Using Peer Instruction to Teach Inquiry-Based Science to Adult Zoo Volunteers

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ABSTRACT

Cleveland Metroparks Zoo (CMZ) provides educational services to the greater Cleveland area with the majority of day-to-day programming being lead by trained docent volunteers. A push by the state of Ohio has increased the required use of inquiry-based science learning in schools (Ohio Department of Education, 2011), making it important that docents leading zoo programs are well trained in inquiry-based science practices so that CMZ can continue to meet the educational needs of area schools. Docents at CMZ have expressed resistance to this transition as well as concerns about young staff creating unnecessary changes in educational programming. Due to documented successes in using peer-instruction to engage resistant audiences (Lasry, 2008), inquiry training sessions featuring docents as the instructors were designed. This study examines whether adult docents respond better to inquiry training if it is delivered through peer-instruction rather than through traditional staff led sessions.

Data was collected through docent surveys with questions assessing their individual attitudes and confidence levels towards inquiry-based learning. Inquiry scores were determined for each individual based on the numerical average of their responses to the survey questions. Pre- and post-training survey responses were compared to reveal any differences in outcome between those that participated in an inquiry training session led by a staff member and those that had a session led by a docent peer. T-test analysis of docent inquiry scores after training revealed that differences between those trained by a staff member and those trained by a peer were not statistically significant.

INTRODUCTION

Adult volunteers can strengthen the reach and effectiveness of an organization, offering manpower, time and expertise often in exchange for personal and social fulfillment rather than monetary compensation. Individuals involved with volunteering exhibit positive social and health benefits, including improvements in physical health and mental function (Fraser, 2009; Hinterlong, 2007; Hong, 2009). Volunteering provides an opportunity for individuals to form a group identity founded in shared interests (Fraser, 2009) and satisfies the older adults' increasing desire to continue intellectual and social growth (Morgan, 2007). One of the leading motivations for older adults to become volunteers is the opportunity to pass along valuable knowledge to the public and to continuing generations through teaching and public interactions (Fraser, 2009; Erlinghagen, 2006).

A large volunteer work force strengthens the efforts of the Conservation Education department at Cleveland Metroparks Zoo (CMZ). The educational team at CMZ consists of paid staff members as well as over 400 volunteers, 200 of which are trained as docents, certified to interpret on-grounds and lead educational programming for participating school groups. (Cleveland Metroparks Zoo, 2011). The Zoo has been providing educational services to the

greater Cleveland area for over fifty years with the majority of day-to-day programming being lead by these trained docents. With a recent push by the state of Ohio for an increased use of inquiry-based science learning in schools (Ohio Department of Education, 2011), it is important that docents leading zoo programs for participating school groups are well trained in inquiry-based science practices so that the Zoo can continue to meet the educational needs of area schools.

These adult volunteers must be taught the process of inquiry-based learning (IBL) themselves if they are to effectively use the method. Since IBL has shown to be more effective than traditional lecture style teaching, it was decided that the CMZ volunteers should be trained in it by actually engaging in inquiry-driven science themselves. There is very limited documentation on IBL being used specifically with adults (Martorell, 2009), but limited studies have shown that it is possible to successfully apply these methods to unusual and untraditional groups such as older adults and senior citizens (Martorell, 2009).

Since the incorporation of inquiry-based educational programming at CMZ during the 2010-2011 academic year, some volunteer docents have been observed as showing discomfort and resistance to this change in educational approach while others have requested further training into the use of inquiry practices. Concerns about young staff creating unnecessary changes in educational programming at CMZ were also voiced. Training sessions were to be designed to help docent volunteers to transition into this new teaching style, aiming not only to instruct, but also to minimize preconceived discomforts and apprehensions.

Previous studies and experiences (Lasry, 2008) have indicated success in using peer instruction to effectively educate and engage a resistant audience, such as the aforementioned docent volunteers, in intimidating topics. The documented experience of Vass (2010) showed that individuals in groups of similar age most enjoyed being taught by their peers. Peer instruction has been linked to significant knowledge gains in students and the number of instructors incorporating peer instruction into their teaching style increases annually due to its success (Crouch, 2001). This study will examine whether adult docents respond better to inquiry training if it is delivered through peer-instruction rather than through traditional staff led sessions. Past and current research leads one to believe that peer-instruction will prove to be a more effective teaching method for this situation than traditional staff led instruction.

METHODS

Docent volunteers at Cleveland Metroparks Zoo (CMZ) were selected to receive training in inquiry-based learning practices due to their involvement in teaching the majority of the on-site educational programs, servicing over 6,000 Cleveland area school students each year (Cleveland Metroparks Zoo, 2011). CMZ's educational programming became more inquiry oriented during the 2010-2011 school year and will continue to become even more inquiry-based in the future

due to the release of updated academic content standards requiring the use of inquiry in the classroom. These changes made it imperative that this group of volunteers received proper training in inquiry.

A team of zoo educators designed a training session for docent volunteers focusing on inquiry-based science practices. The session included hands-on introductory activities, examples of simple inquiries, access to manipulative objects and tools for observational exploration, and opportunities for small group collaborations on simple inquiry projects. For an outline of the training session, see Appendix A. Four inquiry-based training sessions were established and run over the span of two weeks. A staff member, trained in IBL techniques, led two of the training sessions and a selected docent volunteer, also trained in IBL techniques, led the other two. Each session ran for two hours and thirty minutes. Docents documented as having participated in or having expressed interest in participating in on-grounds educational programming at the Zoo were contacted through phone and email and were asked to attend one of the Inquiry Training sessions. Information on these available sessions also appeared in print in the volunteer monthly newsletter as well as on posters near the time clock in the volunteer office.

Prior to the sessions, each participating docent was given a "Pre-Training Survey" (Appendix B), designed to assess their attitudes and confidence levels toward inquiry-based learning. Each of these surveys was marked numerically, with a matching numbered copy to be given during the "post-training survey" portion. This numerical coding ensured that the pre and post training surveys for each participant could be accurately matched. The "Post-Training Survey" was distributed at the end of their session in a stamped and addressed envelope. They were told to wait between five and seven days before filling out the post survey (in order to allow the information to settle in) mailing it back two weeks after the training. The same survey was used for the pre and post assessments so that responses could be compared before and after the trainings (Appendix B). Only fully completed surveys with both pre- and post-training copies submitted were analyzed in the study.

After collecting the completed surveys from all participants, they were divided into two groups: those that participated in the staff led training and those that participated in the peer instructed training. This separation was made based on the numerical assignments of each completed survey. For data analysis, each participant was assigned an "inquiry score" that served to show their overall attitude/confidence towards IBL using a scale of one through five, with one being low (not confident) and five being high (very confident). Inquiry scores were calculated by finding the mean of response scores given for eight of the ten survey questions for each participant (two questions were removed from analysis because they did not measure inquiry attitudes, but instead served to get feedback on additional programmatic information not included in this study). Inquiry scores from before and after trainings, as well as scores from the staff led group and the peer instructed group, were compared and any differences were noted. A t-test was used to determine if any of these differences were statistically significant.

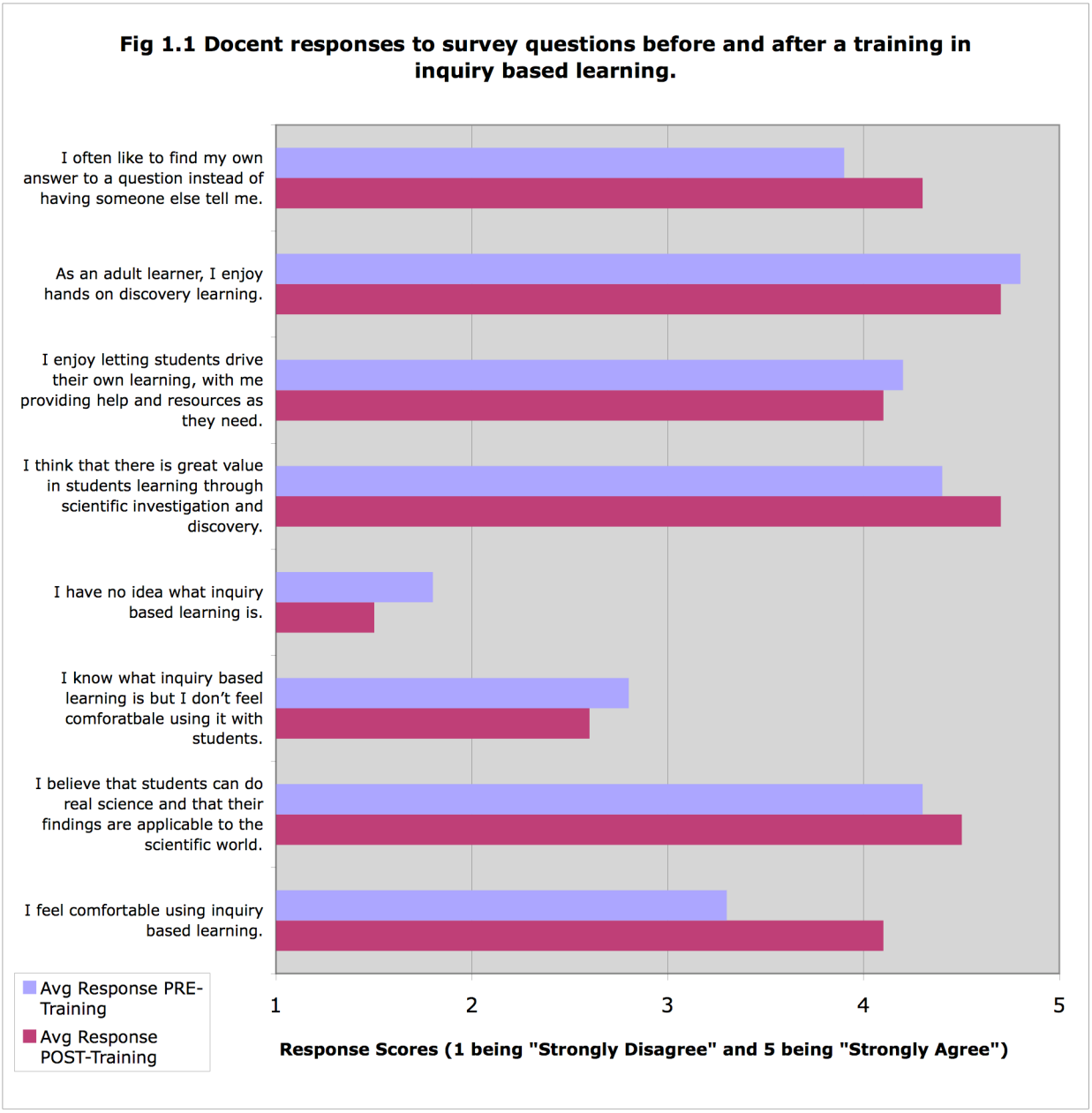
RESULTS/DATA

Twenty-one docents chose to participate in the training sessions on inquiry-based learning. Of those twenty-one participants, seven indicated that they regularly volunteered in the program space, serving once or twice each week. Two reported as volunteering with the inquiry program once or twice each month while five indicated more sporadic involvement, having served once and not returned. There were seven docents that reported never volunteering with the inquiry programs before the training session. Of the Twenty-one docent participants, fifteen submitted pre-training and post-training completed surveys, eight from the group led by a staff member and seven from the peer instructed group.

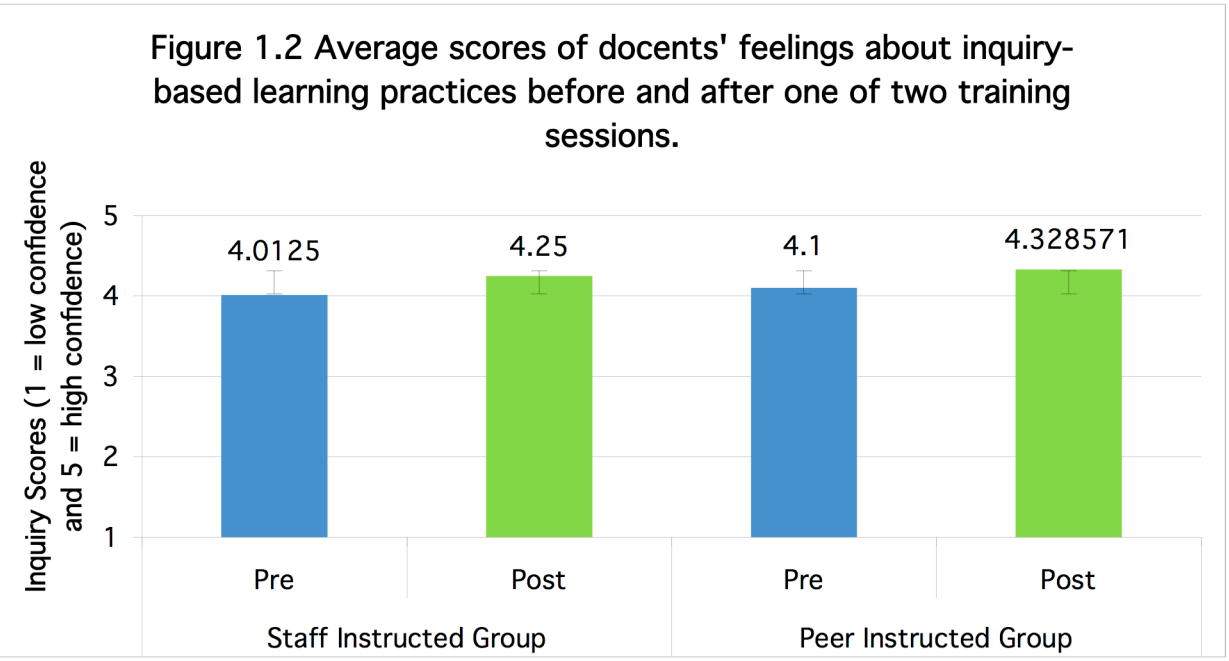
The average response of docents to each of the survey questions is displayed in figure 1.1, where a score of one represented "strongly disagreeing" with a given statement and five represented "strongly agreeing" with the statement. Scores from before and after training sessions were compared and results showed an overall scoring *increase* for statements that: 1) expressed joy in working to discover an answer, 2) placed value on student learning through discovery, 3) indicated overall comfort in using IBL, and 4) believed students are capable of doing real science. Scores *decreased* for statements that: 1) reported the participant finding joy in hands-on discovery, 2) indicated feeling uncomfortable and/or unknowledgeable about IBL, and 3) expressed enjoyment in letting students drive their own learning.

An "inquiry score" was calculated for each participant based on his or her scored responses to the survey questions (fig 1.1). The inquiry score was determined by finding the average numerical response to the eight survey questions for each participating docent, providing a look at the docents overall feelings towards inquiry. The average inquiry score for both groups of docents (staff instructed and peer instructed) was calculated (fig 1.2) in order to make cross comparisons possible.

The average inquiry score for the staff instructed (control) group was 4.01 (rounded) and 4.10 for the peer instructed (test) group. A t-test was run and determined that the difference in pre-training values between both docent groups was not statistically significant ($p = 0.969$). T-test analysis also revealed no significant difference between the post-training scores of both docent groups ($p = 0.821$).



There was a numerical increase between the pre-training and post-training inquiry scores for both groups. The control group showed a numerical increase of 0.24 after participation in the training. A t-test revealed no significance in this difference ($p = 0.166$). There was also a numerical increase of 0.23 in the test group from the pre-training to the post-training scores, but statistically there was no significant difference in that data either ($p = 0.352$).



DISCUSSION

When reviewing the responses to individual survey questions, it was surprising to see decreased scores post-training for the statements of "As an adult learner, I enjoy hands-on discovery learning" and "I enjoy letting students drive their own learning, with me providing help and resources as they need." While the numbers could suggest that the training caused respondents to actually lessen their attitudes/confidence levels about inquiry in regards to these topics, additional influences could also have affected the outcomes. The information that was gathered from participants was self-reported, which could mean that some personal biases were at play. Dunning and Kruger (1999) found that individuals often believe they hold considerable knowledge in a certain subject matter that they may not have any true experience with and so would rate themselves as highly competent in that area. After detailed training in and exposure to the subject however, they realize that they are not as knowledgeable or comfortable as they had originally thought and post assessments reflect a more informed, yet sometimes lesser-scored self-response. This effect may have been present with this test group, as their definitions of inquiry-based learning were not openly defined.

Despite the possibility of skewed definitions and understanding of inquiry prior to participation in the training sessions, docents did begin their involvement displaying similar average inquiry scores, with a difference of 0.09 between the two groups pre-training scores. This indicated that both groups entered into the trainings with similar feelings towards inquiry, providing a relatively equal start from which to measure any changes.

Upon completion of the study, statistical analysis showed that the effects on docent attitudes toward inquiry-based learning after the training sessions were not significantly different between those trained by a CMZ staff member and those trained by a peer docent. This evidence does not support the original prediction that the peer instructed group would show significantly higher increases in attitudes toward inquiry-based learning than the staff instructed group. Although no statistical significance was found to indicate that one instruction method was more effective than the other, it also did not show one to be less effective than the other. Additional training for docents serving as peer instructors of these sessions could prove to have more significant effects than this study showed. Throughout the course of this study, the docent chosen to serve as the peer instructor often strayed from the training session outline and engaged in social communication and sharing anecdotes with the group members instead of remaining focused on inquiry methods. This ended up detracting from the total amount of time spent engaged in inquiry and could have potentially affected the overall experience of the participants. Despite this discrepancy, however, the overall outcomes for each group remained relatively equal.

While statistically there was no significance to any changes, there did exist a numerical increase from docent pre-training inquiry scores to docent post-training inquiry scores for both test groups. The increases in scores for the control and test groups were 0.24 and 0.23 respectively. While this held no statistical significance and is an almost equal increase for each group, it did show that participation in the IBL training sessions contributed to an overall increase in attitudes toward the use of inquiry. This would suggest that regardless of the instructor, IBL training sessions, in general, improve docent attitudes and confidence levels when it comes to using inquiry. This provides support for further training sessions being offered to docents that wish to become involved with inquiry-based science programming at CMZ.

ACTION COMPONENT

Inquiry-based learning is a relatively new concept in the education department at Cleveland Metroparks Zoo. Given that the majority of educational programming at CMZ has been updated to focus on inquiry, it is important that docents receive training in this learning style, as they are often the program leaders. Given the results of this study showing that a relatively short and basic training session can positively affect docent attitudes and confidence levels when it comes to inquiry, volunteers will hopefully be more open to the idea as inquiry sessions are written into the mandatory educational training.

The next specific step is to develop an “Inquiry Mentor” program where docents can apply to be trained as inquiry instructors to either lead or co-lead (with staff members) training sessions for other docents wishing to get involved with educational programming at CMZ. Communication with other local parks and organizations has been started as well in regards to their experiences with peer-instruction. Participant outcomes will continue to be monitored for the duration of the

training programs to gauge the effectiveness of the peer-instruction model. These findings will be shared with other local organizations.

CONCLUSION

Statistical analysis showed that the effects on docent attitudes toward inquiry-based learning after training sessions were not significantly different between those trained by a CMZ staff member and those trained by a peer docent. This outcome did not support the original prediction that incorporating peer instruction would prove to be a more successful method by which to introduce the concept of IBL to docents than through traditional staff instruction. Although no statistical significance was found, numerical trends in this study suggested that no matter who leads the session, inquiry-based trainings, in general, could contribute to an increase in docent attitudes and confidence levels when using inquiry in educational programs. Further studies and attitude assessments need to be done in order to gain a more complete understanding of the effects that peer-instruction may have when teaching inquiry-based learning to adult docent volunteers.

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APPENDIX A: Inquiry Training Session Outline

DOCENT INQUIRY TRAINING SESSION

1) Have each participant fill out a number-coded "Pre-Training Survey" as they sign in for the session.

2) Introductory Activity: Observation Game

   a) Have a variety of biofacts arranged on a table, covered with a cloth. Remove the cover and allow the participants to observe the layout for one minute. After one minute, recover the items and ask the group a series of questions about what they saw: How many of the skulls were herbivore skulls? How many different types of feathers? How many items where there all together? Etc.

   b) Afterwards, ask the group what they thought the goal of this activity was. The goal was to awaken their sense of observation, as that is where all inquiry begins.

3) Inquiry Overview: What is Inquiry Based Learning?

   a) Explain the concept behind inquiry based learning and the significant outcomes that it has had on students of all ages.

   b) Highlight studies done previously at Cleveland Metroparks Zoo on the positive impacts of inquiry based learning on local students' knowledge and attitudes toward science.

   c) Introduce types of Inquiry (Guided, semi-guided and open), Cycle of Inquiry (Observation, Question, Prediction, Test, Data Collection, Analyze, Share Results) and the guiding questions for a good inquiry/comparative question

   d) Highlight the programs offered by CMZ that are inquiry based and have the group draw out the aspects that make it an inquiry program. Allow time to share examples of their own experiences in these programs.

4) Putting it into Practice: Small Group Inquiries

   a) Lead the group to the African Elephant Crossing exhibit space. This is the space where the majority of current inquiry based programs take place at the Zoo.

   b) Allow the group 15 minutes of free observation time, taking notes on the things they choose to observe. Leader reminds them that they can observe any aspect that they choose, but they must be prepared to share at least 5 observations with the rest of the group when the time is over.

c) After the 15 minutes, facilitate the sharing of observations among the group. Allow for conversation and further questions to arise during this sharing. Discuss possible comparative questions that could come of these shared observations.

d) As a group, choose 2 observations/comparative questions to further explore. Divide the group in half and assign each group one of the 2 questions.

e) Each group takes 15 minutes to design a method of testing their question.

f) Each group is then given 30 minutes to collect data by running their designed tests and an additional 15 to analyze and discuss conclusions.

g) Both groups come together for the end of the training to share what they found during their inquiries.

5) Wrap Up

a) Close with a sharing of thoughts and/or ideas that arose as a result of this training.

b) Again highlight the programming that is currently inquiry based (Connections to Africa, Built to Survive, Guide by Cell, Vet Bags, Connections to Africa Classroom Toolkit) and encourage those interested to try volunteering for one of these programs

c) Distribute the self addressed stamped envelopes containing the number coded "Post-Training Surveys" with the instructions that they should each give themselves a 5-7 day period for the information to sink in, then fill out this survey and mail it back in 2 weeks.

6) Thanks for Coming!!!

APPENDIX B: Docent Survey

WANTED: DOCENT FEEDBACK

Now that Connections to Africa and other inquiry-based educational programming is up and running, we want to step back and take a look at how it's all working together. We would like to be able to better prepare participating docents and overall improve the overall educational experience for volunteers and school groups participating in our programs. Please provide us with some of your feedback on this quick form (and be sure to leave any additional notes or items you'd like to bring to our attention) in the sections marked. It should only take a moment and it is truly appreciated.

Thank you so much!

Connections to Africa (on-site program for grades 1-3)

1. How often do you volunteer/have you volunteered for the onsite educational program: *Connections to Africa*?
   - 0 times, I have never volunteered for it
   - 1-2 times each Week
   - 1-2 times each Month
   - I have participated once or twice, but no more than that

2. If you have never participated in *Connections to Africa,* please indicate your reasons why by checking all of the following that apply:
   - Not interested in volunteering for educational programs
   - Feel uncomfortable with the inquiry-based learning style that the program uses
   - Feel uncomfortable with the technology used in the program
   - Schedule doesn't work for me (can't volunteer M-F during the school day)
   - Other _____

3. If you could change one thing to make *Connections to Africa* a better program for volunteers to get involved with, what would that one thing be?

Please respond to the following statements by circling the number (1-5) that best represents your level of agreement (1 = Strongly Disagree and 5 = Strongly Agree).

	Strongly Disagree				Strongly Agree
I feel comfortable using inquiry-based learning techniques.	1	2	3	4	5
I believe that students can do real science and that their findings are applicable to the scientific world.	1	2	3	4	5
I know what inquiry-based learning is but I don't feel comfortable using it with students.	1	2	3	4	5
I have no idea what inquiry-based learning is.	1	2	3	4	5
I think that there is great value in students learning through scientific investigation and discovery.	1	2	3	4	5
I enjoy letting students drive their own learning, with me providing help and resources as they need.	1	2	3	4	5
I feel that docents need more training in Inquiry-based learning techniques if we are to use them in programs.	1	2	3	4	5
I feel comfortable helping students use technology.	1	2	3	4	5
As an adult learner, I enjoy hands on discovery learning.	1	2	3	4	5
I often like to find my own answer to a question instead of having someone else tell me.	1	2	3	4	5

Any Additional Comments/Points for Consideration: