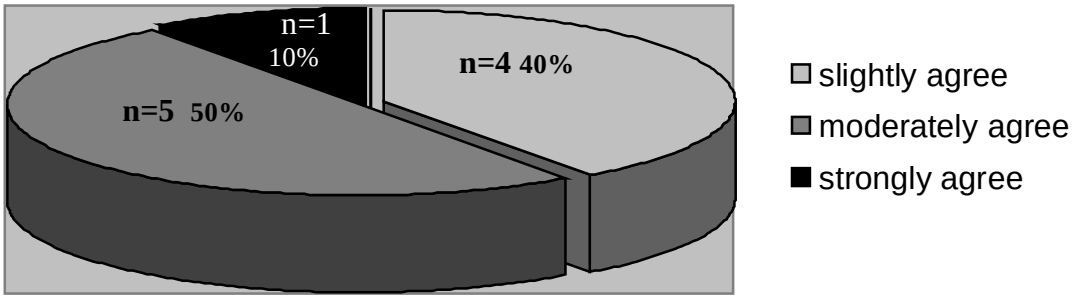

Figure 19. Pie chart representing teacher-participants' degree of agreement with "My involvement in this workshop has increased my ability to develop a standards-based unit incorporating the research investigation process." The scale for responses included "strongly disagree," "moderately disagree," "slightly disagree," "neutral," "slightly agree," "moderately agree," and "strongly agree." One participant did not respond to this item.

Impact of Implementation and Follow-Up Activities

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 slightly less than "confident" after, and less 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.

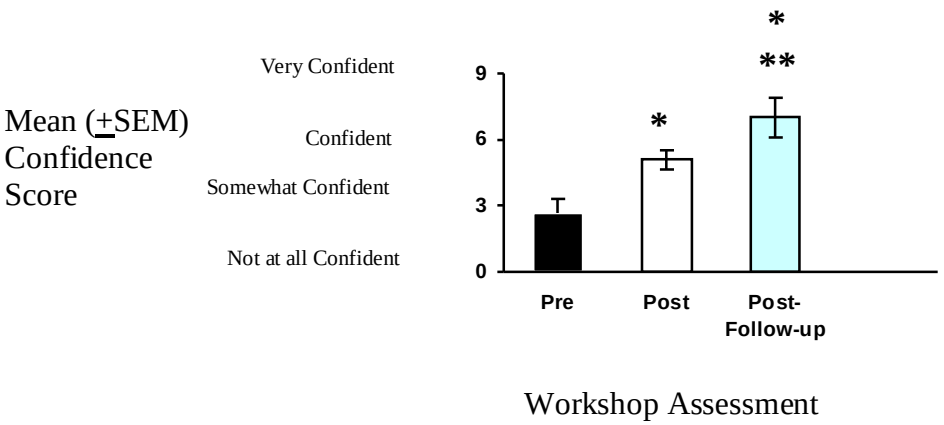

Figure 20. Teachers' self-reported confidence in their ability to use scientific inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value). N=9, two participants did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

One-way repeated measures ANOVA: $F(2,16) = 18.08$, $p<0.001$
*Mean post-workshop confidence significantly greater than mean pre-workshop confidence; mean post-follow-up confidence significantly greater than mean pre-workshop confidence; ** Mean post-follow-up confidence 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).

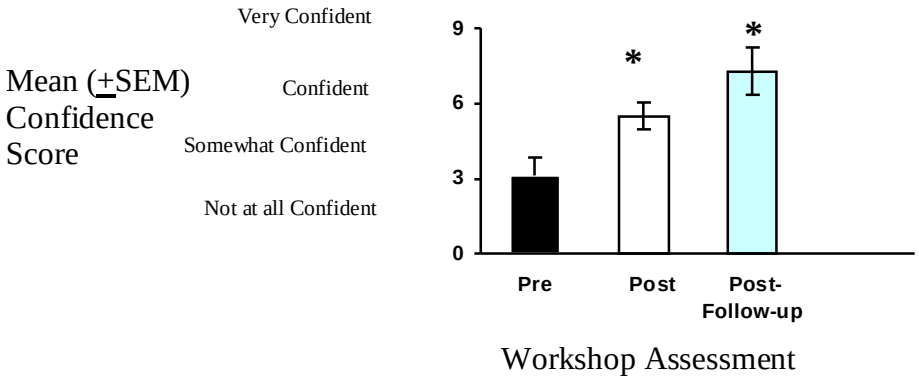

Figure 21. Teachers' self-reported confidence in their ability to teach and engage their students in scientific research activities.

One-way repeated measures ANOVA: $F(2,16) = 12.71$, $p<0.001$

*Mean post-workshop confidence significantly greater than mean pre-workshop confidence; mean post-follow-up confidence 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.

Similarly, although participants' confidence in their understanding of teaching science through inquiry following implementation and follow-up activities appeared to increase above the post-3-day workshop confidence level, these confidence levels were not statistically different (Figure 22, below).

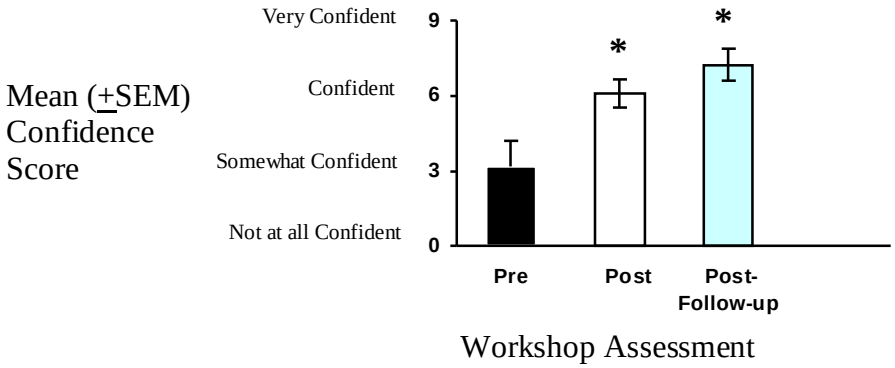

Figure 22. Teachers' self-reported confidence in their understanding of teaching science through inquiry. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

One-way repeated measures ANOVA: $F(2,16) = 12.01$, $p<0.001$
*Mean post-workshop confidence significantly greater than mean pre-workshop confidence; mean post-follow-up confidence significantly greater than mean pre-workshop confidence.

The impact of both the implementation of the RIP into the classroom and the individual participant follow-up activities resulted in an increase in teacher confidence in ability to address content standards in the classroom. By the end of the classroom implementation and follow-up, confidence levels had significantly increased from a pre-initial workshop level of "somewhat confident" to above "confident" (Figure 23, below).

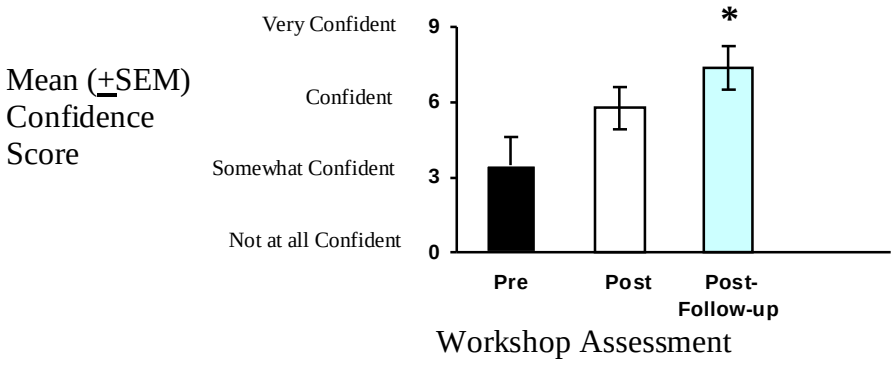

Figure 23. Teachers' self-reported confidence in their ability to address content standards in their classroom. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident" ('9'-value).

One-way repeated measures ANOVA: $F(2,16) = 8.34$, $p=0.003$
*Mean post-follow-up confidence significantly greater than mean pre-workshop confidence.

After implementation of the RIP into the classroom and individual follow-up, confidence of participants in their ability to completely and accurately address the scientific inquiry benchmarks appeared to be 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 below "somewhat confident" to "confident" after the 3-day workshop and to between "confident" and "very confident" after the implementation and follow-up activities. Although not statistically different, there was a trend for a difference between the Post-Workshop confidence and the Post-Follow-Up confidence levels.

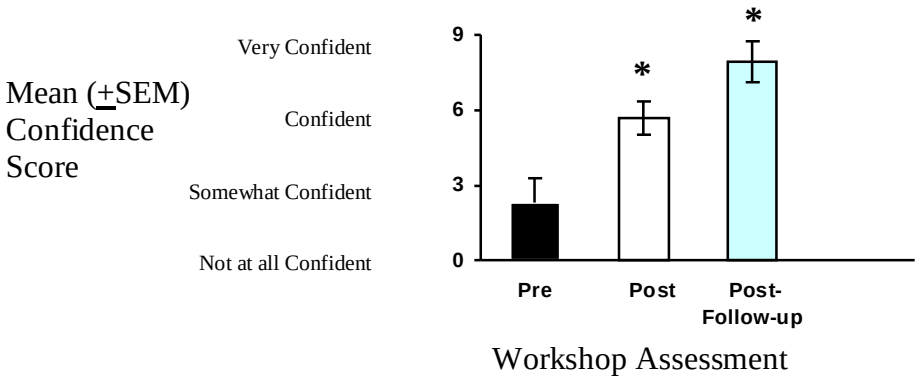

Figure 24. Teachers' self-reported confidence in their ability to completely and accurately address the scientific inquiry benchmarks. The response scale for the confidence items included "not at all confident" ('0'-value), "somewhat confident" ('3'-value), "confident" ('6'-value), and "completely confident"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

One-way repeated measures ANOVA: $F(2,16) = 17.33$, $p<0.001$

*Mean post-workshop confidence significantly greater than mean pre-workshop confidence; mean post-follow-up confidence 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.

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.

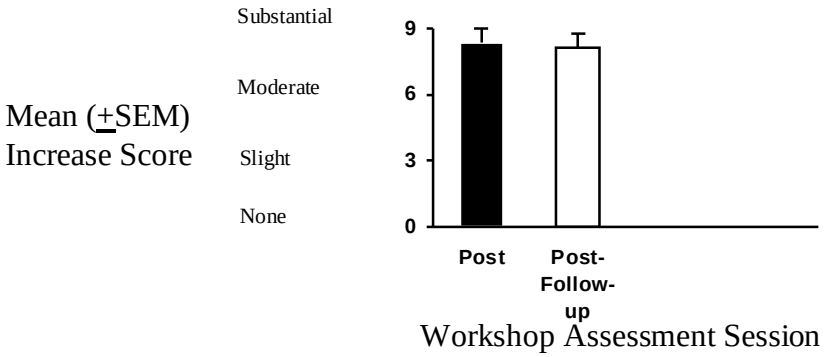

Figure 25. Teacher self-reported increase in understanding of how to analyze research data after the initial 3-day workshop session (Post) compared to after participating in the entire program. N=8, three subjects did not respond to this item on the Post-Workshop and/or Post-Follow-Up Questionnaires.

* Mean post-follow-up assessment value was not statistically different from the mean post-3-day assessment value [F (1,7) = .13, p>0.05].

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

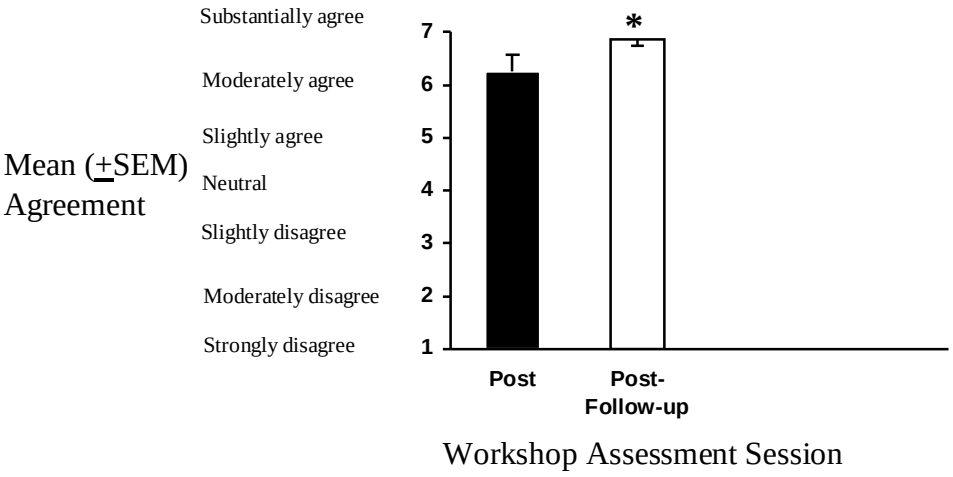

Figure 26. The extent to which teachers agreed with the statement, "My involvement in this workshop has increased my ability to engage my students in standards-based science learning through scientific inquiry," after the 3-day workshop session (Post) compared to after the follow-up session. N=8, three subjects did not respond to this item on the Post-Workshop and/or Post-Follow-Up Questionnaires.

*Mean post-follow-up assessment value was significantly greater than the mean post-3-day assessment value [F(1,7) = 5.65, p<0.05].

Teachers' perceived 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).

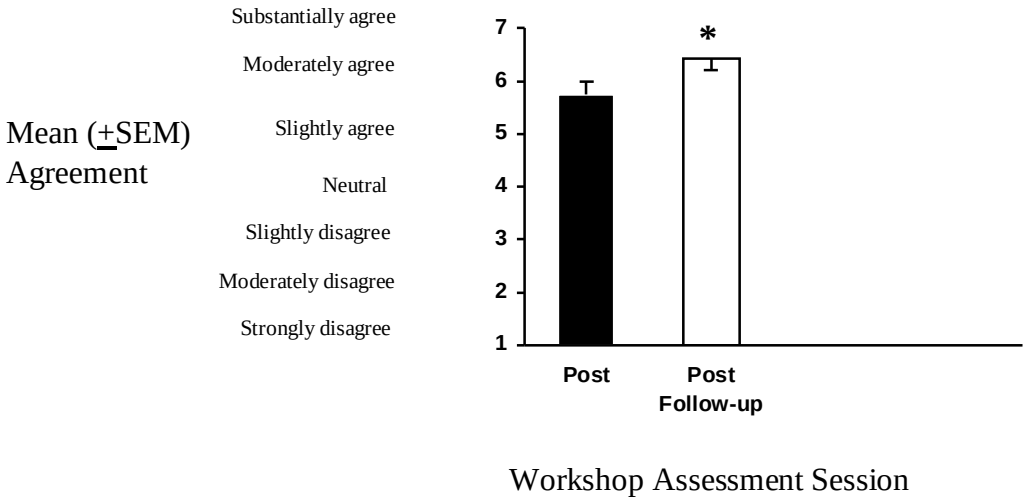

Figure 27. The extent to which teachers agreed with the statement, "My involvement in this workshop has increased my ability to develop a standards-based unit incorporating the research investigation process," after the 3-day workshop session (Post) compared to after the follow-up session. N=8, three subjects did not respond to this item on the Post-Workshop and/or Post-Follow-Up Questionnaires.

*Mean Post-Follow-Up Questionnaire value was significantly greater than the mean Post-Workshop Questionnaire value [$F(1,7) = 18.02$, $p=0.004$].

All of the 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 science literacy/inquiry program (Figure 28, below).

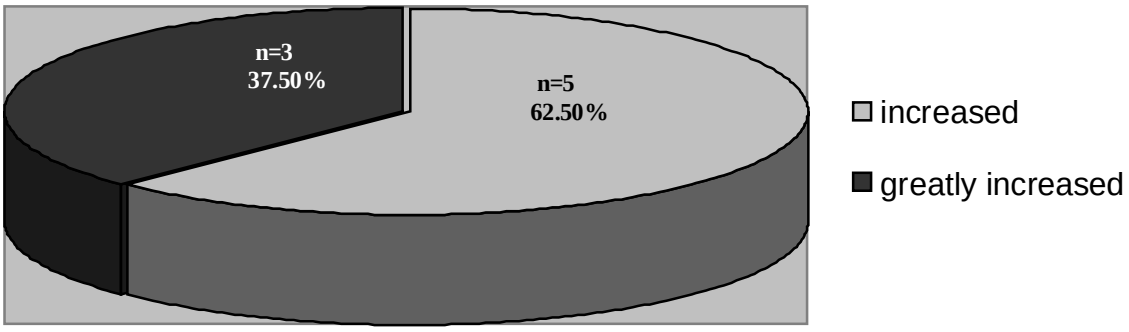

Figure 28. Pie chart representing teacher-participant responses in completing the following sentence: "Since participating in this inquiry workshop program, my use of scientific inquiry in the classroom _____." The scale for responses included "greatly decreased," "decreased," "remained unchanged," "increased," and "greatly increased." N=8, three subjects did not respond to this item on the Post-Follow-Up Questionnaire.

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).

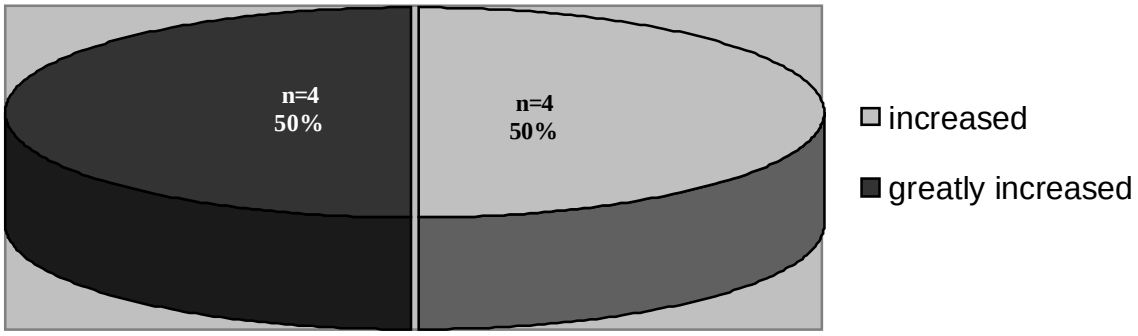

Figure 29. Pie chart representing teacher-participant responses in completing the following sentence: "Engaging my students in learning science through inquiry has _____ their interest in learning science." The scale for responses included "greatly decreased," "decreased," "not changed," "increased," and "greatly increased." One of the eighteen participants who attended the follow-up session did not respond to this item. N=8, three subjects did not respond to this item on the Post-Follow-Up Questionnaire.

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

All seven of the program-participants who participated in individual follow-up agreed that their follow-up experience enhanced the quality of their classroom inquiry experiences with their students, with five agreeing "a large amount" or "completely" and two "a moderate amount" (Figure 30, below).

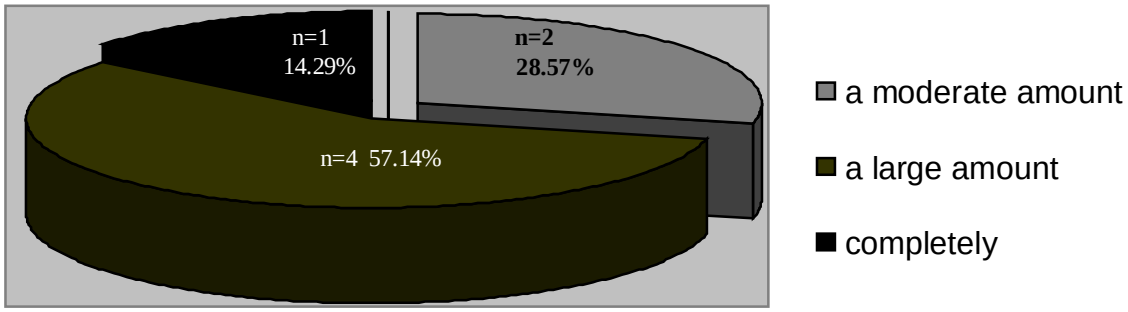

Figure 30. Pie chart representing teacher-participant responses to the question, "To what extent, if any, did the follow-up sessions enhance the quality of your classroom inquiry experiences with you students?" The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely."

Program participants felt that the individual teacher follow-up was a valuable tool for enabling them to use the RIP in their classroom instruction. All of the workshop-participants who participated in individual follow-up stated that their participation in the follow-up contributed moderately, "a large amount," or "completely" to their ability to implement the RIP with their students (Figure 31, below).

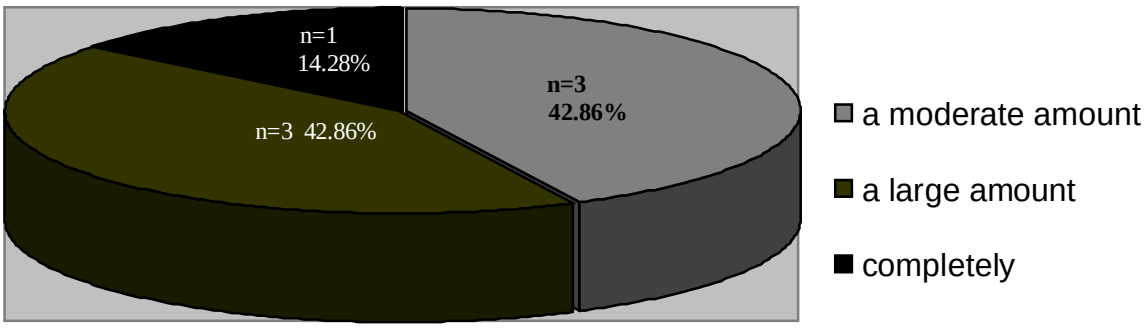

Figure 31. Pie chart representing teacher-participant responses about the extent to which the follow-up sessions contributed to their ability to implement the RIP with their students. The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely." N=7, four subjects did not respond to this item on the Post-Follow-Up Questionnaire.

One workshop participant reported complete influence, five "a moderate" or "large" influence, and one a slight influence of their participation in individual follow-up activities on changes in their understanding of the research investigation (Figure 32, below).

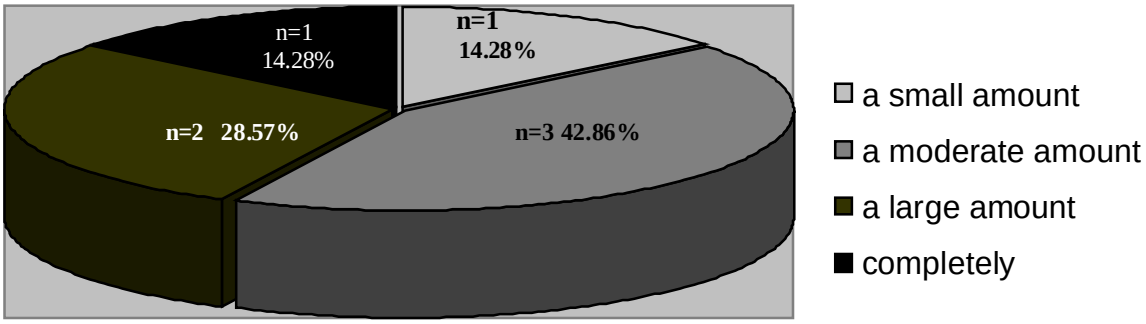

Figure 32. Pie chart representing teacher-participant responses as to the extent to which the follow-up sessions changed their understanding of a research investigation. The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely." N=7, four subjects did not respond to this item on the Post-Follow-Up Questionnaire.

Almost 75% (4 of 7) of the teachers who took part in individual follow-up activities responded that their participation led to a "large" or complete increase in their understanding of the RIP (Figure 33, below).

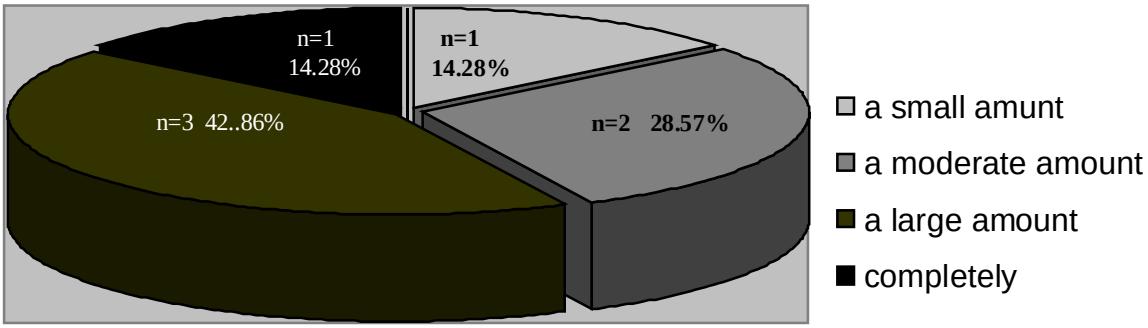

Figure 33. Pie chart representing teacher-participant responses as to the extent to which the follow-up sessions increased the clarity of their understanding of the RIP. The scale for responses included "none," "a small amount," "a moderate amount," "a large amount," and "completely." One of the 16 teachers who participated in the individual follow-up activities did not respond to this item. N=7, four subjects did not respond to this item on the Post-Follow-Up Questionnaire.

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."

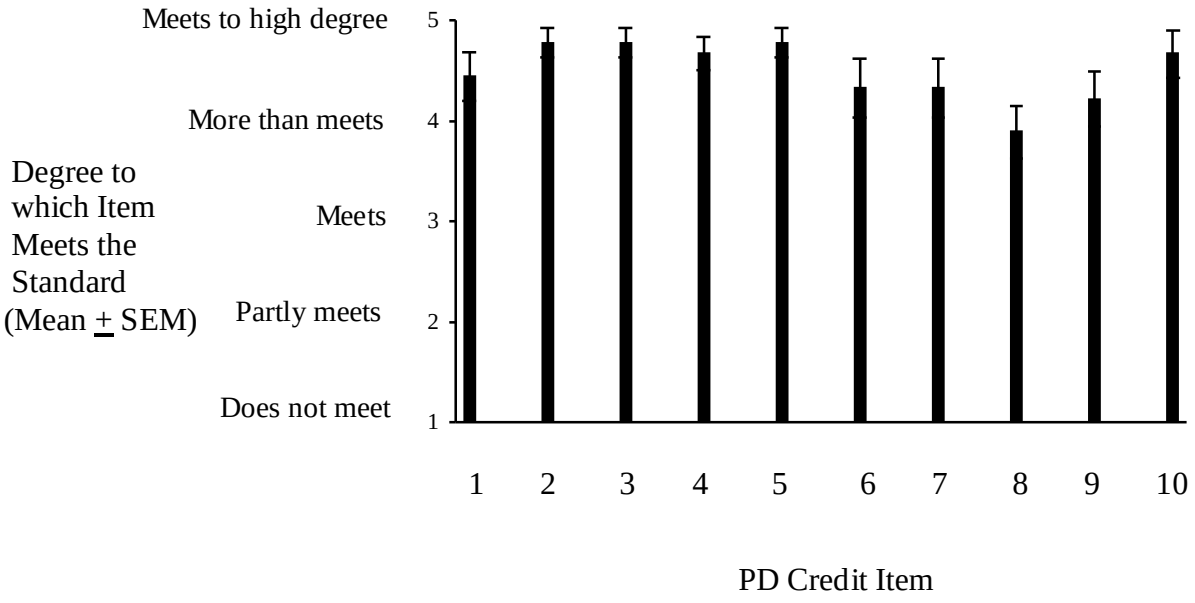

Figure 34. Honolulu District 2003 Science Literacy-Scientific Inquiry Professional Development Workshop.

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-6 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.