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Investigation of Science Education Attitudes in Alternative High School Settings

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ABSTRACT

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This study compared the attitudes of administrators, teachers and students in school settings for at-risk students. Students are considered at-risk if they are not academically successful. Teacher and student science education attitudes were analyzed by survey data and categorization of teaching practices. Additionally, data from classroom videotapes and teacher interviews was collected to support and triangulate survey data. Study participants were selected from two school settings for at-risk students 1) public alternative schools (PAS) and 2) private residential treatment centers (RTC). When the survey questions were analyzed by school type and teacher classification several differences were found between 1) teacher responses, 2) students responses and 3) the difference between student and teacher responses. However, when students were analyzed by their teachers' teaching classification no significant differences were found for any of the survey questions or question groupings.

Keywords: science education, attitudes, at-risk, alternative high schools, residential treatment centers

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Introduction

This study compared the science education attitudes of teachers and students. We analyzed data about science teaching practices and the importance placed on teaching science. Data was collected through surveys, videotapes and interviews with students and teachers serving at-risk students. Two school settings for at-risk students were examined: 1) public alternative schools (PAS) and 2) residential treatment centers (RTC).

Nationally, alternative high schools served 66,388 at-risk students in 2006 (U.S. Department of Education, 2006a). Students are generally considered at-risk if they are not academically successful. The reasons a student may be classified at-risk vary but may include special education, English language learner (ELL), behavioral disorders, abnormal amounts of school absences or an abusive home environment. At-risk students come from a variety of ethnic and socioeconomic backgrounds (U.S. Department of Education, 2006a; U.S. Department of Education, 2006b). At-risk students who attend PASs have shown a pattern of difficulty succeeding in the traditional school system. At-risk student difficulties may arise due to excessive absences, behavioral problems, substance abuse or gang activity (Dicintio & Gee, 1999; Knesting & Waldron, 2006; Ryan et al., 2007). Within the state of Utah there are 20 accredited PASs (Northwest Accreditation, 2008). Each school district sets their own criteria for referring a student to one of the PASs; however, the student referral process usually involves the reasons listed above (Provo School District, 2009).

In the report *Before It's Too Late* (2000), The National Commission on Mathematics and Science Teaching (NCMST) for the 21st Century, discusses the rising need for scientifically literate individuals within the workplace. The Third International Mathematics and Science Study (TIMSS) shows United States students going from leaders in achievement among 4th

graders to last in achievement among high school students. High school graduates within the United States are not prepared for the challenges they will face in the workplace (U.S. Department of Education, 2000). These educational shortfalls have been blamed in part for the economic failures of the U.S. (AAAS, 1990). Through a better understanding of science education attitudes at PASs and RTCs, it may be possible to motivate at-risk students within their science classes and produce a larger population of science literate high school graduates.

RTC is defined in this study as a nonpublic school for students considered at-risk who live on campus for the duration of their enrollment. The Northwest Association of Accredited Schools may accredit RTCs and PASs. During the 2008-2009 school year there were 37 accredited RTCs within the state of Utah, which is more than any other state. For example Idaho had 11 accredited RTCs and Montana had 1 (Northwest Accreditation, 2008).

Schools serving at-risk students in Utah are anticipating a shift in enrollment from PASs to RTCs based on USBOE Rule R277-702. This ruling lowered the age requirement for the Utah General Education Developmental (GED®) Testing administration to 16 (Utah State Office of Education, 2009a). While many states have RTCs for at-risk students, Utah is one of the only states that allow parents to keep their children in RTCs without student consent until the age of 18 (Utah State Legislature, 2009). The combined factors made Utah an ideal location for this study.

This study further compared the data collected from PASs and RTCs to determine if teacher and student responses differed when 1) school type or 2) teacher classification was used as a grouping factor. The rationale for grouping by school type is that RTCs within Utah are not held to the same school accreditation standards as Utah PASs. As a result, RTCs and PASs may not have the same resources available to students and staff. Some examples of differing resources may be credentialed teachers, professional development, classroom space and laboratory supplies. Discrepancies in resources may cause a difference in science education attitudes.

Research Questions

1. What are science attitudes of teachers and students in school settings for at-risk students?
2. Are teacher attitudes significantly different between a) school types and b) teacher classifications?
3. Are student attitudes significantly different between a) school types and b) teacher classifications?
4. Are student attitudes significantly different than the attitudes of the teachers at their respective a) school type and b) teacher classification?
5. Are student views of their teachers' attitudes significantly different than the attitudes of the teachers at their respective a) school type and b) teacher classification?

Literature Review

PASs and RTCs both serve student populations composed of students who often are classified as special education, English language learners, at-risk, emotionally disturbed or with behavioral disorders. In order to understand what teaching methods are most effective and efficient in PASs and RTCs, it is necessary to understand what those classifications mean in terms of student needs.

Special Education

A large number of students entering PASs and RTCs are classified as needing special education services. Students receiving special education services may have learning disabilities that impede their academic success. Research has shown that students with learning disabilities can achieve if they receive a) one-on-one attention from the teacher b) flexible time for assignments and, c) instruction including inquiry teaching methods (Jameson, 2007; Rogers et al., *in press,* Skarbevik, 2005). In other instances, special education students may be highly intelligent and yet academically unchallenged. Their boredom can lead to finding entertainment through behaviors ranging from acting out in class to substance abuse (Battin-Pearson et al., 2000).

English Language Learners

In July 2007, the U.S. Census Bureau (2008) reported the Hispanic population had reached 15.1% of the total U.S. population. The American Community Survey found in 2006 that 26.6% of the 7.8 million Spanish speakers, ages 5 to 17 years old, could speak English less than “very well” (U.S. Census Bureau, 2006). Hispanic non-English speaking students may enter schools struggling academically due to the language barrier. Many ELL students are referred to alternative high schools and the U.S. Census Bureau reported that in 2006 38.2% of students in alternative schools were minorities (U.S. Department of Education, 2006b).

The services provided by PASs and RTCs are not always necessary for ELL students; however, if PASs and RTCs provide instruction suited to ELL, students can experience success. Inquiry science teaching activities provide an effective environment for language development through the integration of opportunities for student communication about a student’s natural curiosity of science (Stoddart et al., 2002). ELL students do not necessarily need to learn

English perfectly before they learn science contrary to the traditional attitude that places ELL students in lower level courses or alternative schools due to their English language deficiency (Stoddart et al., 2002).

At-risk Students Classified by Section 504: Behavioral Disorders and Emotionally Disturbed

Generally, the term at-risk refers to a student's lack of academic success. There is no official federal or state classification describing the characteristics of at-risk students. However at-risk students can fall under the federal law Section 504 of the Rehabilitation Act of 1973 (Section 504). Section 504 was designed to protect the rights of individuals with disabilities in programs and activities that receive Federal financial assistance from the U.S. Department of Education (U.S. Department of Education, 2009). The disabilities covered under Section 504 are varied and may include students with mental or emotional illness.

Many students attending PASs or RTCs may be labeled as emotionally disturbed by the school systems. Students may be labeled as emotionally disturbed for the following reasons: 1) an inability to learn which cannot be explained by intellectual, sensory, or health factors, 2) an inability to build or maintain satisfactory interpersonal relationships with peers and teachers, 3) inappropriate types of behavior or feelings under normal circumstances exhibited in several situations, 4) a general pervasive mood of unhappiness or depression or 5) a tendency to develop physical symptoms or fears associated with personal or school problems (Section 504).

Understanding the students' learning motivations may help teachers engage and motivate at-risk students in their classroom (den Brok, Levy, Brekelmans, & Wubbels, 2005; Lang, Wong, & Fraser, 2005). Students classified under Section 504 may have a negative attitude towards school because of previous failures. Students classified under Section 504 who have more control of the curriculum and are intellectually challenged show more personal interest in their learning environment (Dicintio & Gee, 1999; Knesting & Waldron, 2006; Martin & Marsh, 2006).

Traditional School Settings

The traditional school settings used in this study do not include PASs or RTCs, but are representative of the regular mainstreamed secondary school. Traditional schools have remained largely unchanged for many years. Students are required to wake up early, attend the same classes each day and follow a structured schedule that offers limited academic variety. The day is usually spent in blocks of 50-90 minutes in large class sizes (30+) that provide little individual teacher attention. Many students are able to function and succeed within the traditional school setting. A subset of students may not function as well due to a lack of control over their education or one-on-one time with the teacher and may develop behavior problems (Dicintio & Gee, 1999; Knesting & Waldron, 2006).

Public Alternative High Schools vs. Residential Treatment Centers

Many public school districts have PASs to provide an environment for at-risk students. PASs are accredited by the state department of education and therefore must follow the same guidelines as traditional schools in terms of student resources and teacher training. PASs often vary in their student population and classroom instruction. Some PASs provide direct instruction while others allow students to work independently on curriculum packets in order to earn their course credits. Although state accreditation along with Northwest Accreditation allows both types of instruction, interaction between teachers and students has been proven to have a greater impact on student learning than independent curriculum packets (Moje, Collazo, Carrillo, & Marx, 2001).

Some students attending PASs find themselves incapable of coping. This may be due to addictions, behavioral disorders or emotional disturbances. Parents are forced to find a private school that meets their child's needs, usually a RTC. Many RTC students face psychological obstacles such as depression, eating disorders, addictions and suicidal tendencies. Students may end up in RTCs in order to overcome their obstacles while receiving an education. The state department of education does not accredit RTCs, however, Northwest Accreditation can accredit them. Northwest Accreditation standards are broad and do not specify what type of resources the school must provide for science instruction the same way state guidelines do. Non-specified resources may include teaching standards; i.e.: teacher certification and on-going teacher professional development.

Without the same state guidelines as PASs, RTCs may not require continued professional development despite research showing improvement in education when teachers have gone through development programs (Hanegan & Nelson, 2002). Science education specifically has been shown to suffer when teachers have limited training and little background knowledge (Ruby, 2006). Additionally, several studies have examined science education improvement for at-risk students through teacher professional development and curriculum supplements (Buxton, 2006; Chisholm et al., 2009; Lee-Pearce, Plowman, & Touchstone, 1998; Lee & Songer, 2003; Marx et al., 2004; Ruby, 2006; Tal, Krajcik, & Blumenfeld, 2006; Tobin, Roth, & Zimmermann, 2001; Varelas et al., 2008).

The first focus of RTCs is the psychological treatment and safety of the students. Treatment may minimize a student's educational experience because of time constraints.

Additionally, RTCs may limit access to standard laboratory materials because of safety concerns. Limited research has been done to determine the best and most efficient teaching method for at-risk students — especially in the area of science; however, the research that has been done shows a need to create a positive student science attitude (Chisholm et al., 2009; Marx et al., 2004).

Science Teaching Methods

Science teachers can incorporate a variety of teaching methods within their lessons. Teaching methods may include: a) direct instruction; a form of teacher centered instruction based on knowledge based facts; b) guided inquiry; a student centered instruction where the teacher proposes the question and provides limited materials. Students are given the opportunity to decide how they will answer the questions proposed by the teacher; and c) open-ended authentic inquiry; a more student centered approach where students use scientific examination to answer their own questions (Colburn, 2000; Furtak, 2006; Hanegan, 2007; Taraban et al., 2007; Thier, 2002).

Teaching methods can be viewed on a spectrum with teachers using direction instruction classified as "Traditional" continuing with teachers classified as "Practicing Inquiry" who consistently use inquiry strategies in all aspects of their teaching. A rubric for classifying teachers into the categories based on the inquiry domains of 1) lesson presentation, 2) questioning skills, 3) communication, 4) engagement of students and 5) classroom organization was designed based on modifications from Llewellyn (2002).

Inquiry Teaching and At-risk Students

The American Association for the Advancement of Science (AAAS) and National Science Education Standards (NSES) both endorse inquiry as a highly effective science teaching strategy (NRC, 1996). Inquiry is an effective teaching method for both traditional classrooms and at-risk students as it encourages students to use higher order thinking skills and provides them with ownership of their learning (Charney et al., 2007; Hanegan, 2007; Roehrig, Kruse, & Kern, 2007; Taraban, Box, Myers, Pollard, & Bowen, 2007).

As mentioned previously many at-risk students are considered highly intelligent, and boredom with traditional school settings may be a factor limiting success. Roth (1995) defines authentic inquiry as the opportunity for students to do real science like real scientists. Students design scientific experiments to solve real questions, collect and analyze data, and draw conclusions based on their findings (Hanegan, 2007; Hume & Coll, 2008; Lee & Songer, 2003; Roth, 1995). Students taught through inquiry are challenged and given more ownership of their work, overcoming boredom.

Additionally, more current literature indicates that inquiry teaching may have an impact on at-risk student learning and achievement (Buxton, 2006; Lee & Fradd, 1998; Marx et al., 2004; Moje, Collazo, Carrillo, & Marx, 2001; Rogers et al., *in press*; Stoddart, Pinal, Latzke, & Canady, 2002). This is supported by studies showing that inquiry driven science activities do improve student academic achievement for ELLs, students of low socioeconomic status, and other at-risk students who have low motivation in school settings (Lee et al., 2006; Marx et al., 2004; Roth, 1995; Stoddart et al., 2002; Tal et al., 2006).

Methods

This study used mixed methods, which is defined as research that combines qualitative with quantitative approaches (McMillian, 2006). Qualitative research is often used in science education research as it allows for more detailed questioning and observation than quantitative research. Within this study qualitative aspects were necessary for several reasons: 1) survey questions did not allow for follow up questions, 2) the videotaping used for teacher categorization was limited to one area of the classroom and 3) classroom observations were limited to three days requiring further information to establish what type of teaching occurred throughout the school year. Analysis of qualitative data traditionally involves breaking a large segment down into smaller parts to find a pattern (Schwandt, 1997). We did this through the transcription of interviews and the analysis of videotapes.

Without any quantitative data to support the patterns emerging from qualitative analysis there is chance of reporting false findings due to researcher bias (McMillian, 2006). Mixed methods were employed in this study in order to provide quantitative support for the finding reported and limit false findings due to researcher bias. Surveys administered to teachers and students were statistically analyzed to answer the research questions.

Data Collection

Approval from the Institutional Review Board (IRB) was obtained to allow study of human subjects. The subjects in this study were teachers and students from two school types: 1) public alternative schools (PASs) and 2) residential treatment centers (RTCs). Three schools were selected from each school type to participate in the study. Several PASs and RTCs were contacted, and those most interested in participating were chosen for the study. All three PASs were open to students within their respective school district for no extra cost. PASs are part of a public school district and receive state funding. The students attended school during the day, but still lived either at home or in a group home. The three RTCs involved in this study were privately funded and students had to either pay to attend, or they were ordered to attend the school as part of court mandated rehabilitation. The students not only attended the school during the day, but they also lived on campus.

Surveys were administered in both school types to teachers focusing on their science education observations and opinions. Student surveys focused on their science education observations and opinions as well as how they perceived their teacher's science education opinions. Teacher surveys were administered on Surveymonkey.com while student surveys were completed in their classrooms on paper. The surveys were administered before the researcher completed the observations or the teacher interviews. Once the surveys were completed the teacher and student answers were tallied in order to analyze the results.

After the surveys were completed, three days were scheduled to observe each teacher's classroom. The researcher videotaped the observations. During the observation the researcher completed the HORIZON instrument Protocols, CETP – Core Evaluation Classroom Observation Protocol (see Appendix C), to identify what type of teaching occurred and record other factors to clarify video observations; such as: the number of students within the classroom.

The videotapes of the classroom observations were then used to classify the teachers' level of inquiry as either 1) Traditional, 2) Exploring Inquiry, 3) Transitioning to Inquiry or 4) Practicing Inquiry. A copy of the UBEST Teacher Inquiry Rating Sheets used to classify teachers can be found in Appendix D. Two different independently trained researchers rated the videotape of each class period (minimum of four class periods per teacher). The scores from all the rubrics for a specific teacher were averaged to determine teacher classification.

Each teacher participated in an audio-recorded interview after completing the survey and classroom observations. The interview questions focused on 1) the teacher's description of at-risk students, 2) the teacher's methods for teaching at-risk students and 3) how the teacher thinks their methods have affected the attitudes of at-risk students (see Appendix B). Each interview was transcribed by the researcher and used to triangulate the statistical data.

Data Analysis

After all the survey data was collected, it was organized into an Excel spreadsheet for data analysis. The survey questions (18) were answered on a Likert scale of statements ranging from 1 most negative to 5 most positive. The classroom was used as the unit of analysis (n=41).

The Least Square Means were found and used to determine the difference between the mean of student responses and the mean of their teachers' responses for each question and category. A negative difference in means represents a student response mean that was higher than the teacher response mean. Subsequent tests were preformed to determine if teacher, student and the difference of their scores could be grouped by school type and/or teacher classification.

ANOVA was used to determine which model (full or reduced) should be used to find the difference in means. A p value <.05 was selected to determine if it was appropriate to group teachers and/or students by 1) school type and/or 2) teacher classification.

If ANOVA showed that it was appropriate to group participants by teacher classification, and there was a difference between the groups, the Tukey Post Hoc Test for all pair wise comparisons was examined. This test was run to compare the Exploring, Transitioning, and Practicing Inquiry means. A p value between two groups of <.05 was selected to determine significance.

Table 1 below defines all the notations used in the data collection and analyses as abbreviations to distinguish a) participants, b) question groups, and c) student opinion or student view of teacher opinion. The same notations were used throughout the data tables and narrative of the findings and discussion. A table outlining which survey questions were found within each category can be located in the findings section of this study.

Table 1 *Data Collection and Reporting Notation*

Notation	Meaning
t	Response to the question is from teachers
s	Response to the question is from the students
d	Analysis of that question or question grouping is based on the difference between the students' mean responses and the teachers' mean responses (student mean-teacher mean)
handson	The analysis is of all the questions in Category A: *Hands-on Science* grouped together
materials	The analysis is of all the questions in Category B: *Access: Materials and Time* grouped together
importance	The analysis is of all the questions in Category C: *Importance of Science* grouped together
a	Denotes that only the questions pertaining to the students' opinions were analyzed
b	Denotes that only the questions pertaining to the students' views of their teachers' opinions were analyzed

Findings

The teacher and student survey questions were grouped into three main categories (see Table 2). The three main categories analyzed using the teacher and student survey data were:

- *Hands On Science*
- *Access: Materials and Time*
- *Importance of Science*

Table 2 *Teacher and Student Surveys Categories*

	Teacher Survey Question Number	Student Survey Question Number	
		Student Opinion	Student View of Teacher
Category A: *Hands-on science*	T3, T4, T5, T6	S3, S4a, S5, S6a	S3, S4b, S5, S6b
Category B: *Access: Materials and Time*	T9, T10, T11, T12, T13, T14, T15, T16	S9. S10a, S11, S12a, S13, S14a, S15, S16a	S9, S10b, S11, S12b, S13, S14b, S16b
Category C: *Importance of Science*	T1, T2, T17, T18	S1, S2, S17, S18a	S1, S2a, S17, S18b

Category A: Hands on Science

Category A asked questions about 1) how the teachers and students define hands-on science, 2) if and how important it was that hands-on science include laboratory exercises, demonstrations, and investigations, 3) how often hands-on science was taught in the classroom and 4) if teaching hands-on science was important. Question 5 asked "Hands-on science in my science class includes laboratory exercises, demonstrations, and investigations…". Teachers and students had the options of: Almost Never, Seldom, Sometimes, Often and Almost Always. The answer options were given a numerical value of 1-5 starting with Almost Never as 1 and going to Almost Always as 5.

Analyses of question 5, definition of hands-on science, were done to compare answers by a) school type and b) teacher classification. Table 3 below shows the results of the analyses of question 5; sub questions t5, s5 and d5. We first compared 1) teachers by school type, 2) students by school type and 3) student vs. teacher response by school type.

Teacher responses (t5) were analyzed by school type (PAS or RTC). The findings indicated that when the two school types were compared the teachers had a difference for their definitions of hands-on science (p<.0001). When the school types were compared the students (s5) also had a difference for their definitions of hands-on science (p=0.0096). The amount of difference between students' responses and their teachers' responses (d5) for questions S5 and T5 was the same between school types (p=0.1717).

Table 3 *Question 5-definition of Hands-on Science*

Question	School Type	LSM	Std Error	F Value	PAS vs. RTC p Value
t5	PAS	3.61	0.08	82.49	<.0001
	RTC	2.76	0.05		
s5	PAS	3.32	0.18	7.46	0.0096
	RTC	2.74	0.11		
d5	PAS	-0.29	0.16	1.94	0.1717
	RTC	-0.02	0.10		
Question	Teacher Classification	LSM	Std Error	F Value	Teacher Classification p Value
t5	Exploring Inquiry [b]	3.42	0.09	65.92	<.0001
	Transitioning to Inquiry	3.62	0.06		
	Practicing Inquiry[c]	2.50	0.08		
s5	Exploring Inquiry	2.80	0.21	1.03	0.3683
	Transitioning to Inquiry	3.10	0.13		
	Practicing Inquiry	3.18	0.18		
d5	Exploring Inquiry [B]	-0.62**	0.20	19.73	<.0001
	Transitioning Inquiry[C]	-0.52**	0.12		

	Practicing Inquiry	0.68**	0.17		

Notes: School Type DF=1
Teacher Classification DF=2
Residuals DF =37
Negative LSM means that students rated that question as lower occurrence or important than their teacher.
A Indicates Exploring Inquiry mean significantly different from Transitioning to Inquiry mean P< .01
a Indicates Exploring Inquiry mean significantly different from Transitioning to Inquiry mean P< .05
B Indicates Exploring Inquiry mean significantly different from Practicing Inquiry mean P< .01
b Indicates Exploring Inquiry mean significantly different from Practicing Inquiry mean P< .05
C Indicates Transitioning to Inquiry mean significantly different from Practicing Inquiry mean P< .01
c Indicates Transitioning to Inquiry mean significantly different from Practicing Inquiry mean P< .05
* Indicates significant difference between student and teacher mean for each teacher classification P< .05
** Indicates significant difference between student and teacher mean for each teacher classification P< .01

When question 5 was analyzed using teacher classification as the grouping, it was found that teachers who were classified at the Practicing Inquiry level had a difference for their definition of hands-on science compared to teachers in both the Exploring and Transitioning to Inquiry classifications (p<.0001). When students were grouped by their teachers' classifications, no difference of their definition of hands-on science was found (p=0.3683). When the difference between student responses and their teachers' responses were examined, students with teachers classified as Exploring and Practicing Inquiry showed a difference of -0.62 and 0.68, respectively. The difference between student responses and their teachers' responses for students with teachers classified as Transitioning and Practicing Inquiry showed a difference of -0.52 and 0.68, respectively.

When all questions in Category A: *Hands-on science* were grouped together for analysis several significant results were found (see Table 4 below). Questions in Category A were analyzed by a) school type and b) teacher classification.

Table 4 *Category A: Hands-on Science*

Question	School Type	LSM	Std Error	F Value	PAS vs. RTC p Value
t3	PAS	3.84	0.24	19.52	<.0001
	RTC	2.56	0.16		
t4	PAS	5.20	0.10	121.09	<.0001
	RTC	3.87	0.07		
t6	PAS	5.23	0.14	86.34	<.0001
	RTC	3.72	0.09		
thandson	PAS	4.47	0.10	118.56	<.0001

	RTC	3.22	0.06		
s3	PAS	3.54	0.16	14.39	0.0005
	RTC	2.82	0.10		
s4a	PAS	4.07	0.14	7.23	0.0107
	RTC	3.64	0.09		
s4b	PAS	3.98	0.15	5.89	0.0202
	RTC	3.52	0.09		
s6a	PAS	3.93	0.17	4.46	0.0415
	RTC	3.50	0.11		
s6b	PAS	4.03	0.14	7.29	0.0104
	RTC	3.57	0.09		
shandsona	PAS	3.72	0.13	12.27	0.0012
	RTC	3.18	0.08		
shandsonb	PAS	3.71	0.14	11.28	0.0018
	RTC	3.16	0.09		
d3	PAS	-0.30	0.27	2.93	0.0951
	RTC	0.26	0.18		
d4a	PAS	-1.13**	0.17	21.04	<.0001
	RTC	-0.23*	0.11		
d4b	PAS	-1.25**	0.16	23.46	<.0001
	RTC	-0.35**	0.10		
d6a	PAS	-1.30**	0.22	17.35	0.0002
	RTC	-0.22	0.14		
d6b	PAS	-1.20**	0.20	18.98	0.0001
	RTC	-0.16	0.13		
dhandsona	PAS	-0.75**	0.14	17.25	<.0002
	RTC	-0.05	0.09		
dhandsonb	PAS	-0.76**	0.15	15.90	0.0003
	RTC	-0.07	0.09		
Question	Teacher Classification	LSM	Std Error	F Value	Teacher Classification p Value
t4	Exploring Inquiry ^{AB}	5.00	0.12	22.33	<.0001
	Transitioning to Inquiry^{C}	4.54	0.07		
	Practicing Inquiry	4.00	0.10		
t6	Exploring Inquiry ^{B}	4.32	0.11	16.24	<.0001
	Transitioning to Inquiry^{C}	3.85	0.07		
	Practicing Inquiry	3.38	0.10		
thandson	Exploring Inquiry ^{AB}	5.00	0.16	19.83	<.0001
	Transitioning to Inquiry^{C}	4.27	0.10		
	Practicing Inquiry	4.00	0.14		
d4a	Exploring Inquiry^{aB}	-1.30**	0.20	12.09	<.0001
	Transitioning Inquiry	-0.72**	0.12		
	Practicing Inquiry	-0.03	0.17		
d4b	Exploring Inquiry^{AB}	-1.59**	0.19	17.13	<.0001
	Transitioning Inquiry	-0.63**	0.11		
	Practicing Inquiry	-0.18	0.16		
d6a	Exploring Inquiry^{AB}	-1.50**	-0.45	7.61	0.0017
	Transitioning Inquiry	-0.45**	0.16		
	Practicing Inquiry	-0.34	0.22		
d6b	Exploring Inquiry^{AB}	-1.64**	0.24	15.11	<.0001
	Transitioning Inquiry	-0.33*	0.15		
	Practicing Inquiry	-0.06	0.21		
dhandsona	Exploring Inquiry^{AB}	-1.00**	0.17	13.83	0.0002

	Transitioning Inquiry[C]	-0.40**	0.10		
	Practicing Inquiry	-0.17	0.15		
dhandsonb	Exploring Inquiry[AB]	-1.10**	0.17	15.90	0.0003
	Transitioning Inquiry[C]	-0.36**	0.11		
	Practicing Inquiry	0.22	0.15		

Notes: School Type DF=1
Teacher Classification DF=2
Residuals DF =37
Negative LSM means that students rated that question as lower occurrence or important than their teacher.
A Indicates Exploring Inquiry mean significantly different from Transitioning to Inquiry mean P< .01
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* Indicates significant difference between student and teacher mean for each teacher classification P< .05
** Indicates significant difference between student and teacher mean for each teacher classification P< .01

When Category A questions were analyzed by school type, teacher (thandson) responses were different (p<.0001). Students were asked to provide their opinion (handsona) to answer questions in Category A. Comparison of school types showed that students (shandsona) answered differently (p= .0012). When students answered questions about what they thought their teachers' opinions (handsonb) were a difference was found (p=0.0018). Further analysis of Category A showed the difference (dhandsona) found in responses was unequal (p= 0.0002) as was dhandsonb (p= 0.0003).

Analysis of the Category A questions grouped by teacher classification also showed differences. Category A questions examined by teacher responses showed a difference between all three teaching classifications (p<.0001) Further analysis of Category A showed that students' answers were not different. Analysis by teacher classification showed dhandsona responses were different in all three teacher classification groups (p=0.0002) as were responses for dhandsonb (p=0.0003).

Category B: Access: Materials and Time

When all questions in Category B: *Access: Materials and Time* were grouped together for analysis several significant results were found (see Table 5 below). Questions in Category B were analyzed by a) school type and b) teacher classification.

Table 5 *Category B: Access: Materials and Time*

Question	School Type	LSM	Std Error	F Value	PAS vs. RTC p Value
t9	PAS	3.90	0.09	45.99	<.0001
	RTC	3.15	0.06		
t10	PAS	5.13	0.08	114.89	<.0001
	RTC	4.13	0.05		
t11	PAS	4.62	0.18	111.22	<.0001
	RTC	2.01	0.12		
t12	PAS	4.70	0.19	4.92	0.03
	RTC	4.19	0.12		
t13	PAS	4.35	0.28	57.92	<.0001
	RTC	1.83	0.18		
t14	PAS	4.87	0.18	16.48	0.0002
	RTC	4.03	0.11		
t15	PAS	4.26	0.26	4.80	0.0348
	RTC	3.58	0.17		
t16	PAS	4.97	0.12	15.78	0.0003
	RTC	4.38	0.08		
tmaterials	PAS	4.55	0.13	51.06	<.0001
	RTC	3.41	0.09		
s9	PAS	3.82	0.17	23.06	<.0001
	RTC	2.85	0.11		
s10a	PAS	4.15	0.14	9.85	0.0033
	RTC	3.64	0.09		
s10b	PAS	4.10	0.13	10.44	0.0026
	RTC	3.58	0.09		
s11	PAS	3.69	0.17	6.49	0.0151
	RTC	3.16	0.11		
s12a	PAS	4.15	0.14	7.35	0.0101
	RTC	3.71	0.09		
s12b	PAS	4.26	0.13	9.71	0.0035
	RTC	3.78	0.08		
s13	PAS	3.41	0.19	25.30	<.0001
	RTC	2.30	0.12		
s14b	PAS	4.00	0.14	19.33	<.0001
	RTC	3.26	0.10		
s15	PAS	3.66	0.20	19.43	<.0001
	RTC	2.62	0.13		
s16a	PAS	3.94	0.14	9.15	0.0045
	RTC	3.44	0.09		
s16b	PAS	4.03	0.14	12.78	0.0010

	RTC	3.42	0.09		
smaterialsa	PAS	3.85	0.11	27.41	<.0001
	RTC	3.16	0.07		
smaterialsb	PAS	3.88	0.11	33.52	<.0001
	RTC	3.13	0.07		
d10a	PAS	-0.99**	0.17	6.17	0.0176
	RTC	-0.49**	0.10		
d10b	PAS	-1.03**	0.16	6.49	0.0151
	RTC	-0.55**	0.10		
d11	PAS	-0.56*	0.25	33.81	<.0001
	RTC	1.15**	0.16		
d13	PAS	-0.94**	0.32	13.79	0.0007
	RTC	0.47	0.20		
dmaterialsa	PAS	-0.70**	0.18	4.65	0.0377
	RTC	-0.25	0.12		
Question	Teacher Classification	LSM	Std Error	F Value	Teacher Classification p Value
t9	Exploring Inquiry^{AB}	3.37	0.11	200.16	<.0001
	Transitioning to Inquiry^{C}	4.71	0.07		
	Practicing Inquiry	2.50	0.09		
t10	Exploring Inquiry ^{AB}	4.90	0.09	7.93	0.0014
	Transitioning to Inquiry	4.50	0.06		
	Practicing Inquiry	4.50	0.08		
t11	Exploring Inquiry ^{B}	2.93	0.21	25.22	<.0001
	Transitioning to Inquiry^{C}	4.00	0.13		
	Practicing Inquiry	2.50	0.18		
t12	Exploring Inquiry^{a}	4.05	0.23	4.06	0.0254
	Transitioning to Inquiry	4.77	0.14		
	Practicing Inquiry	4.50	0.20		
t15	Exploring Inquiry ^{B}	4.74	0.31	21.57	<.0001
	Transitioning to Inquiry^{C}	4.50	0.19		
	Practicing Inquiry	2.50	0.27		
tmaterials	Exploring Inquiry	4.00	0.16	12.54	<.0001
	Transitioning to Inquiry^{C}	4.39	0.10		
	Practicing Inquiry	3.56	0.14		
d9	Exploring Inquiry^{Ab}	-0.19	0.27	43.35	<.0001
	Transitioning Inquiry^{C}	-1.48**	0.16		
	Practicing Inquiry	1.10**	0.23		
d10a	Exploring Inquiry^{a}	-1.10**	0.20	3.56	0.0387
	Transitioning Inquiry	-0.50**	0.12		
	Practicing Inquiry	-0.62**	0.17		
d10b	Exploring Inquiry^{A}	-1.20**	0.19	6.25	0.0046
	Transitioning Inquiry	-0.45**	0.12		
	Practicing Inquiry	-0.73**	0.16		
d11	Exploring Inquiry^{A}	0.44	0.30	16.45	<.0001
	Transitioning Inquiry^{C}	-0.63**	0.18		
	Practicing Inquiry	1.07**	0.26		
d13	Exploring Inquiry	-0.14	0.38	2.64	0.0844
	Transitioning Inquiry	-0.71**	0.23		
	Practicing Inquiry	0.16	0.33		
d15	Exploring Inquiry ^{B}	-1.70**	0.40	16.92	<.0001
	Transitioning Inquiry^{C}	-1.47**	0.24		
	Practicing Inquiry	0.83*	0.34		
dmaterialsa	Exploring Inquiry	-0.52**	0.21	8.69	0.0008

	Transitioning Inquiry[C]	-0.91**	0.13		
	Practicing Inquiry	0.01	0.18		
dmaterialsb	Exploring Inquiry[b]	-0.61**	0.20	10.69	0.0002
	Transitioning Inquiry[C]	-0.90**	0.12		
	Practicing Inquiry	0.06	0.17		

Notes: School Type DF=1
Teacher Classification DF=2
Residuals DF =37
Negative LSM means that students rated that question as lower occurrence or important than their teacher.
A Indicates Exploring Inquiry mean significantly different from Transitioning to Inquiry mean P< .01
a Indicates Exploring Inquiry mean significantly different from Transitioning to Inquiry mean P< .05
B Indicates Exploring Inquiry mean significantly different from Practicing Inquiry mean P< .01
b Indicates Exploring Inquiry mean significantly different from Practicing Inquiry mean P< .05
C Indicates Transitioning to Inquiry mean significantly different from Practicing Inquiry mean P< .01
c Indicates Transitioning to Inquiry mean significantly different from Practicing Inquiry mean P< .05
* Indicates significant difference between student and teacher mean for each teacher classification P< .05
** Indicates significant difference between student and teacher mean for each teacher classification P< .01

When Category B questions were analyzed by school type, teacher (tmaterials) responses were different (p= <.0001). Students were asked to provide their opinion (materialsa) to answer questions in Category B. Comparison of school types showed that students (smaterialsa) answered questions differently (p= .0012). When students answered questions about what they thought their teachers' opinions (materialsb) were a difference was found (p=<.0001). Further analysis of Category B showed the difference (dmaterialsa) was unequal (p= 0.0003).

Analysis of the Category B questions, grouped by teacher classification, showed several differences. Category B questions examined by teacher responses showed a difference between teachers in classifications Transitioning and Practicing Inquiry (p=<.0001) Further analysis of Category B showed that students' answers were not different. Analysis by teacher classification showed responses were different between Transitioning and Practicing Inquiry teacher classification groups, dmaterialsa (p=0.0008). Responses to dmaterialsb were different between Exploring and Practicing Inquiry groups as well as Transitioning and Practicing Inquiry groups (p=0.0002).

Category C: Importance of Science

When all questions in Category C: *Importance of Science* were grouped together for analysis several significant results were found (see Table 6 below). Questions in Category C were analyzed by a) school type and b) teacher classification.

Table 6 *Category C: Importance of Science*

Question	School Type	LSM	Std Error	F Value	PAS vs. RTC p Value
t1	PAS	3.85	0.156	6.71	0.0136
	RTC	4.33	0.10		
t2	PAS	5.24	0.31	18.72	0.0001
	RTC	3.63	0.20		
d1	PAS	0.16	0.17	4.18	0.048
	RTC	-0.27*	0.11		
d2a	PAS	-1.55**	0.35	11.80	0.0015
	RTC	-0.14	0.22		
d2b	PAS	-0.93**	0.34	10.57	0.0025
	RTC	0.39	0.22		
Question	Teacher Classification	LSM	Std Error	F Value	Teacher Classification p Value
t1	Exploring Inquiry^{AB}	4.76	0.18	18.66	<.0001
	Transitioning to Inquiry^{c}	3.51	0.11		
	Practicing Inquiry	4.00	0.16		
t2	Exploring Inquiry^{AB}	5.00	0.37	12.54	<.0001
	Transitioning to Inquiry	4.00	0.22		
	Practicing Inquiry	3.50	0.32		
timportance	Exploring Inquiry^{ab}	4.08	0.17	4.59	0.0166
	Transitioning to Inquiry	3.53	0.10		
	Practicing Inquiry	3.50	0.15		
d1	Exploring Inquiry ^{AB}	-0.90**	0.21	18.33	<.0001
	Transitioning Inquiry	0.49**	0.13		
	Practicing Inquiry	0.24	0.17		
d2a	Exploring Inquiry^{AB}	-2.24**	0.41	10.81	0.0002
	Transitioning Inquiry	-0.50*	0.25		
	Practicing Inquiry	0.20	0.35		
d2b	Exploring Inquiry^{AB}	-1.79**	0.41	13.05	<.0001
	Transitioning Inquiry	0.15	0.25		
	Practicing Inquiry	0.83*	0.35		
d18a	Exploring Inquiry^{B}	-0.18	0.29	5.43	0.0085
	Transitioning Inquiry^{C}	-0.52**	0.18		
	Practicing Inquiry	-1.37**	0.25		
dimportancea	Exploring Inquiry^{ab}	-0.58**	0.18	4.63	0.0160
	Transitioning Inquiry	-0.04	0.11		
	Practicing Inquiry	0.06	0.15		
dimportanceb	Exploring Inquiry^{Ab}	-0.44**	0.16	5.86	0.0062
	Transitioning Inquiry	0.12	0.10		
	Practicing Inquiry	0.21	0.14		

Notes: School Type DF=1
Teacher Classification DF=2

Residuals DF =37
Negative LSM means that students rated that question as lower occurrence or important than their teacher.
A Indicates Exploring Inquiry mean significantly different from Transitioning to Inquiry mean P< .01
a Indicates Exploring Inquiry mean significantly different from Transitioning to Inquiry mean P< .05
B Indicates Exploring Inquiry mean significantly different from Practicing Inquiry mean P< .01
b Indicates Exploring Inquiry mean significantly different from Practicing Inquiry mean P< .05
C Indicates Transitioning to Inquiry mean significantly different from Practicing Inquiry mean P< .01
c Indicates Transitioning to Inquiry mean significantly different from Practicing Inquiry mean P< .05
* Indicates significant difference between student and teacher mean for each teacher classification P< .05
** Indicates significant difference between student and teacher mean for each teacher classification P< .01

Category C questions were analyzed by school type and no differences were found. Analysis of the Category C questions, grouped by teacher classification, showed several differences. Examination of Category C questions by teacher (timportance) showed a difference between teachers in classifications Exploring and Transitioning to Inquiry as well as in Exploring and Practicing Inquiry (p=0.0166). Analysis by teacher classification showed the difference between students' and their teachers' responses (dimportancea) were different between teachers in classifications Exploring and Transitioning to Inquiry as well as in Exploring and Practicing Inquiry (p=0.0160). The difference between students' and their teachers' responses (dimportanceb) were different between teachers in classifications Exploring and Transitioning to Inquiry as well as in Exploring and Practicing Inquiry (p=0.0062).

Discussion

To summarize the findings, when the survey questions were analyzed by school type and teacher classification several differences were found between 1) teacher responses, 2) student responses and 3) the difference between student and teacher responses. However, when students were analyzed by their teachers' teaching classification no significant differences were found for any of the survey questions or question groupings. The differences found in responses are discussed in more detail below. To help the reader follow the rest of the discussion a chart of participating teachers, their school type and teacher classification is provided (see Table 7).

Table 7 *Participant Profiles*

Teacher	School Type	Classification
Daniel	PAS	Transitioning to Inquiry
Tanner	PAS	Transitioning to Inquiry
Paul	PAS	Practicing Inquiry
Josh	RTC	Practicing Inquiry
Emily	RTC	Exploring Inquiry
Donna	RTC	Transitioning to Inquiry
Charles	RTC	Transitioning to Inquiry
Andrew	RTC	Exploring Inquiry

When teachers were asked how often "Hands-on science in my science class includes laboratory exercises, demonstrations, and investigations…" teacher responses differed depending on school type. Teachers at PASs responded that hands-on science included laboratory exercises, demonstrations and investigations more often than teachers at RTCs. Students answered this question the same way as their teachers showing that hands-on science involved laboratory exercises, demonstrations, and investigations more often in PASs.

RTC teachers in this study often commented that they felt limited in the amount of hands-on science they could provide in their classroom due to limited supplies and restrictions on equipment for safety reasons. When asked what strategies teachers used in the classroom, one RTC teacher stated her challenges with appropriate lessons:

> Donna: Hands on. They (students) seem to like that (hands-on). But it's very challenging here to do that – to come up with something appropriate – for example for the cell unit, I have them (students) make cells out of construction paper and label them.

Another RTC teacher stated:

> Emily: While I do try to use hands on. I don't – I can't say I am successful (with hands-on).

It was also found that teachers in the RTCs lacked state teaching certification more often than those in the PASs and therefore did not receive the same amount of training in science teacher preparation. Additionally, while discussing effective teaching methods in the interviews, some PAS teachers mentioned professional development they had received while no RTC teachers mentioned any kind of professional development. One PAS teacher stated:

> Paul: So I try to give them opportunities like that. Project Crawfish (professional development he has been involved with) was big, has been a really big one. …so you know I think it's been better but I still feel like I lack a lot of the skills that I probably need to be a great teacher, but I'm really trying to get those (skills) and I think it's made a difference. It's helped my students like my classes more than they used to.

The desire to obtain and use new teaching skills was also mentioned by another PAS teacher as he discussed ideas he had started incorporating into his teaching after reading current research.

> Tanner: They've got a University professor from the University of Wyoming and he's really high into some of the radical theories of transformative education where we can politically and socially transform the inequalities that we have… I've got some of those on my wall back there: writing in journals and role-play and drama, storytelling and verbal linguistic things, brainstorming and discussion and analysis, and cooperative learning. There's movement, there's humor, there's metaphor, simile, drawing and artwork. So, you know we really want to change it up and switch it up.

When teachers were asked the same question but grouped by their teaching classification Exploring and Transitioning to Inquiry teachers reported that hands-on science including laboratory experiences happened more often than teachers classified as Practicing Inquiry. However, when their responses were compared with their respective students' responses a significant difference was found showing that students reported hands-on science happening less often than their Exploring and Transitioning to Inquiry teachers. Students whose teachers fell into the Practicing Inquiry category reported that hands-on science including laboratory investigations happened more often than their teachers did.

When all the questions from Category A: *Hands-on Science* were analyzed together the results were similar to those found for question 5. One interesting difference was that when asked more questions about hands-on science students in the PASs had a different mean response than their teachers. They scored the occurrence and importance of hands-on science lower than their teachers did and incorrectly predicted how their teachers felt about the occurrence and importance of hands-on science. Also, students whose teachers were classified as Practicing Inquiry were able to correctly predict how their teachers felt about the occurrence and importance of hands-on science, while those with Exploring and Transitioning to Inquiry teachers could not.

The survey also asked teachers to respond to questions that related to Category B: *Access: Materials and Time* as available in their classroom. When all questions were grouped together and analyzed it was found that teachers in PASs responded significantly higher than those in RTCs. Students in the PASs also responded higher to questions than students at RTCs. When interviewed and asked about what they did in science class, PAS teachers specifically mentioned materials they had brought into class. One PAS teacher stated:

> Paul: I try to be hands on. I've been very limited in my overall resources, which means just lab supplies. My science budget is really limited but in the spring and fall we go outside quite a bit – we do insect labs, we do aquatic insect labs. I try to give them opportunities to try to do their own things like we do a microscope lab where they can bring anything they want that's safe into the building and look at it, and then I'll keep microscopes up for after we do the cell lab for like a month and it's kind of surprising – kids will find something in the building they want to look at. So I try to give them opportunities like that.

Another PAS teacher gave the researcher a tour of their classroom after the interview showing all the materials he had collected for his students use such as: bug nets, microscopes, rocket launchers and telescopes. This was the same observation day he had made rockets in class with his students.

During interviews with the RTC teachers there was no mention of laboratory resources. As quoted in the previous section some of the teachers felt they could not provide equipment or materials for hands-on science in their classrooms because it would not be appropriate based on the safety restrictions.

When all the questions from Category B: *Access: Materials and Time* were grouped and analyzed by teaching classification teachers in the Transitioning to Inquiry group responded significantly higher than those in Practicing Inquiry. However, when their students were asked the same questions there was no significant difference in the responses of any students regardless of teacher classification. While the Transitioning to Inquiry teachers responded that their students had more access to materials their students did not similarly respond; their responses to the same questions were significantly lower. No evidence was found within the teacher interviews to explain this difference.

The last group of questions addressed by the survey pertained to Category C: *Importance of Science*. When Category C questions were grouped together and analyzed by school types there were no differences found. When Category C questions were analyzed by teacher classification, teachers within the Exploring Inquiry classification responded higher than teachers in both the Transitioning and Practicing Inquiry classifications. However, their students rated Category C questions significantly lower than their teachers. When asked during the interview about their students' attitudes toward science the Exploring Inquiry teachers felt that only a portion of their students viewed science as important. One Exploring Inquiry teacher stated:

> Emily: Well it's interesting because some of them (students) really get excited when I bring out – you know - some kind of equipment or lab – and you know they can see it is going to be hands on and others don't – you know they think it's boring. 'That's dorky – am I going to have to do that?' kind of an attitude.

Another Exploring Inquiry teacher responded to the question by stating:

> Andrew: we have students who are very enthusiastic about science and we also have students who couldn't care less about science.

Additionally, the Exploring Inquiry students felt their teachers' opinion of Category C questions were significantly lower than what their teachers had actually responded. Exploring

Inquiry teachers may personally feel science is at a certain level of importance but their students do not recognize this. When asked in the interview if they felt the teaching methods used in class had affected their students' attitudes toward science, the Exploring Inquiry teachers responded with less certainty than the teachers in other classifications:

> Andrew: In some cases.
>
> Emily: What appeals to some students won't appeal (to other) students.

After analysis of all the survey data and teacher interviews, it was consistently seen that teachers in RTCs responded lower than the PAS teachers when asked about the 1) occurrence and importance of hands-on science, 2) access to materials and time for science and 3) the importance of science. The interviews indicated that a lack of professional development opportunities for RTC teachers may have been part of the reason for these differences. Further research could be done to examine the affects of professional development on teacher attitudes toward hands-on science. Professional development that has PAS and RTC teachers working together may provide an opportunity for RTC teachers to learn how PAS teachers are incorporating hands-on science into their lessons.

Research could be done to investigate the differences between materials available to PAS and RTC teachers. This information could lead to recommendations on what types of laboratory equipment are appropriate for use in PASs and RTCs and will aid teachers in their efforts to teach hands-on science. Once this is done the teachers in both schools could be trained in how to safely and effectively use the hands-on science resources available to both groups.

In addition to difference between school types, a consistent difference between Exploring Inquiry teachers' responses and their students' responses was found. Exploring Inquiry students consistently responded lower than their teachers for all categories when answering about their own opinions and what they thought their respective teachers' opinions were. Somewhere in their teaching the Exploring Inquiry teachers experienced a disconnect between what they were trying to teach and what the students were perceiving. Additional research through more detailed interviews of Exploring Inquiry teachers and their students could be done to try and find the source of this disconnect.

As the number of students entering alternative school systems, such as PASs and RTCs, increases it is imperative that science education within these schools is conducted in a manner that allows students to succeed. The United States is in continual need of more individuals educated within the field of science (U.S. Department of Education, 2000); PAS and RTC students could be the ones to fulfill that need. RTC teachers lag behind PAS teachers in the categories of hands-on science and access to materials and time for science. This study has shown that RTC teachers feel science is as important as PAS teachers, but clearly they need more training in how to implement science practices in their classrooms. PAS and RTC teachers need continual training where they can come together and learn how to provide appropriate hands-on science and access to materials in their classrooms.

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Appendix A- Teacher and Student Surveys

Teacher Survey

Please complete the statement below using the best option.

1. Science in my school is taught as frequently as reading, writing, and mathematics…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

2. Teaching science at the same level of importance as reading, writing, and mathematics in my school is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

3. Hands-on science instruction is taught in your classroom…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

4. Hands-on science instruction in my classroom is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

5. Hands-on science in my classroom includes laboratory exercises, demonstrations, and investigations…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

6. Including laboratory exercises, demonstrations, and investigations as hands-on science in my class is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

7. You are provided with funds for hands-on science activities…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

8. Providing teachers with funds for hands-on science activities is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

9. Students in my class are provided with materials and time for hands-on science activities…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

10. Providing students with materials and time for hands-on science activities in my classroom is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

11. My students have access to proper materials in my classroom…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

12. Providing students with access to proper materials in my classroom is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

13. I have access to a science laboratory…

Occurrence: Almost Never Seldom Sometimes Often Almost Always

14. Having access to a science laboratory is…

Importance: Very Unimportant Unimportant Neutral Important Very Important

15. I utilize the science laboratory…

Occurrence: Almost Never Seldom Sometimes Often Almost Always

16. Utilizing the science laboratory is…

Importance: Very Unimportant Unimportant Neutral Important Very Important

17. I promote science education through my interactions with students inside and outside of class…

Occurrence: Almost Never Seldom Sometimes Often Almost Always

18. Promoting science education through my interactions with students inside and outside of class is…

Importance: Very Unimportant Unimportant Neutral Important Very Important

Student Survey

Please complete the statement below using the best option.

1. Science in my school is taught as frequently as reading, writing, and mathematics…

Occurrence: Almost Never Seldom Sometimes Often Almost Always

2a. Teaching science at the same level of importance as reading, writing, and mathematics in my school is…

Importance: Very Unimportant Unimportant Neutral Important Very Important

2b. My science teacher considers teaching science at the same level of importance as reading, writing, and mathematics in my school…

Importance: Very Unimportant Unimportant Neutral Important Very Important

3. Hands-on science instruction is taught in my science class…

Occurrence: Almost Never Seldom Sometimes Often Almost Always

4a. Hands-on science instruction in my science class is…

Importance: Very Unimportant Unimportant Neutral Important Very Important

4b. My teacher considers hands-on science instruction in my science class…

Importance: Very Unimportant Unimportant Neutral Important Very Important

5. Hands-on science in my science class includes laboratory exercises, demonstrations, and investigations…

Occurrence: Almost Never Seldom Sometimes Often Almost Always

6a. Including laboratory exercises, demonstrations, and investigations as hands-on science in my science class is…

Importance: Very Unimportant Unimportant Neutral Important Very Important

6b. My teacher considers including laboratory exercises, demonstrations, and investigations as hands-on science in my science class…

Importance: Very Unimportant Unimportant Neutral Important Very Important

9. In my science class I am provided with materials and time for hands-on science activities…

Occurrence: Almost Never Seldom Sometimes Often Almost Always

10a. Providing students in a science class with materials and time for hands-on science activities…

Importance: Very Unimportant Unimportant Neutral Important Very Important

10b. My teacher considers providing students in a science class with materials and time for hands-on science activities…

Importance: Very Unimportant Unimportant Neutral Important Very Important

11. I have access to proper science materials in my science class…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

12a. Having access to proper science materials in science class is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

12b. My teacher considers having access to proper science materials…
Importance: Very Unimportant Unimportant Neutral Important Very Important

13. I have access to a science laboratory…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

14a. Having access to a science laboratory is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

14b. My teacher considers having access to a science laboratory…
Importance: Very Unimportant Unimportant Neutral Important Very Important

15. I utilize the science laboratory and supplies…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

16a. Utilizing the science laboratory and supplies is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

16b. My teacher considers utilizing the science laboratory and supplies…
Importance: Very Unimportant Unimportant Neutral Important Very Important

17. During class my science teacher discusses their personal experiences with science outside of the school…
Occurrence: Almost Never Seldom Sometimes Often Almost Always

18a. Having my science teacher discuss their personal experiences with science outside of the school during class time is…
Importance: Very Unimportant Unimportant Neutral Important Very Important

18b. My science teacher considers discussing their personal experiences with science outside of the school during class to be…

Importance: Very Unimportant Unimportant Neutral Important Very Important

Appendix B- Teacher Interview Questions

Interviews Questions for Teachers

1. What is your description of an “at-risk” student?

2. What is the typical student attitude of an “at-risk” student toward science in school?

3. What is your teaching method/strategy with “at-risk” students?

4. In what ways do you implement the strategies you mentioned previously?

5. Has your strategy affected the attitude of your “at-risk” students in the classroom?

6. Extension question: Why has your strategy affected your classroom according to how you answered question 5?

Appendix C- Horizon Instrument Protocols

CETP – Core Evaluation Classroom Observation Protocol

CETP – CORE EVALUATION CLASSROOM OBSERVATION PROTOCOL

I. Background Information

A. Observer

1. Name: ______________________________

2. CETP: ____________ Institution Name: ____________________

3. Date of Observation: ______________________

4. Length of observation: ____________________

5. Was the teacher informed about this observation prior to the visit? O Yes O No

B. Teacher/Faculty

1. Name: ______________________________

2. CETP Teacher? O Yes O No

3. Gender: O Male O Female

4. K-12: Licensure/certification ______________________________

OR College Rank: (*Check one.*)

O Instructor/Adjunct Faculty
O Assistant Professor
O Associate Professor
O Full Professor
O TA: primary responsibility? ____________________
O Other:

II. Classroom Demographics

A. What is the total number of students in the class at the time of the observation?

O 15 or fewer O 26–30 O 61-100
O 16–20 O 31–40 O 101 or more
O 21–25 O 41–60

B. Was a paraprofessional or teaching assistant in the class?
O Yes O No

C. 1. Grade Level (K-12)________
OR
2. Student Audience (majority of students. *Check all that apply*):
(a) O Prospective teachers: (1) O Elementary (2) O M.S. (3) O H.S.
(b) O Liberal Arts Majors
(c) O Mathematics/Science Majors

D. Subject Observed/Descriptive Course Title: ______________________________

E. Scheduled length of class__________(minutes)

III. Classroom Context

Rate the adequacy of the physical environment for facilitating student learning.

	1	2	3
1. Classroom resources: (from "sparsely equipped" to "rich in resources")	O	O	O
2. Room arrangement: (from "inhibited interactions among students" to "facilitated interactions among students")	O	O	O

IV. Class Description and Purpose

A. Classroom Checklist:

Please fill in the instructional strategies (*not* the instructor's actual activities, in case they are correcting papers or something noninstructional), student engagement, and cognitive activity used in each five-minute portion of this class in the boxes below. There may be one or more strategies used in each category during each interval. For example, SGD, HOA, and TIS often occur together in a five-minute period, but SGD and L do not.

Type of Instruction

L	lecture/presentation	CL	cooperative learning (roles)
PM	problem modeling	LC	learning center/station
SP	student presentation (formal)	TIS	teacher/faculty interacting w/ student
LWD	lecture with discussion	UT	utilizing digital educational media and/or technology
D	demonstration	A	assessment
CD	class discussion	AD	administrative tasks
WW	writing work (if in groups, add SGD)	OOC	out-of-class experience
RSW	reading seat work (if in groups, add SGD)	I	interruption
HOA	hands-on activity/materials	OTH	Other: Please describe.
SGD	small group discussion (pairs count)		

Student Engagement:

HE high engagement, 80% or more of the students engaged
ME mixed engagement
LE low engagement, 80% or more of the students off-task

Cognitive Activity:

1 **Receipt of Knowledge** (lectures, worksheets, questions, observing, homework)
2 **Application of Procedural Knowledge** (skill building, performance)
3 **Knowledge Representation** (organizing, describing, categorizing)
4 **Knowledge Construction** (higher order thinking, generating, inventing, solving problems, revising, etc.)
0 **Other** (e.g., classroom disruption)

Time in minutes:

	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
Instruction												
Student												
Cognitive												

	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120
I												
S												
C												

B. **In a few sentences, describe the lesson you observed and its purpose.** Include where this lesson fits in the overall unit of study, syllabus, or instructional cycle. Note: This information needs to be obtained from the teacher/faculty.

V. Ratings of Key Indicators

In this section, you are asked to rate each of a number of key indicators as descriptive of the lesson in five different categories, from 1 (not at all) to 5 (to a great extent). Note that any one lesson may not provide evidence for every single indicator; use DK, "Don't Know," when there is not enough evidence for you to make a judgment. Use N/A, "Not Applicable," when you consider the indicator inappropriate given the purpose and context of the lesson.

1. **This lesson encouraged students to seek and value alternative modes of investigation or of problem solving**	1 2 3 4 5 DK N/A
2. Elements of abstraction (i.e., symbolic representations, theory building) were encouraged when it was important to do so	1 2 3 4 5 DK N/A
3. Students were reflective about their learning	1 2 3 4 5 DK N/A
4. The instructional strategies and activities respected students' prior knowledge and the preconceptions inherent therein	1 2 3 4 5 DK N/A
5. **Interactions reflected collaborative working relationships among students (e.g., students worked together, talked with each other about the lesson), and between teacher/faculty and students**	1 2 3 4 5 DK N/A
6. The lesson promoted strongly coherent conceptual understanding	1 2 3 4 5 DK N/A
7. **Students were encouraged to generate conjectures, alternative solution strategies, and ways of interpreting evidence**	1 2 3 4 5 DK N/A
8. The teacher/faculty displayed an understanding of mathematics/ science concepts (e.g., in his/her dialogue with students)	1 2 3 4 5 DK N/A
9. **Appropriate connections were made to other areas of mathematics/ science, to other disciplines, and/or to real-world contexts, social issues, and global concerns**	1 2 3 4 5 DK N/A

For the following questions, select the response that best describes your overall assessment of the *likely effect* of this lesson in each of the following areas, from 1 (no effect) to 5 (great effect).

10. **Students' understanding of mathematics/science as a dynamic body of knowledge generated and enriched by investigation**	1 2 3 4 5 DK N/A
11. Students' understanding of important mathematics/science concepts	1 2 3 4 5 DK N/A
12. **Students' capacity to carry out their own inquiries**	1 2 3 4 5 DK N/A

VI. Capsule Description of the Quality of the Lesson

In this final rating of the lesson, consider all available information about the lesson, its context and purpose, the complete instructional cycle, and your own judgment of the relative importance of the ratings you have made. Select the capsule description that best characterizes the lesson you observed. Keep in mind that this rating is *not* intended to be an average of all the previous ratings, but should encapsulate your overall assessment of the quality and likely impact of the lesson. Please provide a brief rationale for your final capsule description of the lesson in the space provided.

O **Level 1: Ineffective Instruction**

There is little or no evidence of student thinking or engagement with important ideas of mathematics/science. Instruction is *unlikely* to enhance students' understanding of the discipline or to develop their capacity to successfully "do" mathematics/science. The lesson was characterized by either (select one below):

O **Passive "Learning"**
Instruction is pedantic and uninspiring. Students are passive recipients of information from the teacher/faculty or textbook; material is presented in a way that is inaccessible to many of the students.

O **Activity for Activity's Sake**
Students are involved in hands-on activities or other individual or group work, but it appears to be activity for activity's sake. Lesson lacks a clear sense of purpose and/or a clear link to conceptual development.

O **Level 2: Elements of Effective Instruction**

Instruction contains some elements of effective practice, but there are *substantial problems* in the design, implementation, content, and/or appropriateness for many students in the class. For example, the content may lack importance and/or appropriateness; instruction may not successfully address the difficulties that many students are experiencing, etc. Overall, the lesson is *quite limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

O **Level 3: Beginning Stages of Effective Instruction** (Select one below.)

O Low 3 O Solid 3 O High 3

Instruction is purposeful and characterized by quite a few elements of effective practice. Students are, at times, engaged in meaningful work, but there are *some weaknesses* in the design, implementation, or content of instruction. For example, the teacher/faculty may short-circuit a planned exploration by telling students what they "should have found"; instruction may not adequately address the needs of a number of students; or the classroom culture may limit the accessibility or effectiveness of the lesson. Overall, the lesson is *somewhat limited* in its likelihood to enhance students' understanding of the discipline or to develop their capacity to successfully do mathematics/science.

O Level 4: Accomplished, Effective Instruction

Instruction is purposeful and engaging for most students. Students actively participate in meaningful work (e.g., investigations, teacher/faculty presentations, discussions with each other or the teacher/faculty, reading). The lesson is well-designed and the teacher/faculty implements it well, but adaptation of content or pedagogy in response to student needs and interests is limited. Instruction is *quite likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

O Level 5: Exemplary Instruction

Instruction is purposeful and all students are highly engaged most or all of the time in meaningful work (e.g., investigation, teacher/faculty presentations, discussions with each other or the teacher/faculty, reading). The lesson is well-designed and artfully implemented with flexibility and responsiveness to students' needs and interests. Instruction is *highly likely* to enhance most students' understanding of the discipline and to develop their capacity to successfully do mathematics/science.

Please provide your rationale for the capsule rating:

Appendix D-Teacher Categorization Rubric

Adapted from Llewellyn, D. (2002). *Inquire within: Implementing inquiry-based science standards.* Thousand Oaks, CA: Corwin Press, Inc.

UBEST Teacher Inquiry Rating Sheet

Video File Name ______________________ Name of Rater ______________________

Instructions:

On each of the four following "Characteristics of Inquiry Domain" tables, mark the inquiry category (Traditional Approach, Exploring Inquiry, Transitioning to Inquiry, or Practicing Inquiry) the teacher exemplifies for each row in that table. Only the first fifty minutes of the class time will be evaluated. The first fifty minutes are divided into 10 minute blocks. Mark the inquiry category the teacher exemplifies during each 10 minute segment within the row for every table.

Once all of the 10 minute segments have been marked for each row in the table, determine the overall rating for that teacher in each of the five "Characteristics of Inquiry Domain" tables. The point values of each column (Traditional Approach = 1 point each mark; Exploring Inquiry = 2 points each mark, Transitioning to Inquiry = 3 points each mark, or Practicing Inquiry = 4 points each mark) are listed at the bottom of the column. Combine the subtotals from each column to form the Grand Subtotal for that domain table. Use the key at the bottom left of the page to determine the overall category rating of the teacher for each "Characteristics of Inquiry" domain table.

Once the category rating for each "Characteristics of Inquiry Domain" table has been found, calculate the overall Teacher Inquiry Rating by using the formulas and table on the last page of this packet. The overall Teacher Inquiry Rating is determined by the summation of the weighted point values from all five "Characteristics of Inquiry Domain" tables.

Characteristics of Inquiry Domains

Table 1:

	Lesson Presentation			
	Traditional Approach	***Exploring Inquiry***	***Transitioning to Inquiry***	***Practicing Inquiry***
1	Teacher is center of lesson.	Teacher is center of lesson, sometimes acts as facilitator.	Teacher is center of lesson, frequently acts as facilitator.	Teacher consistently acts as effective facilitator and coach.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
2	Teacher frequently lectures and uses demonstrations and activities to verify science information.	Teacher usually lectures and does demonstrations and activities to explain science information.	Teacher occasionally lectures and uses demonstrations and activities to reinforce science concepts.	Teacher occasionally lectures and uses investigations to apply science concepts.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
3	Teacher lectures first and then provides students with activity or lab.	Teacher attempts to use 5-E Learning Cycle Approach.	Teacher frequently uses 5-E Learning Cycle approach with satisfactory success.	Teacher regularly and effectively uses 5-E Learning Cycle approach, assesses prior knowledge.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
4	Teacher uses only demonstrations and structured activities.	Teacher uses demonstrations and attempts open-ended activities.	Teacher uses demonstrations and open-ended activities and occasionally attempts teacher-initiated and student-initiated inquiries.	Teacher uses all stages of inquiry and and consistently provides teacher-initiated and student-initiated inquiries.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
5	Teacher plans only whole-class instruction.	Teacher plans whole-class instruction but occasionally uses small-group instruction.	Teacher plans whole-class instruction and regularly uses cooperative learning groups.	Teacher effectively plans for whole-class instruction as needed and frequently uses cooperative learning groups.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
6	Teacher has difficulty with unexpected results.	Teacher begins to accept unexpected results.	Teacher easily accepts unexpected results.	Teacher accepts and anticipates unexpected results.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
	subtotal @ 1pt each	subtotal @ 2 pts each	subtotal @ 3 pts each	subtotal @ 4 pts each
				Grand Subtotal

Overall Category:	Grand Subtotal Range:
Traditional Approach	1-30
Exploring Inquiry	31-60
Transitioning to Inquiry	61-90
Practicing Inquiry	91-120

Overall Lesson Presentation: ____________________

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Table 2:

	Questioning Skills			
	Traditional Approach	***Exploring Inquiry***	***Transitioning to Inquiry***	***Practicing Inquiry***
1	Teacher asks mostly low-level, recall, and knowledge-level questions.	Teacher asks recall and comprehension-level questions, attempts application and evaluation-level questions.	Teacher poses higher-level and open-ended questions.	Teacher uses all levels of questioning and adjusts level to individual students.
	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50
2	Teacher uses questions to impart knowledge and solicit a desired response from students.	Teacher uses questioning skills to initiate discussion.	Teacher uses questioning skills to assess prior knowledge and initiate interactions between teacher and students and students and students.	Teacher uses questioning skills to assess prior knowledge, facilitate discussions, and construct knowledge.
	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50
3	Teacher leads students to answer questions correctly, provides correct answer.	Teacher leads student to answer questions correctly, attempts prompting strategies.	Teacher frequently uses probing, prompting, and redirectioning techniques.	Teacher consistently uses probing, prompting, and redirectioning techniques.
	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50
4	Teacher rarely asks open-ended questions.	Teacher sometimes attempts to pose open-ended questions.	Teacher frequently poses open-ended questions.	Teacher consistently and effectively uses open-ended questions.
	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50
5	Teacher does not use wait-time strategy.	Teacher occasionally uses wait-time strategies.	Teacher frequently uses wait-time strategies.	Teacher consistently and effectively uses wait-time strategies.
	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50
6	Teacher follow up students' answers by repeating student answer, saying "Okay," or going on to the next question.	Teacher attempts to follow up students' answers with positive reinforcement before going on.	Teacher frequently provides praise and positive reinforcement and follows up students' answers with additional probing questions.	Teacher consistently provides praise and positive reinforcement and follows up students' answers with additional probing and engaging questions.
	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50
7	Teacher provides answers when students cannot answer questions.	Teacher attempts rephrasing techniques when students cannot answer questions.	Teachers frequently uses prompts and rephrasing techniques when students cannot answer questions.	Teacher consistently and effectively uses prompts and rephrasing techniques when students cannot answer questions.
	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50	1-10 min, 11-20, 21-30, 31-40, 41-50
	subtotal @ 1pt each	subtotal @ 2 pts each	subtotal @ 3 pts each	subtotal @ 4 pts each
				Grand Subtotal

Overall Category:	Grand Subtotal Range:
Traditional Approach	1-35
Exploring Inquiry	36-70
Transitioning to Inquiry	71-105
Practicing Inquiry	106-140

Overall Questioning Skills: ____________

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Table 3:

	Communication			
	Traditional Approach	***Exploring Inquiry***	***Transitioning to Inquiry***	***Practicing Inquiry***
1	Teacher rarely allows students to share information with each other through small-group discussions and dialogue.	Teacher occasionally allows students to share information with each other through small-group discussions and dialogue.	Teacher frequently expects students to share information with each other through small-group discussions and dialogue.	Teacher consistently expects students to share information with each other through small-group discussions and dialogue.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
2	Teacher speaks mainly from the front of the room.	Teacher usually speaks from the front of the room and occasionally moves about.	Teacher frequently moves about the room, speaking from different areas.	Teacher effectively moves about the room, speaking from different areas to monitor and enhance learning.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
3	Teacher communicates by standing above and over students.	Teacher occasionally communicates to students by kneeling by or sitting on a student seat to make level eye contact.	Teacher frequently communicates to students by kneeling by or sitting on a student seat to make level eye contact.	Teacher consistently communicates to students by kneeling by or sitting on a student seat to make level eye contact.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
4	Teacher provides little positive reinforcement.	Teacher provides occasional positive reinforcement.	Teacher provides frequent positive reinforcement.	Teacher provides frequent and equitable positive reinforcement.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
5	Communication is mostly from teacher to student but rarely from student to student.	Communication is usually from teacher to student but occasionally from student to student.	Communication is occasionally from teacher to student but frequently from student to student.	Communication effectively varies from teacher to student and from student to student according to the situation.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
6	Expectations are not clearly stated.	Expectations are occasionally not clearly stated.	Expectations are usually clearly stated and understood.	Expectations are clearly stated and understood.
	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50	1-10 min / 11-20 / 21-30 / 31-40 / 41-50
	subtotal @ 1pt each	subtotal @ 2 pts each	subtotal @ 3 pts each	subtotal @ 4 pts each
				Grand Subtotal

Overall Category:	Grand Subtotal Range:
Traditional Approach	1-30
Exploring Inquiry	31-60
Transitioning to Inquiry	61-90
Practicing Inquiry	91-120

Overall Communication: ____________

Table 4:

	Engagement of Students																			
	Traditional Approach					***Exploring Inquiry***					***Transitioning to Inquiry***					***Practicing Inquiry***				
1	Teacher engages students through oral questioning and discussions.					Teacher engages students through oral discussion and open-ended questions.					Teacher engages students through open-ended discussions and investigations.					Teacher engages student through open-ended discussions, investigations, and reflections.				
	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50
2	Minimal student engagement.					Occasional student engagement.					Frequent student engagement.					Frequent self-engagement by students.				
	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50
3	Students are mostly passive but teacher uses some hands-on activities.					Students are occasionally active; teacher uses hands-on activities but attempts open-ended investigations.					Students are mostly active; teacher uses hands-on activities but attempts open-ended investigations and encourages student-directed explorations.					Students are consistently active; teacher uses hands-on and minds-on activities that encourage open-ended, student-initiated investigations and explorations.				
	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50
4	Teacher rarely solicits information from students.					Teacher occasionally solicits information from students.					Teacher frequently solicits information from students.					Teacher frequently and effectively solicits information from students.				
	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50	1-10 min	11-20	21-30	31-40	41-50
		subtotal @ 1pt each					subtotal @ 2 pts each					subtotal @ 3 pts each					subtotal @ 4 pts each			
																		Grand Subtotal		

Overall Category:	Grand Subtotal Range:
Traditional Approach	1-20
Exploring Inquiry	21-40
Transitioning to Inquiry	41-60
Practicing Inquiry	61-80

Overall Engagement of Students: ______________________

Calculation of Overall Teacher Inquiry Rating

Table 5:

Domain Category Table	Grand Subtotal		Weighted Subtotal
Lesson Presentation		(GS/120)*25	
Questioning Skill		(GS/140)*25	
Communication		(GS/120)*25	
Engagement of Students		(GS/80)*25	
	Weighted Total		

Overall Teacher Inquiry Rating: ____________________

Video File Name: ____________________

Name of Rater: ____________________

Appendix E-Sample Interview Transcript

Researcher: What are your name and the name of the school you work at?
Paul: Okay – Jorge Escalante. *Laughs*. Just kidding – Paul.
Researcher: What is your description of an at risk student?
Paul: Whew … man, you know in a lot of ways I think all high school aged kids are at risk. You know, there are so many dangers these kids face and if you look at every kid in this building, they all come with a different story and what – what may not – what one student may be able to handle, another can't. So, but the generalizations you're e looking at – uh, lower socioeconomic status, I think that – you know, that's a risk factor, um - broken families, cycles of abuse. Um, these kids – these kids are habitual non-participators - from the time they were in elementary school they wouldn't participate in any activities. Um, a lot of these kids have felt alienated or they've been labeled when they were really young and they've lived up to their label. Um, you know absolutely alcohol and drug abuse and use, addiction definitely contributes to a lot of these students. We have very few students that come from stable two family households. And even the ones that you do, we – like we used to go to a lot of – we do parent teacher conferences in the houses. And it was amazing, because some of the parents – you thought 'oh they've got it together', and you would get to their house and you would immediately walk in and you knew they didn't have it together. There were massive things going on. Um, I had a student last year who – who lived in a great big house in a rich part of town and what we didn't – you know what we found out why he was acting that way was because he was getting – he was literally getting physically abused to the point where he was finally taken out of there. This is a sixteen year old that they take out of the home – you know, so all of those factors contribute but also learning disabilities, kids that have low self esteem issues, and also kids that are very intelligent – maybe there had been boredom in school so they begin to act out and uh manifest negative behaviors because of that. That's a long definition …
Researcher: What do you typically see as the attitude towards science when you first get these students in your class?
Paul: Um – man, it runs the spectrum. One of the – I mean you get stereotype things where you see – where you have um, you know – some female students think science is a boy thing. And boys think sometimes science is a boy thing. And then you've got cultural considerations. Some cultures value science more than others and education in general more. Um, but you know I wouldn't say that they're – I think they're more averse to English and math than they are to science. I think science they see as cool things. Um, one of my – one of my struggles here is just the transiency. I mean, such a high percentage of students are moving all the time. They're coming in and out of school. So, it's hard to kind of keep a full year long focus on the value of science, but the first term, I spend a lot of time showing them how science has helped their lives and I show them how to use – we do a thing where we use the scientific method in their own lives and how to solve problems and you know I think that you are able, if you can justify it and prove to them why science is valuable – I think most of them actually begin to look at it favorably. And so you can kind of get away from the aversion or the – you know the scary part of science. (3:45)
Researcher: What are some teaching methods and strategies that you use in your class?
Paul: Um … I try to be you know I try to be hands on. I've been very limited in my overall resources, which means just lab supplies. My science budget is really limited but in the spring and fall we go outside quite a bit – we do insect labs, we do aquatic insect labs. We do – I try to

give them opportunities to try to do their own things like we do um uh a microscope lab where they can bring anything they want that's safe into the building and look at it, and then I'll keep microscopes up for after we do the cell lab for like a month and it's kind of surprising – kids will find something in the building they want to look at. So I try to give them opportunities like that. Project Crawfish was a big, has been a really big one. Um, I do the kids really like dissections here so we do sharks. Typically we do sharks, frogs, and um pigs. Um … we'll do a cow eyeball usually. I do – I'll do basic things like um … we dissect owl casts to do little skeletons and stuff like that. So kind of hands on things but the other thing is you can't do that with all forms of science so I try to bring in social issues. I try to bring in – um - things that are going to motivate kind of strong feelings so we do debates on stem cells. We do – I try to get some classical things that way. I try to use a visual – something visual … um – almost everyday, even if it's just like one thing – I try to have a visual component to all my classes. Um – but I do show movie clips and things like that. Um – and then I – oh some of the students, not all of them, but some of the students like to draw so I work on observational skills. A lot of these students when – who are taught an insect lab, where we have to catch insects and draw a living insect - and uh - and we do it with plants too. They'll catch a bee and so they'll draw a bee like they have the bee pictured in their mind. And they don't actually ever look at it. So a lot of these students don't – I'm being recorded hahaha – a lot of students don't look at things closely so I try to give them that skill – um and then I really bring – try to bring life skills into my classes just because of where I work. So I try to mix it up as much as I can – make things as hands on or tie them emotionally to something they can have strong feelings about related to their own lives as much as I can and there's always room for improvement but I- I think a lot of the things these kids actually respond to pretty well.
Researcher: Do you think that the strategies you have used have affected the attitudes of the kids that have been in your class?
Paul: Yeah, I – I mean just in my career from going to a textbook teacher to using the book nonstop and worksheets every day, to what I do today – uh my CRT scores – you know they're still not where I want them but I've – I – when I look – when I look at my CRT scores what I'm looking at is a student's been in my class the whole year that has good attendance and I look at that score as sort of my benchmark. And those students have improved quite a bit. So I don't love CRT's as an assessment of teaching effectiveness, especially here – but it's been one of my lines of evidence of student motivation, the amount of complaints I get, the student interest – you know, one thing I like is when a kid will come in after school or in lunch or in between classes to share some science thing with me. Those – the more kind of authentic I've tried to make it – the more real life I've tried to make it – I've seen much greater improvement that way. Uh – and you know I can – I mean I can prove that to myself just by giving them the book one day and have them do the work, and then – or teaching units using the book and giving a test at the end. They don't do well that way, so you know I think it's been better but I still feel like I lack a lot of the skills that I probably need to be a great teacher, but I'm really trying to get those you know and I think it's made a difference. It's helped my students like my classes more than they used to.
Researcher: Thanks!
Paul: Is that it?
Researcher: Yeah.