

## **Connecting the Dots: A Scaffolded Model for Undergraduate Research**

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### **Abstract**

In order to assist in scaffolding the knowledge acquisition necessary for the completion of a meaningful action research project, the authors applied for and received an undergraduate research grant to build research-focused assignments that guide preservice teachers in developing specific research skills. This article will discuss the design of the research assignments, the analysis of student work and instructor feedback, and propose a model for scaffolding higher-level research skills in lower-level teacher education courses.

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College graduates who participate in undergraduate research learn from practical experiences and gain specific skills necessary for their chosen field; examples might include conducting research, analysis of data, presentation skills, and reading scientific literature (Davis, Mahatmya, Garner, & Jones, 2015; Harrison, Dunn, & Coombe, 2006; Hu, Kuh, & Li, 2008). Students participating in undergraduate research projects gain confidence in their ability to think and work like researchers. For example, students show an improved ability to apply knowledge and skills, critically think and problem-solve, and understand how scientific knowledge is built (Seymour, Hunter, Laursen, & DeAntoni, 2004). Allowing undergraduate students to fully participate in research early in their academic career can increase positive self-efficacy as researchers (Folk, 2016), and support their growth as researchers throughout their college experience. Incorporating research into undergraduate courses will help to increase students' understanding of the subject, helping them gain a greater interest and enthusiasm for course content (Healey, Jordan, Pell, & Short, 2010). Furthermore, it exposes them to research methods that they will experience through professional development once they enter the teaching profession (Smith & Sela, 2005).

Although the frequency and quality of undergraduate student engagement in research at both liberal arts institutions and research universities are increasing (Hu, Kuh, & Gayles, 2007),

most current scholarship on undergraduate research is bounded within specific science, technology, engineering and mathematic (STEM) disciplines (Gilmore, Vieyra, Timmerman, Feldon, & Maher, 2015; Mena, Schmitz, & McLaughlin, 2015; Seymour et al, 2004). While efforts to increase opportunities for undergraduate scholarship and creative activities in the arts, humanities, and social sciences hope to promote the academic success for students (Davis et al, 2015), many efforts to integrate research and teacher education have fallen short of engaging students, particularly undergraduate students, in the research culture of schools and departments (Brew, 2010).

While undergraduate research may be prevalent in STEM and social studies programs, students report lower level of student/faculty interaction on research projects in colleges of education (Carini & Kuh, 2003). Commonplace in graduate teacher education programs, a focus on undergraduate research with preservice teachers can provide a plethora of benefits for the preservice teacher and their future students (Vaughan & Burnaford, 2015). By incorporating research activities into their coursework, practicums, and student teaching experiences, preservice teachers will have the opportunity to hone their abilities to problem solve difficult tasks, think critically and reflectively about what they do, and collect evidence to prove their effectiveness according to D. Zambo and Zambo (2007). The purpose of introducing preservice teachers to research, more specifically to action research, is to build the teaching dispositions often associated with effective teaching. Exposure to action research as a methodology may also have a positive effect on their self-efficacy as educators, leading to longer, more productive careers in the field of education according to Smith and Sela (2005) and D. Zambo and Zambo. Other advantages of introducing action research to preservice teachers is that it lays the foundation for long-term, essential practices of observation, reflection, and inquiry, helping to make the teacher researchers more flexible and open to the learning process (Carboni, Wynn, & McGuire, 2007). Action research also provides teacher candidates and their professors with opportunities and support in learning to investigate, analyze, and reflect in critical ways that focus on exploration of productive growth and action in the instructional environment and provide opportunities to revisit and rethink decisions, philosophy, and practices (Lassonde, 2009). Action research will help teachers identify educational needs and issues which, in turn, evolve into defensible, responsible plans of action. Pre-service and in-service teachers must define themselves as critical thinkers, engaged learners, reflective practitioners, and future leaders in the field of education (Beisser & Connor, 2004). Table 1 highlights specific programs and their use of action research to build dispositions within preservice teachers.

Table 1

*Examples of Undergraduate Research from the Education Field*

Author(s)	Population	Mode of Instruction	Dispositions Developed
Beisser & Connor, 2004	Pre-Service teacher education students at a large Midwest university	Undergraduate students in action research course	Students become critical and reflective thinkers
Carboni, Wynn & McGuire, 2007	Seniors in the elementary teacher preparation program at Duke University	Action research project during student teaching	Lays the foundation for long-term practices of observation and reflection
Ferri & Wilches, 2005	Pre-service foreign language teachers at a University in Colombia	Action research project during methodology and administration leadership course	Develops research skills through exploring pedagogy, confronting theory, and self-reflecting
Harrison, Dunn, & Coombe, 2006	Pre-service teachers in early childhood education program at a university Australia	Research projects in undergraduate courses	Provide students with skills to conduct and use relevant research
Lassonde, 2009	28 undergraduate teacher candidates at a state-affiliated university located in upstate New York.	Action research project in language and literacy course	Introduces students to professional language while teaching them to inquire and reflect in critical ways
Moore & Gilliard, 2008	Pre-service teachers in early childhood education program at a small university in Montana	Action research project in early childhood professionalism course	Students developed more effective forms of instruction and assessment
Smith & Sela, 2005	Pre-service teachers from one of the largest teacher education colleges in Israel	Action research project during student teaching	Creates a focus on systematic improvement, personal reflection, and fosters a sense of community
Strand, 2006	Senior music education students at a small liberal arts college	Action research project during student teaching	Increased development critical thinking skills, and reflective capabilities
Zambo & Zambo, 2007	Pre-service teachers at a public university in the southwestern United States	Action research project during practicum and student teaching	Improved problem solving skills and self-efficacy

There is significant discussion within the literature centered around undergraduates'

limited transformative potential and the role action research should play at the undergraduate level due to preservice teachers' lack of classroom experiences and limited opportunity to focus on improving their teaching practices. However, Kosnick (2000) argues that while undergraduates certainly need more exposure to professional literature, action research can help them acquire skills, attitudes, and knowledge that they may be able to transfer in the future. It has also been suggested that undergraduates may benefit from a more structured action research experience with a focus on question development and collaboration along with exposure to literature. This scaffolding approach may increase the likelihood that students in teacher education programs will transfer inquiry skills into classroom practice (Carboni et al., 2007).

Currently, students in our teacher education program complete an action research project in their capstone course, however, just as the literature states, they too seem to struggle with an authentic connection to the literature as well as research question development (Kosnick, 2000). In order to assist in scaffolding the knowledge acquisition necessary for the completion of a meaningful action research project, the authors applied for and received an undergraduate research grant to build research-focused assignments that guide undergraduate preservice teachers in developing specific research questions and analyzing relevant literature related to key current issues in the public school system. The objective of this grant was to maximize the impact of research experiences across the various sections of each course. The research experiences are designed to be similar enough for students to be able to easily transfer skills between courses but build off the notion of a spiral curriculum, adding depth each time a skill is reinforced and discussed in a new context. It is our goal to build the notion of inquiry within our students as well as the skills to connect to the existing literature in the field.

As a solution to the reoccurring difficulties students face in their capstone projects, we saw a need to tease out the problem areas of question development and literature analysis, and teach these skills more directly and earlier in the teacher education program. The prerequisite courses (Introduction to Teaching and Introduction to Diversity) in the teacher education program, taken simultaneously or sequentially, were identified for undergraduate research integration. As previously mentioned, the goal of the redevelopment of these courses was to create a scaffolded experience that maximized the impact of the research process. Through the use of annotated bibliographies, the formulation of research questions, and literature reviews, undergraduate students are exposed to and take part in research that is current and meaningful to their coursework and field experiences. This article will discuss the design of the research assignments, the analysis of the data collected through LiveText, and propose a model for scaffolding higher-level research skills in lower-level teacher education courses.

### **Design of Research Assignments**

Using LiveText as an assessment tool, feedback on assignments and student growth were captured using specific research areas as part of the rubric designed for each assignment in the courses (e.g. critical thinking, knowledge of informational literacy, formulating questions, and communication). The rubric was designed in collaboration with the assessment team from the Undergraduate Research Office as part of the grant received for this research project (see Appendix). A two-point formative assessment model was used to capture growth as well as provide students with an opportunity to revisit and reflect on their key assignments in order to incorporate professor feedback and reach a deeper level of understanding and analysis. Through

the feedback that students received on their first draft, they were able to demonstrate a higher level of learning on the identified student outcomes on the final draft.

### Student Learning Outcomes

As previously mentioned, student learning outcomes for the new research assignments were assessed using rubrics that were created in conjunction with the university's undergraduate research department. Table 2 outlines the assignments and activities created in both courses to support the growth of undergraduate research skills.

Table 2

#### *Description of Assessments used to Promote Undergraduate Research*

Name of assessment	Type of assessment	Identified student learning outcomes	Assignment description
Locating peer-reviewed journal articles	Class activity	Knowledge of informational literacy	Students work with library staff to learn how to search for peer-reviewed journal articles in their chosen area of focus
Annotated Bibliography	Two-point assessment	-Knowledge of informational literacy -Critical thinking and interpretation -Communication	Students choose 3 peer-reviewed articles and complete an annotated bibliography in APA format
Research Question Development	Class activity	-Formulating questions -Critical thinking and interpretation	Students work in small groups to analyze and create research questions in their area of focus
Statement of the Problem Paper	Two –point assessment	-Knowledge of informational literacy and sources -Critical thinking and interpretation -Formulating questions -Communication	Students use the articles from their annotated bibliography to write a statement of the problem paper, integrating the literature to support their ideas and claims.
Synthesized Research Project	Summative assessment	-Critical thinking and interpretation -Communication	Students work with other students in a similar area of focus to synthesize their findings in a presentation to the class.

## Results

The results from the first semester of coursework indicate significant growth across all identified student learning outcomes as measured through the two-point assessments in LiveText (annotated bibliography, statement of the problem paper). We have chosen to share an example from each course for brevity, but the growth shown is representative of all sections. Figures 1 and 2 show first and final drafts for the annotated bibliography assignment completed by students in the Spring 2016 section of Introduction to Teaching (EDF 2005). As the figures show, 74% of students were scored as competent or exemplary in their first draft, and 87% of students were scored as competent or exemplary in their final draft of this assignment. This growth can be attributed to the individualized feedback by professors while grading the first draft. In addition, feedback also spurred student questions about the assignment and highlighted student misconceptions. Reflections on the importance of this feedback will be discussed later.

Rubric: Distinction through Discovery (QEP) Student Achievement Rubric

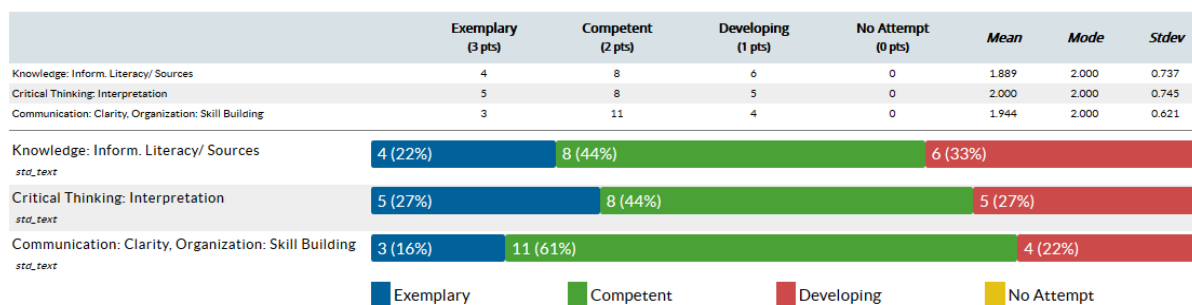


Figure 1. First draft of annotated bibliography assignment in EDF 2005 in Spring 2016.

Rubric: Distinction through Discovery (QEP) Student Achievement Rubric

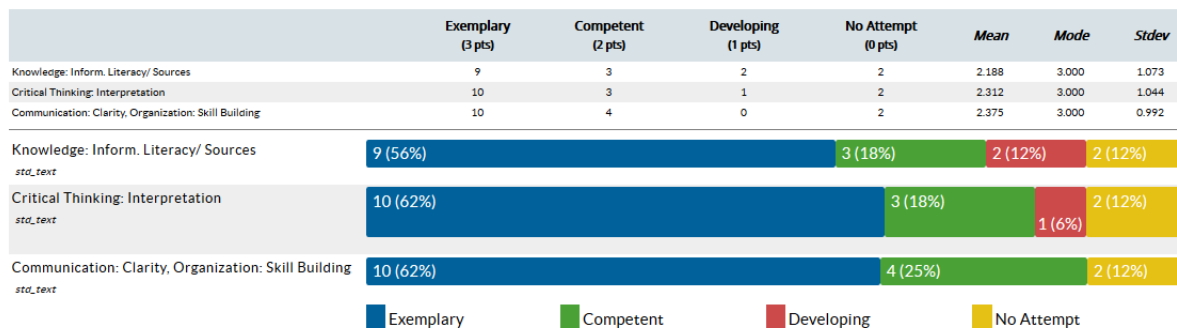


Figure 2. Final draft of annotated bibliography assignment in EDF 2005 in Spring 2016.

Similar results can be seen in the growth of student learning on the statement of the problem assignment, which builds off of the skills students have attained in the annotated bibliography assignment. As Figures 3 and 4 show, 70% of students were scored as competent or exemplary in their first draft, and 75% of students were scored as competent or exemplary in their final draft of this assignment in the Introduction to Diversity course (EDF 2085). As this assignment occurs in the latter half of the semester, we see more students growing into the exemplary category in skills like critical thinking (14% to 24%) and the ability to formulate questions (10% to 34%).

Rubric: Distinction through Discovery (QEP) Student Achievement Rubric

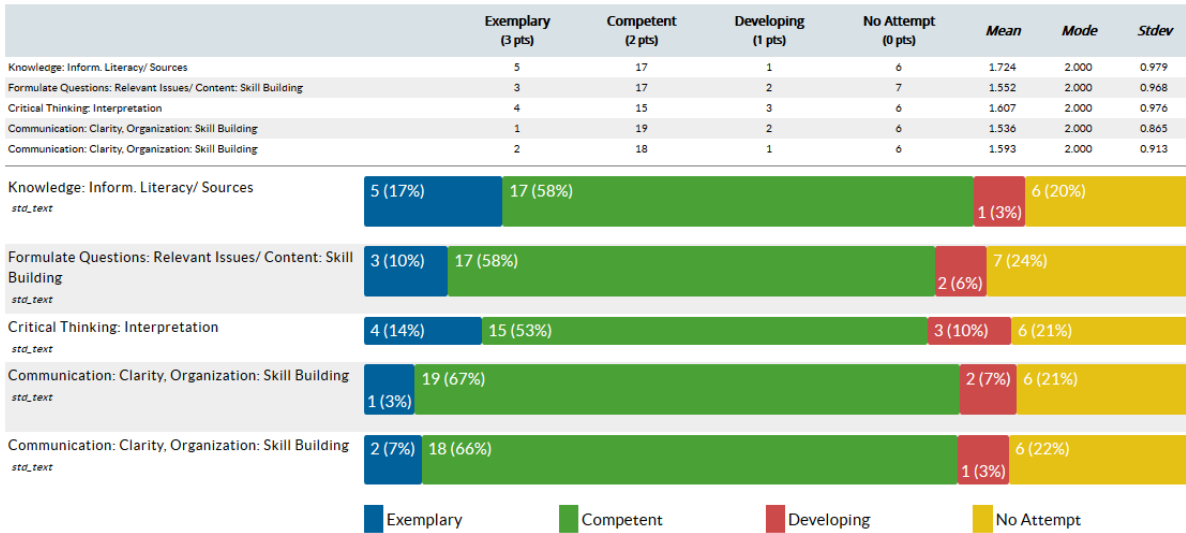


Figure 3. First draft of statement of the problem assignment in EDF 2085 in Fall 2015.

Rubric: Distinction through Discovery (QEP) Student Achievement Rubric

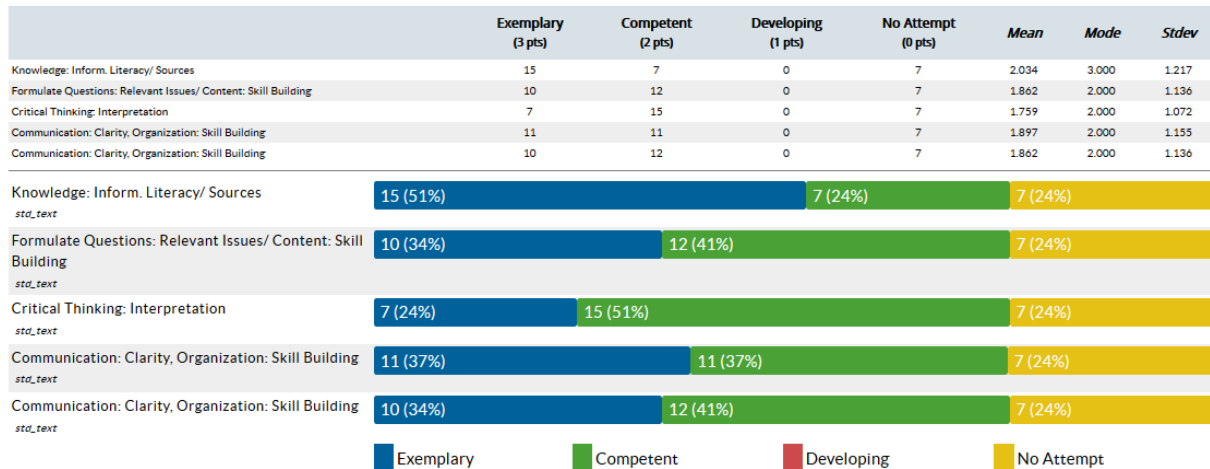


Figure 4. Final draft of statement of the problem assignment in EDF 2085 in Fall 2015.

## Role of Feedback

As previously mentioned, specific and individualized feedback was given to each student on the first draft of their two-point assessments (annotated bibliography and statement of the problem paper). After reviewing the initial student learning gains, questions began to arise about the impact of feedback on those gains. In an attempt to look for trends in the feedback, we downloaded all feedback comments given to students in LiveText on their first drafts of both the annotated bibliography assignment and the statement of the problem paper. The goal was to look for *what* was being commented on as well as *how* we were commenting on it. Was there clearly something the students universally struggled with? How did our feedback support or advance their own understanding of research?

Table 3 illustrates examples of some of the key trends we saw in our own feedback. Overall, we used a positive, constructive tone with our students, often noting the positive aspects of their work as well as what they could improve on. Specifically in the annotated bibliography assignment, there seemed to be general confusion (based on the high number of times we commented on it) about what a peer-reviewed article was and how to properly cite it using APA format. As students moved into the statement of the problem paper, we saw more feedback on using literature to support their ideas and claims as well as how to maintain an academic tone in a piece of writing that required them to state a problem and argue for a solution.

Table 3

*Trends in Feedback on Student First Drafts*

Category of Feedback	Example
Positive, individualized feedback	“Kate, this is a good start and you did an excellent job focusing on the key aspects of the study...in your final draft, add at least 2 sentences to each annotation that discusses why these findings are important”
Positive and negative feedback together	“Your writing is strong, I would like to see this assignment with the peer-reviewed, journal articles on your topic.”
Feedback on technical errors (grammar and APA)	“Check for grammar errors and awkward phrases.” “Your citations are missing some pieces.”
Suggestion of a tool to further assist the student	“Check some grammar errors, you may want to use an online grammar tool to help catch them all.” “Some of your sentences don't sound natural and feel a little pieced together. The writing center is a good source for this.”
Feedback on how to use support from literature	“In a small writing piece like this, unless the quote is absolutely perfect, it can be distracting. Plus, the one in part 1 is so long that it takes away from what YOU are trying to say.” “You were able to weave two of your articles into your paper, but you left one out. I need to see evidence of the three articles in your final paper.”
Feedback on academic tone	“Lastly, this is an academic paper so you need to keep some of the personal clichés and beliefs out of it because it lowers the writing level.”

## Recommendations

### Pedagogical Implications

The inclusion of undergraduate research activities and assessments into teacher education courses can have positive outcomes both in the acquisition of research skills as well as the development of teaching dispositions that support student learning and teacher development. Through the analysis of feedback given to students in these courses, we recommend that instructors include direct instruction on meaningful ways to respond to feedback before students



are required to do so in the course. This might include some examples of feedback that the instructor uses often as well as some modeling from the instructor on how to address the concerns or suggestions given within feedback. This “pre-teaching” will open a dialogue about the expectations of student growth and model explicit instruction for preservice teachers.

### **Formative Assessments**

We used formative assessments that were similar in content and cognitive demand in order to capture student growth in specific research skills. Using formative assessments combined with meaningful feedback ensures that students have a way to feed forward their learning into the next assignment. The opportunity to revise and work on a task for an extended amount of time is an effective assessment practice to build self-efficacy and knowledge in students, and using formative assessments within a teacher education program models an assessment formula students may not have seen in their own experiences as a student in K12.

### **Conclusions**

While the benefits of incorporating undergraduate research are clear, its importance in teacher education programs may be particularly essential. Many of the characteristics the profession sees as positive teaching dispositions (e.g. reflection, inquiry, observation, data analysis) are also skills that can be developed in research courses. By incorporating the use of those skills in preservice courses as well as modeling them through instruction, we are supporting the development of key teaching dispositions for the classroom. Undergraduate research is an opportunity for preservice teachers to see themselves as researchers and connect to the literature in their own field, exposing them to the current research being done in classrooms across the globe and addressing the gap between research and practice.

Lastly, the feedback given to students was an unintended source of data in this project, yet became a key point of reflection for both professors involved. Asking *why* there was growth in student learning and how feedback may have contributed, provided an opportunity for reflection on the success of these assignments and how they need to be refined for future use. Examining the impact of feedback also presented another modeling opportunity as we began to adjust the language used in our comments to make them more student and learner-friendly. As researchers ourselves, using jargon and phrases that students may not understand may hinder their ability to make revisions to their assignments, being cognizant of this tendency is necessary to maximize the impact of feedback. Teaching preservice teachers requires that we examine the impact of our own instructional practices to ensure that we are modeling not only effective teaching practices, but the ability to reflect and make research-based decisions about our classrooms so they, in turn, will do the same as practitioners.

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## Appendix

### Rubrics for Assignments

Distinction through Discovery (QEP) Student Achievement Rubric

	Exemplary (3 pts)	Competent (2 pts)	Developing (1 pt)	No Attempt (0 pt)
Knowledge: Inform. Literacy/ Sources FL-FAU-QEPSLO- 2014.1.C	Differentiates scholarly resources from popular works and consistently uses them as appropriate for the discipline of inquiry. May also critically evaluate sources.	Differentiates the features of scholarly resources from those of popular works, but does not critically evaluate them nor consistently use discipline-appropriate sources in the inquiry	Minimally distinguishes nor critically evaluates scholarly resources from popular works; or uses inappropriate sources for the inquiry	Failed to submit, or failed to submit on time
Critical Thinking: Interpretation FL-FAU- QEPSLO-2014.4.B	Interpretation is thorough and accurate without errors. Interpretation addresses what had been anticipated as well as any unexpected results that were obtained	Interpretation is generally accurate with some errors. Results are only evaluated in the context of what was anticipated.	Interpretation is not based on the actual results of inquiry, or is inaccurate or inadequate with respect to the context of the inquiry.	Failed to submit, or failed to submit on time
Communication: Clarity, Organization: Skill Building FL- FAU-QEPSLO-2014.6.A.sb	Oral and written communication is completely focused, organized, and clear with no errors affecting comprehension	Oral and written communication is generally focused, organized, and clear with only a few errors that do not detract from comprehension.	Communication is disorganized, incoherent, vague, or inappropriate; or student demonstrates competency in oral OR written communication but fails to demonstrate competency in both.	Failed to submit, or failed to submit on time

Distinction through Discovery (QEP) Student Achievement Rubric

	Exemplary (3 pts)	Competent (2 pts)	Developing (1 pt)	No Attempt (0 pt)
Knowledge: Inform. Literacy/ Sources FL-FAU-QEPSLO- 2014.1.C	Differentiates scholarly resources from popular works and consistently uses them as appropriate for the discipline of inquiry. May also critically evaluate sources.	Differentiates the features of scholarly resources from those of popular works, but does not critically evaluate them nor consistently use discipline-appropriate sources in the inquiry	Minimally distinguishes nor critically evaluates scholarly resources from popular works; or uses inappropriate sources for the inquiry	Failed to submit, or failed to submit on time
Formulate Questions: Relevant Issues/ Content: Skill Building FL-FAU-QEPSLO-2014.2.A.e	Identifies and consistently distinguishes questions, problems, or principles that are within the scope of the discipline from those that are not.	Identifies some questions, problems, or principles that are within the scope of the discipline of inquiry but does not generate new ones, nor distinguish these from those that are not within the scope of the discipline	Minimally identifies, distinguishes, or generates questions, problems, or principles that are within the scope of the discipline of inquiry	Failed to submit, or failed to submit on time
Critical Thinking: Interpretation FL-FAU- QEPSLO-2014.4.B	Interpretation is thorough and accurate without errors. Interpretation addresses what had been anticipated as well as any unexpected results that were obtained	Interpretation is generally accurate with some errors. Results are only evaluated in the context of what was anticipated.	Interpretation is not based on the actual results of inquiry, or is inaccurate or inadequate with respect to the context of the inquiry.	Failed to submit, or failed to submit on time
Communication: Clarity, Organization: Skill Building FL- FAU-QEPSLO-2014.6.A.sb	Oral and written communication is completely focused, organized, and clear with no errors affecting comprehension	Oral and written communication is generally focused, organized, and clear with only a few errors that do not detract from comprehension.	Communication is disorganized, incoherent, vague, or inappropriate; or student demonstrates competency in oral OR written communication but fails to demonstrate competency in both.	Failed to submit, or failed to submit on time