INCREASING TEACHER REFLECTIVE PRACTICES

ACROSS A SCIENCE DEPARTMENT

by

Jeffrey Edwin DeGlopper

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Jeffrey Edwin DeGlopper

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DEDICATION

I dedicate this Capstone work to the careful assistance of my advisor, Eric Brunsell, Ed.D., to my wife, Francesca, for the support and the many hours when I was absent, and to the memory of my father, who always wanted this for me.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

There are very few programs to assist veteran teachers to become more reflective about their practice. This project sought to assess the effectiveness of this work in expanding individual teacher reflective thought, in increasing departmental collaboration and reflective discussion, and in instilling positivity and empowerment in its participants in a small science department at an urban public school. Six teachers at various points in their careers, teaching grades six through twelve, were exposed to the basics of reflective thought and its relationship to teacher practice through professional development. This effort was supported in a number of ways: by weekly electronic journaling, incorporating both free-form reflections and reflections on predetermined prompts; through teacher-investigator guided reflections of classroom observations; and email-based peer reflective discussions about videotaped lessons. Changes in teacher reflectivity were measured in five ways: an analysis of pre-project interviews designed to assess and categorize initial levels of reflective judgment, a comparison of pre- and post-project surveys designed to target both individual and group reflective practice in the classroom and across the department, evaluation of teacher electronic journals over five weeks, and analysis of teacher-investigator and peer reflective discussions.

The data suggested that teachers did not increase either the depth or frequency of personal reflection. Reflective practice, while apparently desirable, was hampered by two main issues: a consuming concern about the inability to develop successful classroom management strategies to handle minor issues effectively and a mistaken belief that academic rigor involves only the increase in the level of content presented, without concern for actual student understanding. As both these issues place the burden of resolution of the achievement problem in someone other than the reflector (i.e. the teacher), these themes represent an anti-reflective strain across the department. While group reflection increased slightly due to teacher participation in the project, surface level thought, mainly dominated by minor difficulties with management and engagement, persisted. While neither goal was achieved, this project served as a thorough investigation of the teachers' current mindset and will provide a strong foundation for future professional development.

INTRODUCTION AND BACKGROUND

As never before, the question of teacher effectiveness has assumed the central focus in the national debate over the improvement of the American educational system. Much of the discussion at this level is focused on the ability of teacher education programs to produce flexible, durable, research savvy, culturally aware teacher candidates. When moving from the national to the local stage, the focus of the discussion often and quickly becomes mired in questions of time, money and professional standards, making finding a solution difficult. Despite improvements in teacher support systems, including support for curriculum development and assessment data analysis both in the form of additional funding and expert personnel, overall student achievement has been stagnant over the last three years at the Milwaukee Academy of Science (MAS) - a science-focused, independent urban public K-12 charter school just west of downtown Milwaukee, Wisconsin. Though secondary (6^{th}-12^{th} grade) science achievement has made overall gains over this time as measured by state-mandated tests as well as national measures (e.g. the ACT), these improvements are slight and are not commensurate with the increased science focus of the school (see Appendix A for recent trends in ACT and Wisconsin Knowledge and Concepts Examination [WKCE] data).

Students at the school site are remarkably similar in background: the student population is over ninety-nine percent African-American, the portion that qualifies for the federal free- or reduced-price lunch program exceeds ninety percent, and a vast majority has no adult role models in their home lives that have completed any post-high school education. Despite its charter school status and popular misconceptions about what that means, MAS suffers from many of the same issues that plague today's urban schools.

As an independent public charter school, families must choose to apply for admission into this school. State law mandates that students may not be turned away based on academic preparation, consistency of attendance, participation by families, prior disciplinary issues, or lack of interest in the intended focus area. Informal discussions with students and their families over the last five years have indicated a number of reasons frequently given for choosing this school over their neighborhood schools: most often these include smaller class sizes, a safer or more controlled environment, and the presence of family members who are students or staff members. While these are all excellent considerations when selecting a school, both new and continuing students often express their unhappiness with the school's science focus. Experience has shown that this unhappiness tends to surface between beginning of seventh and the end of eighth grades, when the level of science instruction intensifies, and the students begin to consider options for choosing a high school. Though the school does not suffer from the more traditional sources of inertia – a large and long-serving staff, an over-developed district-level bureaucracy, or powerful and conservative teachers' and administrators' unions - this lack of interest on the part of students and their families often serves the same purpose.

School staffing issues have also served to slow progress and to stifle innovation. High turnover rates in both the high school teaching staff and the 6^{th} – 12^{th} grade administration team have developed a culture of uncertainty. While the secondary science department involved in this project has maintained a fairly consistent staff with an adequately-defined common goal, the departments around them are in an annual state of flux. School-wide, continuity of policies and overarching philosophy has been

difficult to maintain, which has made efforts to overcome current stagnation in achievement.

Research Focus

It was hypothesized that this stagnation is due, in large part, to the development of a faculty and school culture that neither encourages nor rewards deep reflection, as opposed to the maintenance of the status quo. This study attempts to determine the effects of a systematic approach to the increase and support of individual, teacher-to-teacher and group teacher reflection on their practice as shown on measures of reflective judgment, attitudes, and collaboration across a single science department. Secondary questions for this study include:

1. How will training on and guided practice with individual reflection techniques affect the depth and complexity of those reflections?
2. How will structured opportunities for one-on-one and group reflection affect the quantity and depth of discussions about instructional issues between staff members?

CONCEPTUAL FRAMEWORK

To someone outside of the education field, it may seem that teachers must, by nature or of necessity, be mindful of the subtle interplay between individual experiences and personalities, group cultures, formal and informal power structures and the particulars and demands of their curriculum in their classrooms. The metaphor of a conductor guiding her orchestra through a daily symphony seems particularly suited to capture the blend of artistry and technical skill that many outside the profession see as necessary to be a teacher. For many reasons, however, this is not often the case. What follows is a review of the literature describing the origins of reflective practice in the classroom, the difficulties maintaining a reflective culture, and some methods found to be successful in the developing and maintaining the spirit of reflection in schools.

Reflective Practice

Over the last three decades, pre-service teacher education programs have enthusiastically embraced a reflective approach to teacher practice. Though this may appear to be a recent trend, reflective practice has its origins in the 1930s in the works of John Dewey. Dewey (1933) put forth his conception of a new American educational system: one in which students were taught to think critically about the knowledge to which they were exposed and the context into which they would incorporate that knowledge, rather than to act as passive vessels for the reception of facts. This new attitude was encapsulated in the phrase reflective thinking, which Dewey defined as "active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusion to which

it tends" (1933/2009, p 7). This type of thought can be seen as a comprehensive philosophical approach to learning rather than a pedagogical method involving a set of steps to work through. There are, however, two subprocesses that Dewey claimed are required for reflective thought to occur: the realization of a problem and the investigation of the resulting belief or the suggested solution. In the words of J. John Loughran (2002), "effective reflective practice involves careful consideration of both 'seeing' and 'action' to enhance the possibilities of learning through experience" (p 37). From the first moment, then, it can be seen that reflecting thinking is an active process, requiring the person reflecting to recognize that there is a problem, to conceptualize the problem fully, to postulate possible conclusions, and to weigh those conclusions in the light of all available evidence.

For those attempting to adopt this reflective stance, two corollaries appear to follow from this proposition. The first is that this approach is not natural for practitioners to assume. It involves a problem-based approach, in which the practitioner maintains a state of mental tension in the hopes that a more rational, just, and/or effective solution will arise after extended consideration, rather than to accept the solution at hand. It is clear that schools, both now and in Dewey's own time, are not the ideal environment for this kind of thinking. Teachers and students are pushed "by the sheer urgency of forces" to solve problems as quickly as possible by arriving at the traditionally accepted answer (Dewey, 1933/2009, p 11). A reflective student or teacher must pull him- or herself out of the moment-to-moment crush and respond to events in ways that may go against his or her instinct or habit and that may be at odds with the environmental pressures he or she experiences.

The second corollary is that this is an approach for practitioners, whose very proximity to and entanglement with events makes reflection difficult. Researchers, including those in educational research, tend to live on an abstract plane; they develop scientifically-tested responses to artificially isolated stimuli or to address problems that are of little or secondary importance to the practitioner in the field being researched. This idea is developed through the writings of Donald Schön, whose work, most importantly Educating the Reflective Practitioner (1987), is considered seminal in the field. In this book, Schön compared the traditional researcher to one who lives in the highlands away from the relevant issues of the field, and the reflective practitioner to one willing to fight through swamps toward a worthy goal. This apparent division between would-be allied approaches belies the fact that what is truly advocated is a synthesis of the two extremes: a practitioner dealing with important real-world problems through his or her ability to reflect on practice and current theory.

Central to this synthesis is the ability to see real-world events, problems and questions in new and enlightening ways. “Effective reflective practice is drawn from the ability to frame and reframe the practice setting, to develop and respond to this framing through action so that the practitioner's wisdom-in-action is enhanced and, as a particular outcome, articulation of professional knowledge is encouraged” (Loughran, 2002, p 42). This ability to reframe one's practice setting requires a particularly challenging set of characteristics: openmindedness, responsibility, and wholeheartedness (Dewey, 1933/2009). Practitioners who are openminded are not trapped by the particular characteristics of their internal worldview. Those who are responsible see the events and solutions through the lens of those the outcomes may affect. Wholehearted practitioners

are dedicated to the process, are not daunted when analyzing their own thoughts and beliefs, and approach each event with the hope that they may learn something new (Zeichner & Liston, 1996).

Schön (1987) developed reflective practice more fully by dividing the unwieldy concept temporally in his attempts to further describe what reflection looks like in practice. When a practitioner is reflecting in the moment, as the event is occurring, with an eye to the actions she will need to take, she is undergoing reflection-in-action. When thinking back on past events in the hopes of improving practice in the future, she is participating in reflection-on-action (1987). This division was a vital initial step in the attempt to define what is meant by reflection for those attempting to put it into practice. It also stands as a critical reminder for practitioners that reflection is a continuous process.

Other researchers have attempted to subdivide reflection in other ways. Valli (1997) saw five modes of reflection, based on the object being considered, focused on the practice of teachers. Technical reflection occurs when the practitioner considers instruction and management in the light of research. Deliberative reflection focuses on the practitioner's ability to choose from the many types of resources available. Personalistic reflection looks at the personal and social growth of the practitioner. Critical reflection expands the focus outward to include the social and political aspects of practice. She rounded out her list with Schön's reflection-in- and -on-action, which incorporates the teacher’s perception of the efficacy of instruction as measured by gains in student understanding both during and after the lesson. She finished her discussion with the claim that effective reflective teachers demonstrate a balanced approach to the

five modes.

Much work in the last three decades has gone into what the researcher-practitioner synthesis described above would look like for teachers. In compiling much of this work, Zeichner and Liston (1996) enumerated the following characteristics.

A reflective teacher is one who:

- examines, frames, and attempts to solve the dilemmas of classroom practice;
- is aware of and questions the assumptions and values he or she brings to teaching;
- is attentive to the institutional and cultural contexts in which he or she teachers;
- takes part in curriculum development and is involved in school change efforts; and
- takes responsibility for his or her own professional development (p 6).

If rearranged properly, one could imagine a series of expanding rings surrounding the reflective teacher: starting with his or her personal qualities and viewpoints and the professional development he or she engages in, outward to the dilemmas of the classroom, again outward to the school change efforts, and finally out to the societal and cultural context in which he or she must operate. This is an important reminder to those who would practice reflection on their own confined to their own internal issues, and one that is crucial to this study: reflection must be connected externally and socially for real change to occur (Sparkes, 1991).

To the above list, Valli (1997) added that, given our shared American character, reflective teaching must include a goal-oriented component. Reflective teachers view their work and their reflection in the context of a problem hindering their progress towards a goal. This set of goals may be external, impressed from above by

governments, school boards and administrators, or internal, developed out of the opinions and experiences of one's unique point of view.

Indeed, reflective teachers approach all aspects of their practice setting and the issues that arise from that particular point of view. This viewpoint is defined and informed by the knowledge, experiences and values that they bring with them from their unique past. (Handal & Lauvas, 1987; Zeichner & Liston, 1996) For better or worse, this viewpoint colors teachers' initial reactions to situations and must be analyzed and, in some cases, overcome to be a truly reflective practitioner. This viewpoint goes by many names in the research: practical theory, practical knowledge, strategic knowledge, teaching metaphors, etc. (Munby & Russell, 1990; Zeichner & Liston, 1996). What is consistent, though, is the important role this worldview plays in the way teachers see themselves and their role in the classroom. In 1706, John Locke appreciated this influence when he wrote, “in truth the ideas and images in men's minds are the invisible powers that constantly govern them, and to these they all, universally, pay a ready submission” (1706/2008, section 1, paragraph 1). Dewey (1933/2009) extended this observation to reflective thinking, when he stated, “the consequences of a belief upon other beliefs and upon behavior may be so important, then, that men are forced to consider the grounds or reasons of their belief and its consequences” (p 7).

Consideration of one's practical theory is not enough, however. Practical theories help practitioners interpret events, which informs action. As shown above, this reflection and, therefore, this action could take place at various times with respect to the event considered or with various goals in mind. Handal & Lauvas (1987) posited three distinct levels to this action: immediate action, as a result of reflection-in-action; planning, as a

result of reflection-on-action; and grander action as a result of moral and ethical reflections. These distinctions, however, are not to be seen as steps towards a goal; rather they are distinctions that are helpful to researchers in much the same way that knowing the classification of stellar types assists in making predictions but has no reality beyond the mind of the scientist.

In the same way, focusing on developing the characteristics above is neither easy nor a sure path to reflectivity. Even though Dewey originally framed the discussion in an educational context, reflection appears at odds with the realities of teaching as experienced by most teachers. Hatton & Smith (1995) compiled a list of these difficulties:

- teaching is commonly believed to require "immediate pragmatic action" rather than reflection;
- teachers often do not view themselves as reflective or as needing reflection to be successful;
- teachers often lack the "time and opportunity for development" required for reflection; and
- teacher education programs, and, though not stated, school environments, view reflection as a component of a larger program and not a fundamental and necessary ideology (pp 36 – 38).

As clearly seen above, the first two are internal and the last two external issues that must be overcome for a teacher to be reflective. However, both the internal and external issues listed above could be said to be facets of the larger, unsupportive culture of schools in the United States. While it is still possible for teachers to develop their reflective practice

within the context of a school culture that works to discourage it, it is clear that few experienced teachers will develop the skills on their own and that many new teachers, fresh from their reflection-focused teacher education programs, will quickly relegate their reflective skills to the idealism of their collegiate program.

Impact of Select Methods for Improving Reflective Practice in Teachers

As stated above, it is possible to improve the quality and frequency of reflective thought in teachers. King and Kitchener (1994) found that through systematic analysis of college students' current stages of reflective judgment, and the application of strategies designed to challenge collegiate programs were able to develop a deeper, more persistent reflective stance in their students. Their analysis involved an interview process in which the subjects were asked to make and defend judgments about the nature of knowledge. Their responses were scored by multiple reviewers, tallied, and distributed along a continuum of seven stages in the development of reflective thought. This continuum ranges from the pre-reflective, characterized by the belief in the certainty of knowledge and the acceptance of the views of authority figures, to the quasi-reflective, in which the subject has accepted the uncertainty of knowledge and the validity of multiple perspectives and contexts, to the reflective, wherein the subject accepts the probabilistic nature of knowledge and the inquiry process as the only means to gauge that probability. (See Appendix C for a more thorough summary of these stages.) Their interview process formed the initial stages of this project and helped to inform continued work with the teachers.

Once the teachers' reflective judgment needs were deduced through the initial

interviews, this study used a number of methods to develop teacher reflection: peer discussions, electronic journaling, and videotaped analyses - all under the formation of a professional learning community.

Peer Discussions

Peer discussions can be a powerful, nonthreatening method for improving teacher reflection. As a group, participants are invited to share events, data, and their reflections, in the hopes of getting a variety of perspectives. This method can help teachers to identify the characteristics of their practical theory, as described above, against the practical theories of the others in the group. As Loughran (2002) stated, "if these small groups are asked to develop assertions about their practice as a result of this sharing, the outcomes can be qualitatively different [than responses given to an authority's questions.] This difference is extended even more when... teachers document and share these assertions with peers (p 38)." Bullough (1989) described the path taken by a small group of teacher education faculty in their efforts to integrate reflection into the direction of their program. In their program development work, this small group of teacher education faculty set about defining their collective definitions of terms and goals, and then brainstormed methods for achieving those goals through repeated discussion and debate. In the end, they used their shared values and goals to enact innovative methods to increase the reflectivity of their teacher education students. Analysis, which seemed to be primarily anecdotal as students worked their way through the new program, led Bullough to conclude: (1) their method for developing shared values was instrumental to the program's success; (2) program development is highly contextual; and (3) both

program development and improvement of reflection are never-ending. Bullough's study is relevant to this study in that a small group of experienced teachers developed a shared set of values, focused on increased reflectivity. This shared set of values was used to inform the rest of the study and to propose innovative methods for increasing opportunities for reflection.

Electronic Journaling

Journaling is perhaps the most widely used method of improving reflection for participants of a study. In some respects, it is the quickest, most complete way to analyze the teacher's practical theory. "Careful attention to how one describes the world appears to give clues to how one constructs it. Such constructions can come under scrutiny only when we speak, or write, and then attend to the language we have used (Munby & Russell, 1990, p 121)." The relatively recent development of online and electronic journals provides this study with powerful tools for the development of reflection. Terrion and Philion (2008) used electronic journals in a program designed to train peer mentors in the metacognitive skills necessary to mentor other college students. Of the fourteen facilities in the program, two piloted the use of electronic journals. In the study, peer mentors were to describe their actions, their rationale and their feelings. Researchers coded 192 electronic journals for themes. They concluded that the journals were highly effective when compared with the "traditional journal" sites, as they provided a safe format for an honest and open discussion between the participants and the supervisors. The Terrion and Philion study helped to inform this study in that the coding method used was a model for coding the electronic journals. In addition, the researchers

suggest adding prompts to respondents to encourage further reflection-on-action, particularly with respect to actions that should be taken if similar situations occur again; this suggestion was incorporated into this study. Hatton and Smith (1995) found through their research that journal discussions resulted in four types of writing, three of which are reflective in nature: descriptive, wherein the author provides an opinion without appeal to justification; dialogic, forming a kind of discussion between the author and himself; and critical, which takes account of the cultural, social, and political contexts. This division was incorporated into the coding method of this study's journal entries.

Videotaped Lessons

Videotaped lessons provide a level of distance and protection, while still allowing practitioners to participate in rigorous self-analysis. Viewing these lessons in a group setting provides further exploration of the personal practical theory as defined against and compared with those of the others in the group. As Harford and MacRuairc (2008) state in their research, “it was... considered an appropriate model for encouraging student teachers to take ownership over their critical development (p 1890).” In the Harford and MacRuairc (2008) study, two groups of ten teachers were selected to participate in a peer discussion and analysis of videotaped lessons. The researchers selected this model because it was student-centered and student-led. Students provided videotaped lessons, lesson plans and a brief description of the context of the school. These analyses were augmented with a scaffolded series of writings designed to provide ever deeper reflection in responses. This mixed method technique was shown to improve both collaboration and reflection for participants. Notably, this method combated the isolation that new

teachers feel as they move into their first classrooms. This research was selected as the proposed study includes both videotaped analysis and reflective writing: teachers worked in pairs to analyze videotaped lessons and respond via email, which constituted an ad hoc shared journal between these teachers. The scaffolded writing prompts are of particular interest as this appears to be troublesome in some of the literature. This process was intended both to foster both the growth of individual reflection and the development of a departmental culture of reflection.

Professional Learning Communities

Finally, these strategies will be embedded within a context modified from the groundbreaking work of Richard DuFour and Robert Eaker (1998) on professional learning communities. In an attempt to make a general procedure for the change of school culture, DuFour and Eaker set out steps borrowed from business and industry, modified to fit the needs of contemporary reform-minded educator and administrator. To create this culture of change, they laid out a six-step process: develop a shared vision, participate in collective inquiry, develop collaborative teams, orient these teams and this work towards the actions they will produce, focus on continuous improvement, and emphasize and celebrate results.

As a part of this project, the science teachers worked to develop a shared vision for the department, including shared values and a set of professional standards that helped guide them when issues arise. This vision was essential for the success of this project, the improvement and motivation of the teachers, and for the sustainability of this work, as "it present[ed] a realistic, credible, and attractive future for the [department] – a future

that is better and more desirable in significant ways than existing conditions." (DuFour & Eaker, 1998, p 62)

Though the teachers in this department are already close personally, to move forward they will need to build a collaborative team, focused on inquiry and rigorous, objective reflection as discussed above. DuFour and Eaker (1998) noted the importance of the reflective posture, stating it "represents a purposeful attempt to make conscious what is unconscious. When teachers become more aware of their school's culture, they will be better able to shape that culture (p 134)."

In the end, many well-intentioned discussions fail in that they are not action- and results-oriented. Armed with the vision, their shared values, and a reflective mindset, the teacher team will spend their time transforming their observations into positive, active change.

METHODOLOGY

Participants

This study required the cooperation of the entire science department, composed of six teachers varying in grades taught, age, gender and years of experience. Their classes spanned the sciences in grades six through twelve, including a sixth, a seventh/eighth, a ninth grade biology, a physics/physical science, an inquiry/anatomy, and a tenth grade chemistry/Advanced Placement teacher. Their years of experience varied as well, with three veterans beyond their fifth year, one in his third year, and two in their first classroom experiences. All are Caucasian, ranging in age from mid-twenties to mid-fifties. All six teachers in the department agreed to and participated in the ongoing professional development program, which included formal development sessions, interviews, observations and meetings. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Intervention

Reflection is not a natural mental approach for most adults in everyday situations. Teachers in particular suffer a nearly constant bombardment of questions, concerns and other demands on their time, their attention and their knowledge. This leads a sizable percentage of teachers to opt for the most expedient course of action in most cases, rather than a considered and careful response that may be more positive, more just or more effective in the long run. For example, in the consideration of implications for the student as a complete person rather than a vessel for specific content knowledge, for the

development of the students into a cohesive and collaborative social group, or for the school culture as a healthy and organic whole. This study implemented a program of departmental consensus building, professional development, as well as individual and group mechanisms for reflection aimed at increasing teachers' commitment to and skill with reflective practice (Appendix A).

From the first, the aim of the project was to create sustained change. At the outset of the project, the teachers met to create a coherent long-term direction for the department through the development of consensus on mission and vision statements, taking as a basis the work of DuFour and Eaker (1998) on professional learning communities. Without this agreed departmental focus, the work done in this project would likely be lost amongst the endless minutiae of administrative mandates. In total, this work served to develop the mindset of the teachers in one essential aspect of reflective practice: the notion that their practice is in part defined by the social and cultural context of the school and the community. This vision guided the work throughout this project and helped sustain the spirit of personal and professional development through the remainder of the academic year.

As some teachers in the department may not have been familiar with reflective practice techniques, all participants will receive an introduction to reflection techniques and their application to teacher practice. To guide this development, each teacher was interviewed using the King and Kitchener Reflective Judgment Interview process (1994). The scores that the teachers received on this helped to determine the best place to meet them in their reflective growth. Once this was determined, the introductory session was developed to match their needs. In addition to meeting the teachers at their own level of

reflective judgment, this professional development session was designed for the specific purposes found in this project, and will be based upon the work of Dewey (1933/2009), Schön (1987), Zeichner and Liston (1996).

This work was supported, reinforced and practiced throughout the project in a number of ways. To maintain regular practice with these skills, the teachers maintained an electronic journal, facilitated by the researcher, documenting their work each week. In this journal, teachers responded to the thoughts and activities of the week through lenses provided both by the reflective tools they have already received and by prompts they are given. These standardized prompts, adapted from the work of Haigh (2000), served to assist teachers in their efforts to reframe their classroom experience - both the successful and unsuccessful events of the week - to help them probe more deeply into their practice (see Appendix F).

This practice was supported through classroom observations. Agreed upon classes were observed and documented using a two-column form designed for this purpose (Appendix E). In the central column, the researcher recorded the events objectively, somewhat in the ethnographic style. Down the right-hand column, the investigator recorded his reflections. Observer comments were withheld until the teachers had had a chance to reflect on their own lesson, with the prompting and assistance of the observer. The left-hand column was left empty for teachers to make their own notes. Teacher reflections were guided by a series of questions, initially focusing on teacher and class strengths and later moving to ongoing, ill-structured problems. These and any clarifying questions were discussed together between the teacher and investigator until a thorough understanding was developed on both sides.

To further practice and reinforce individual reflection, and to support the departmental collaboration, the teachers shared a videotaped lesson during weeks two and three with researcher-selected partners from within the department. These lessons served as a basis for peer reflection, paying particular attention to those core goals agreed to in the department's initial meetings. This type of discussion was intended to serve a number of purposes: to increase the idea of multiple perspectives - a key understanding under reflective thought; to reinforce the notion that culture change must be affected by all members of the group; and to inspire greater collaboration and improved discussion between science teachers.

After the project's completion, the major findings were disseminated to the participants. The teachers, too, shared out what they have learned and how the department might keep up this kind of work in a way that is both sustainable and useful.

Data Collection

Central to the success of this project is the measurement of teachers' ability to think reflectively. This assessment is problematic as it must necessarily involve well-defined gradations within the abstract space of reflective thought, as well as an indirect method of eliciting data. King and Kitchener (1994) developed an interview process, called the Reflective Judgment Interview, and a series of levels of reflective judgment that will be used in this project. In this model, the interviewee is presented with a scenario in which there is some controversy or uncertainty about what is known. After the scenario is presented, the interviewer asks a series of probing questions (both scenarios and probing questions are found in Appendix D). This process is utilized to explore interviewees'

understanding of the scenario, their epistemology, and their response to uncertainty, particularly in academic situations. Responses are coded, analyzed and categorized into levels, as seen in Appendix C. This interview process was performed before the intervention to gauge participants' initial stages of reflective thought and this analysis was used to develop the remainder of the project.

The Reflective Judgment Interview provided access to pre-intervention reflective thought, which, in turn, guided the level of the intervention. To assess changes in focus or the perceived levels of collaboration experienced by members of the department as a result of the intervention, a number of methods were employed. Most objectively, a pre- and post-intervention survey addressed changes in a broad spectrum of areas, both individual- and group-oriented. (See Appendix B). The post-intervention survey also included prompts that more directly assess the changes due to the teachers' work in this project. This survey was given online, using a Google Documents form.

Throughout the intervention, the teachers reflected on their practice in an electronic journal, in response to weekly prompts developed to increase teacher reflective thought: specifically their awareness of their own viewpoint, the validity of other perspectives on classroom culture and events, and their experience with reflective techniques. The sequence of prompts was the same for all participants and was developed using interpretations of the baseline judgment scores of the group, aimed at meeting the teachers at a level that was both accessible and challenging. By using common prompts, it was hoped that teachers would have a common weekly focus and a shared vocabulary that might initiate departmental dialogue. While each teacher maintained his or her own journal apart from the other participants, it was regularly accessed, monitored and

facilitated by the researcher. In this way the teachers could reflect more openly in a neutral environment, taking advantage of the psychological and emotional distance afforded by an online forum. These journals were coded and analyzed for general themes and increasing depth and complexity of thought in an attempt to show the continuum of growth throughout the five weeks.

Lessons were observed with notes taken in an ethnographic style, paying particular attention to the instances in which the teacher demonstrated evidence of reflective thought. Teachers and the researcher met to discuss and reflect jointly on the lesson observed in an attempt to build the reflective skills and mindset of the teachers. The notes from these discussions were coded and analyzed to show evidence of increased frequency and depth of reflection.

In weeks two and three of the project, partner groups used electronic communications to discuss each others' videotaped lessons. Lessons from each teacher were videotaped for twenty-minute segments during randomized periods of the day and days of the week to ensure that the activity in the class was representative of the teachers' actual practice. A duration of twenty minutes was selected as it was short enough that reflecting partners would be able to watch multiple times and yet long enough that it would likely feature a number of types of activities that occur during an average class period. Each teacher was asked to view and reflect upon his or her partner's lesson and to reflect upon what was seen from three points of view: an objective third-party, an average student in the class, and the teacher leading the lesson. Within those different perspectives, participants were given possible suggestions to focus their reflection in the form of questions, found in Appendix K. Peer reflections were emailed between partners,

taking advantage of the security and confidence afforded by the medium. These email messages were also analyzed for depth and complexity and for evidence of improved reflective judgment and increased skill.

At the end of the study, these data as a whole were analyzed for themes, which will be used to guide future work. All sources of data will be correlated to ensure validity (see Table 1).

Table 1
Data Triangulation Matrix

Primary Question: What are the effects of a systematic approach to the increase and support of both individual and group teacher reflection on their practice?			
Focus Questions	Data Source 1	Data Source 2	Data Source 3
1. How will training on and guided practice with individual reflection techniques affect the depth and complexity of those reflections?	Comparison of pre-and post-project surveys sections focused on individual attitudes	Analysis of teacher daily electronic journals	Analysis of transcripts of one-on-one discussions about classroom observations
2. How will structured opportunities for individual and group reflection affect the frequency and depth of discussions about instructional issues between staff members?	Comparison of pre-and post-project surveys sections focused on group practice	Analysis of transcripts of one-on-one discussions about classroom observations	Analysis of peer reflections on videotaped lessons

DATA AND ANALYSIS

Measurement and analysis of teacher reflection presents a number of challenges. For the most part, these challenges were met through the use of thematic analysis: the definition of common or expected themes and the frequency with which those themes are referenced throughout the document being analyzed. Identification of the major themes in the teachers' reflection and the development of those themes over time, if any, form the heart of the following analysis.

Baseline

To establish a baseline for project work and to determine the amount of support needed, teacher-subjects were interviewed and those interviews were analyzed using an abbreviated form of the King-Kitchener method. The prompts, which focused on food chemistry and evolution, were selected to present, first, an issue that was somewhat noncontroversial and then another that was highly controversial amongst department members. Care was taken both in the interview and during transcript analysis to focus on the ways the teachers thought about knowledge and what is knowable, and the ways they justified their ideas and beliefs.

As seen in Table 2, each teacher presented a small spectrum of judgment, spanning two of the stages defined by this process. In no case was a teacher scored across a spectrum greater than two stages, which would have called into question either the interview method or the interpretation and would have required a recalibration and re-scoring of all results.

Table 2
Stage Scores for Each Probe Question by Teacher

	TEACHERS					
	1	**2**	**3**	**4**	**5**	**6**
Interviewee's Opinion	4	4	5	5	5	5
Evolution of Knowledge	5	3	5	5	6	6
Justification	4	3	5	6	6	6
Certainty of Knowledge	4	4	5	6	6	6
Evaluation of Arguments	4	4	5	5	5	5
Why there is Diversity	5	4	5	5	5	5
Role of Experts	5	3	5	5	6	5
SCORE	**4,4,5**	**3,4,4**	**5,5,5**	**5,5,6**	**5,6,6**	**5,5,6**

Seen as a whole, the teachers' responses hover around stage 5, and so that was taken as the approximate level of the department. Stages 4 and 5 are considered representative of Quasi-Reflective Thinking, and are described thus:

> [R]easoning more typical of the middle stages (Stages 4 and 5) recognizes that knowledge claims about ill-structured problems contain elements of uncertainty; thus there is an understanding that some situations are truly problematic. The difficulty is in understanding how judgments ought to be made in light of this uncertainty. Individuals who hold the assumptions of Stages 4 or 5 typically argue that, while judgments ought to be based on evidence, evaluation is individualistic and idiosyncratic. While they acknowledge differences between well- and ill-

> structured problems (a developmental advance over the earlier stages), they are often at a loss when asked to solve ill-structured problems because they don't know how to deal with the inherent ambiguity of such problems. (King & Kitchener, 1994, Loc 334-338)

What was seen most often was a willingness to accept contextualized systems of justification rather than coherent, cross-context reasoning, an overemphasis of the belief that the bias developed through one's upbringing calls into question the rationality of others' conclusions, and the contradictory belief that there are objective scientific authorities who will eventually weigh in and solve these and similar ill-structured problems. As a result, it was decided to provide more basic reflective support as the teachers moved through this process.

Further explorations were conducted through an introductory meeting designed to introduce the teachers to some basic tools of reflective thought and for them to develop a long-term vision for the department. During this meeting, items of importance were discussed, labeled and categorized into themes by the teachers (See Appendix I). The themes indicated were promising as they covered the breadth of reflective domains, from the individual (Rigorous Academic Standards, Achievement and Inquiry Methods) to the classroom (Classroom Culture) to the department and school (Teacher Collaboration) to the community (Community Perception). See Figure 1 for theme frequencies.

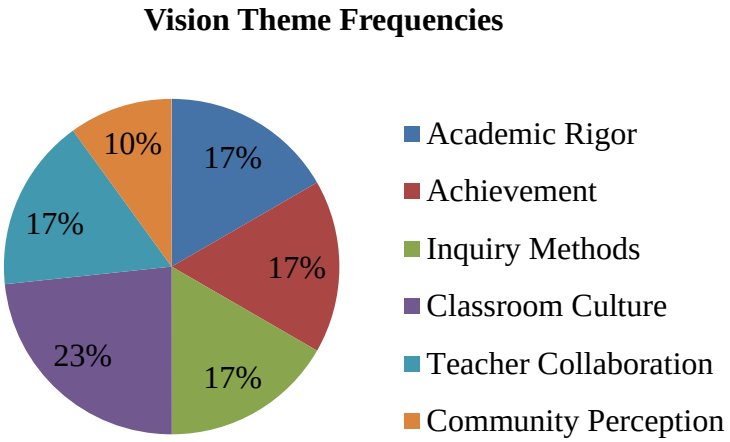

Figure 1. Vision Statement Brainstorming - Theme Frequencies.

This expanded view can be seen as a direct outgrowth of discussions about the reflective process and the particulars of this project during this initial meeting, as school and community awareness have never been discussed at meetings as departmental concerns.

As the most frequent theme, classroom culture was referenced in a number of ways. First, the teachers discussed an increase in the students' desire, both to be in their specific classroom and, more generally, to be at a school that focuses on science (4 comments). Second, the teachers discussed the differences between our current culture – more social and less serious – and an academic and professional culture as seen, for example, at the college level (2 comments). Finally, one comment noted the need for improvement of the students' understanding of academic ethics.

Though this will be discussed in greater depth later, four of the five comments submitted listed "academic rigor" as a need for the future. This was contrasted with a single comment that listed student self-accountability and high teacher expectations.

Using these themes as a foundation, the department developed a vision statement for work over the next five years. From multiple drafts of individual goals, a single statement was compiled:

> By the spring of 2017, the Milwaukee Academy of Science will be recognized throughout southeastern Wisconsin as a pre-college leader in health science education. Its students will come to school prepared to engage in rigorous and authentic scientific work and empowered to monitor their own academic success. Its staff will collaborate to maximize teacher efficacy and to maintain the focus of its comprehensive secondary (6-12) science sequence. The students and staff will work together to create a culture that is both academic and professional. Graduates will leave the department proficient in the skills and knowledge necessary for success at the post-secondary level.

As indicated by the teachers, all aspects of this statement must be fulfilled for the department and the school to be considered a success. It should be noted that their inclusion in this list is an indicator that these areas are also considered areas of current concern by the staff and thus can be seen as an assessment of the department's current issues from the teacher perspective.

A number of obstacles to this success were identified during this discussion, obstacles that made some of the work difficult throughout this project. The main barriers identified focused on the teachers' current workload: time to (formally) reflect as an individual during the workday and shared time to reflect as a department or a subset of the department. As Teacher Collaboration was identified as an area of concern, this was a first confrontation between the vision and the difficulties of its implementation.

One other obstacle was identified by two members of department in informal debriefing discussions later that day. These two teachers - both of whom were considered more advanced in reflective practice, scoring 5,6,6 and 5,5,6 on their RJI - noted that they had previously thought of our department as a single unit driving towards a single goal. While a vague consensus was arrived at eventually, they noted that each teacher had very different priorities under the umbrella of "success in science". Though they did not know this at the time, this result was also reflected in the teachers' responses to the pre-project survey, wherein teachers were asked to identify their top two priorities: critical thinking received 5 votes; academic rigor - 4 votes; and love of science, the production of well-rounded students, and students that feel successful each received 1 vote apiece. This spectrum of responses is, in part, due to the demands of the differing grade levels represented in this department; clearly a sixth grade teacher is, of necessity, primarily concerned with different issues than an Advanced Placement Biology teacher.

However, more troubling is the false belief that there is, indeed, a full departmental consensus. To highlight the point, this was described to the teachers metaphorically like a small group of people trying to pull a sled westward in a blinding snowstorm: if some of the group are pulling northwest, some southwest, and some at points in-between, the sled may move westward, but it will not move as quickly as if everyone pulled due west. Though the intent was to shock the teachers into a state of unease with their accepted philosophical stance, its success was limited. This can be seen in the increased variety of responses to the same priority question in the post-project survey: 4 votes for critical thinking; 3 for both academic rigor and students feeling successful; and 1 each for love of science and production of well-rounded students.

Reflective Practice

With this as a background, the department began their weekly exploration of the ideas and techniques of reflective practice, initially highlighting reflection as an individual process. Weekly personal reflective journals were analyzed for theme and contextual content. During initial analysis, 12 themes were identified, either by their frequency within the text or by their logical inclusion in documents pertaining to teacher practice. These themes were then defined, applied in an initial reading, and further refined to better address the initial findings. The final definitions of each theme can be found in Appendix H and their relative frequencies in Figure 2. Statements in each response were evaluated for unambiguous references to these themes. Finally, thematic reference frequencies were tabulated, the results of which are seen in Table 4. Through this process two major themes were identified: concerns about classroom management, and an identification and thorough misunderstanding of academic rigor.

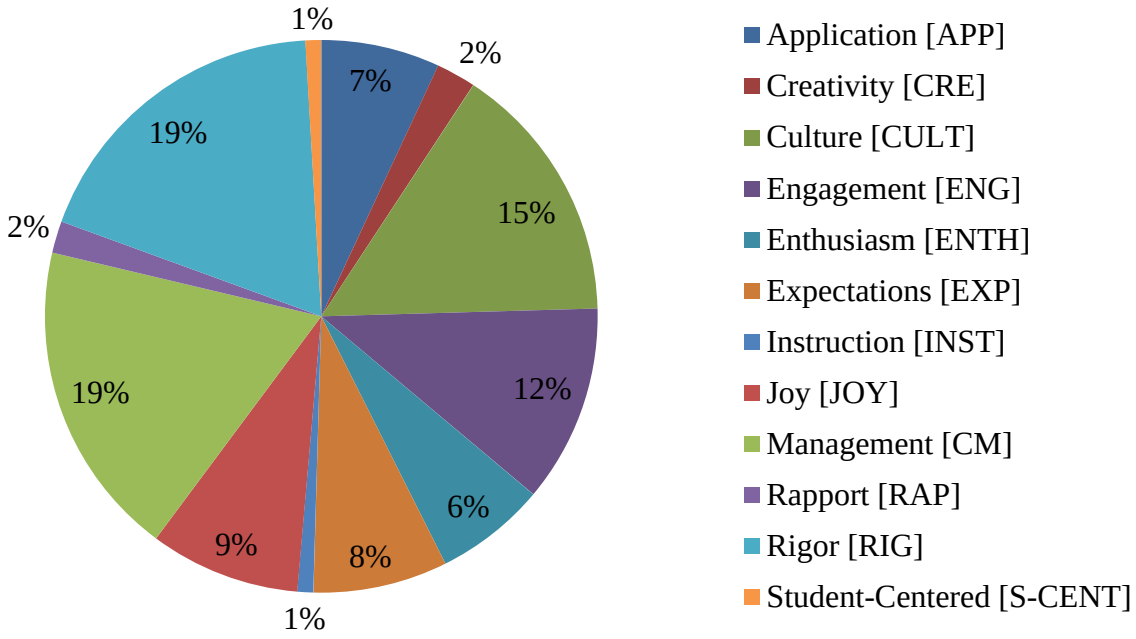

Figure 2. Journal Theme Frequency as a Percentage of the Whole.

Table 3
Journal Theme Frequencies

THEMES	Prompt 1 Teacher Strengths	Prompt 2 Role Models	Prompt 3 Class Culture	Prompt 5 Five Whys	TOTAL
Application [APP]	3	7	3	2	**15**
Creativity [CRE]	3		2		**5**
Culture [CULT]	6	2	19	6	**33**
Engagement [ENG]	7	10	5	3	**25**
Enthusiasm [ENTH]	7	3	3	1	**14**
Expectations [EXP]	5	4	5	3	**17**
Instruction [INST]				2	**2**
Joy [JOY]	1	7	11		**19**
Management [CM]	14	7	2	17	**40**
Rapport [RAP]		3	1		**4**
Rigor [RIG]	8	5	18	9	**40**
Student-Centered [S-CENT]		2			**2**

The pervasiveness of the classroom management theme was unexpected. Not only was classroom management mentioned no fewer than 40 times throughout the teachers' journaling, 5 of the 6 teachers selected a management issue for their responses to prompt five, regarding an ongoing issue. In post-project survey responses, 4 of the teachers rated "the need for better classroom management" as one of their top two most pressing issues. Survey responses also indicated that teachers most strongly agreed (4.3 out of 5.0) that, as a result of this project, they were more likely to discuss classroom management issues with other teachers. (See Appendix J for the complete pre- and post-survey results.) Interestingly, this must be weighed against survey responses: it was found that the largest decrease in frequency was measured in how often the teachers reported to find other teachers' suggestions about classroom management issues useful: a drop of 13.3% on the five-point scale – from 4.2 to 3.5 – where a 5 indicated "very often" and a 1 "very rarely".

This seems to represent a growing frustration with discipline across all seven grades, suggesting that (a) student behavior is increasingly disruptive - not likely across every grade and after more than eight months of school to acclimatize to teachers' methods; (b) the teachers have a growing realization about the detrimental impact of previously accepted behaviors - also unlikely due to the school-wide year-long focus on the improvement of discipline; or (c) that the level of teacher reflection is stalled at this surface level, well before they can begin to consider the crucial disparity between teacher academic practice and resulting student achievement.

This idea of a reflective holding pattern appears to have confirmation in the teacher responses during the second round of post-observation reflective discussions. In

this round, teachers were asked to identify ongoing issues with the particular class observed, rather than the strengths they focused on in the first round. Of the 6 responses, only 2 indicated academic issues (developing an algebra-sense, and engaging seniors who are academically "checked out") and four indicated disciplinary issues (refocusing students, students talking out of turn, students not following directions, and students' unruly behavior when moving between stations). While all four teachers indicated that their efforts both in and out of class to address these issues had been successful during the observed lesson, clearly none of the teachers would classify these problems as "solved". It is also interesting to note from the above list that the level of the disciplinary matters mentioned never exceeded a general level of minor infractions that may well have been handled lessons been more engaging.

This is not to say that academic issues were not discussed in this project. Most often the discussion centered on the theme of academic rigor. As seen in the journal analysis table above, rigor and related topics were indicated as many times as classroom management. At the outset, it should be noted that "[r]igor should be defined as quality of thinking, not quantity of content." (Brunsell, personal communication, April 27, 2012) However, this concept is often misunderstood and misused and so it is important to understand what the teachers themselves mean by these comments. It seems their working definition of rigor can be inferred from a representative comment from journal prompt five: "The pace and rigor of the class [are] held [to] very high standards... and if students have a hard time keeping up, or grasping the material at the high level it is taught, they may need differentiated instruction or they will fall behind." This comment and others like it seem to indicate that rigor, to the teachers in the department, means

pushing the level of content presented up without regard to current student understanding or interest and without modification for student aptitude or preparation. In the 40 instances of its identification in teacher journals, rigor is never directly related to methods of assessment, innovative pedagogy or deeper student understanding, thus appearing to confirm this inference.

What is troubling about this misconception is how it appears to get in the way of real reform and helpful reflection. The self-congratulatory tone in which it is often mentioned coupled with the exasperated tone in which disciplinary struggles are admitted suggests the belief that many of the department's academic troubles would be solved with better classroom management and without recourse to improved assessment or pedagogy. Taken together, these two issues place the burden of solving the science department's achievement issues squarely on the shoulders of the students, abrogating the teachers from the need to change. This is contrary to the tenets of the reflective stance, which establish the need to see the locus of problems springing from the one doing the reflecting, as one can only control one's own actions in attempts to affect a solution.

This conjecture is supported by the survey responses in which only one teacher indicated "the need for better content-specific professional development" as a pressing issue, and that was rated a second-highest need behind something of greater perceived importance. This is further supported by its absence from the list of topics discussed during teachers' post-observation reflective discussions: while 11 of the 12 identified journal themes were mentioned at least one time, no one unambiguously identified their need for greater rigor (using their definition).

Thematic analysis of this sort must take into account the journal prompts presented to the teachers - as journal prompt three directly addressed classroom culture, it seems its frequency is artificially high. Discounting this result somewhat unveils the teachers' minor emphasis on student engagement with a frequency of 25 or 12% of the themes identified. Engagement was also indicated by two of the teachers as ongoing issues during the second round of observation reflections. As student engagement can be viewed as the intersection between effective classroom management, appropriate and interesting content, and student-centered pedagogy, this emphasis is a welcome addition to the list of overarching themes and will be the focus of future professional development efforts.

The journal analysis and observation discussion data fail to indicate unambiguous individual growth, as the themes identified - and all of those discussed above – are common to both. More than that, however, they present a persistent shallow level of reflection or even a decidedly anti-reflective stance, which might best be described as survival mode. This is best exemplified by the teachers' discussion of their teacher role models in journal prompt two. Role models were described as "patient", "happy", "funny", "interesting", etc. While these qualities are all positive and might all be used as part of a description of a universal ideal teacher, they are all surface qualities, not speaking to motivation, thought-processes, decision-making, philosophical stances, or personal values. As teachers in their own right, it might be imagined that, had they been more reflective, they would have seen the use of each of these as tools to certain ends, and those ends might be described and evaluated in light of their recent professional

experience, the values the teachers espoused, the overall goals of the American education system, or the specific vision of this department.

In short, this surface level discussion represents two possible issues: first, the teachers are accustomed to being given tasks that they must complete, and thus they have been trained that completion, not quality, is the key to these administrator-driven assignments; and second, the teachers are not yet ready to confront the deeper issues in their own practice, despite the weeks of shared discussions over the course of this project.

Pre- and post-project survey results may call this claim into question. It seems that, though it is not represented in the written work, the teachers feel that they have made progress towards a new, more reflective practice. In most categories, the teachers reported that they were more likely to participate in facets of individual reflection, they were more positive about their work and their classrooms, and they felt more successful in general at the end of the project. Of the 30 comparison prompts, twenty-one showed an average increase, ranging between 0.167 and 1.167 on the five-point scale, five showed no change and only four indicated a decline in the frequency of activities. The comparison prompts with the greatest change in mean responses can be seen in Table 4.

Table 4
Survey Responses with Greatest Change

Prompt	Pre Mean	Post Mean	Change	Percent Change
How often do you attempt to identify the problem with an emotional student before attempting to solve it?	3.8	4.3	+ 0.5	+ 10%
How often do you consciously note the effect of school culture on student attitudes?	3.7	4.2	+ 0.5	+ 10%
How often do you discuss behavior issues with other teachers	4.3	4.8	+ 0.5	+ 10%
How often do you discuss educational research with other teachers?	2.3	2.8	+ 0.5	+ 10%
How often do you discuss issues with teachers outside of our school?	2.8	4.0	+ 1.2	+ 24%
How often do you find other teachers' opinions about management issues useful?	4.2	3.5	- 0.7	- 14%

The completion and unreadiness conjectures described above seem especially significant when analyzing the department's group reflection work. While all teachers eventually participated in the peer video reflection, the reticence expressed and the delays experienced indicated a lack of comfort with the process and, perhaps, a failure to see the link between their personal actions and the achievement of the departmental vision as they themselves developed it. Indeed, initially the intent was to perform two rounds of peer-reflection, but these delays made this step impossible within the project's timeframe.

When completed, the peer reflections were analyzed for theme in the same manner as the journal responses. This method was chosen because the level of writing, the themes described and the overall focus were very similar to the journal writing. When describing each others' classrooms, then, it was found that the teacher maintained a similar focus. Classroom management and student engagement, different by

researcher-developed definition but closely related in practice, dominated the themes indicated with frequencies of 27 and 21 respectively. When compared with the low frequencies of comments on real-world applications of science (2), creative approaches to content chosen (1), or improved instruction techniques (0), the difference is clear. (See Table 5 for a complete listing.)

Table 5
Peer Reflection of Videotaped Lessons – Theme Frequencies

THEMES	Frequency
Application [APP]	2
Creativity [CRE]	1
Culture [CULT]	7
Engagement [ENG]	21
Enthusiasm [ENTH]	3
Expectations [EXP]	10
Instruction [INST]	0
Joy [JOY]	7
Management [CM]	27
Rapport [RAP]	1
Rigor [RIG]	7
Student-Centered [S-CENT]	1

Within the subset of comments on management, most focus on actual or potential disruptions, and fewer on the techniques that are used to address those disruptions. Though the teachers were pushed to provide evidence for their comments at all points throughout the project, very rarely were causes for these disruptions explored.

Of the management and engagement strategies discussed, one management system that was mentioned fairly often was the Lemov strategies. This “Teach like a Champion” program, founded by Doug Lemov, has been the overall focus of the school

across all grades and disciplines this year and thus, in many ways, has become the *lingua franca* for teachers. While this was not believed to be the case in the science department, where there is a distinctly different culture built upon shared personal interests and a common passion for the subject, its frequency within the lesson commentaries would suggest otherwise. The teachers are given frequent trainings, are observed many times by administrators and their peers, and have developed professional goals around this program, all of which emphasize its importance to the school culture and, also, suggest an area of need across all subjects and grades.

Interestingly, comments about both rigor, as the teachers define it, and joy (as defined as a spirit or culture emphasizing light-heartedness and happiness over professionalism) were mentioned equal numbers of times (7). As the teachers were only taped for one lesson, instead of the two originally intended, this may be an outgrowth of the randomness of the lessons selected for viewing. It is probable that the lessons from a different day would have produced greater discussions about academic rigor, as two of the lessons taped were reviews of previously taught material and only one was an initial hands-on guided exploration.

Changes in responses on the survey suggest a deeper complexity when looking for theories to explain teacher comments. The two areas of largest change are particularly puzzling. First, the teachers claimed that they would consult teachers outside of our school for assistance much more often, jumping from 2.8 to 4.0 or a gain of 24%. Second, and somewhat paradoxically, the teachers claimed that other teachers opinions are useful much *less* often, falling from 4.2 to 3.5 for a loss of 14%. The teachers also strongly agree (mean response of 4.7 out of 5.0) that they would seek out a colleague for

assistance as a direct result of the work in this project. Within the subset of "discussion with colleague" prompts, the teachers also strongly agree (mean response of 4.3 out of 5.0) that they would be more likely to seek out a colleague to discuss management issues - an agreement that is the second highest of this subset. This may suggest the growing realization that struggles with disciplinary issues are indeed school-wide and other, informal assistance should be sought.

INTERPRETATION AND CONCLUSION

Taken as a whole, these data present a somewhat bleak view of the current state of the department, its teachers, and the overall success of the project. It appears that both aims – to encourage and deepen both individual reflective thought and group reflective discussion – fell far short of their intended levels.

Independent Reflection

Individual reflection, while undertaken with enthusiasm and genuinely acknowledged to be helpful by the teachers afterward, did not appear to increase in depth, complexity or frequency as a result of this project. Through their journals, the teachers identified the themes that were most present in their thoughts. Together the related themes of classroom management and student engagement consumed 30% of their reflections. While these themes in and of themselves are not necessarily indicative of a shallow reflectivity, the level of these discussions more greatly indicated an exasperation with minor daily student misbehavior than a search for its root causes, an exploration of the culture that allows those behaviors to continue, or a self-examination about the values and priorities that appear to be in conflict with their audience.

This is further supported by the teachers' survey responses and observation discussions. When asked to identify their top two greatest needs, they overwhelmingly indicated better professional development on classroom management techniques and better organization, each garnering 33% of the possible votes. When asked to reflect on issues in their classrooms after randomly selected lessons, the teachers overwhelmingly indicated disciplinary and student engagement issues, with only one mention of an

academic concern.

This reflection was further hampered by an idiosyncratic notion of academic rigor and its value in the science classroom, as seen in 18.5% of the identified journal themes. Its definition merely as a high level of content appeared to hamper their understanding of their own need for improvement in instruction and assessment and the vital role the student perspective plays in a teacher's reflective practice. As the teachers indicated the need for better science-specific academic professional development with only one vote out of twelve (8.3%) and only slight improvements on questions regarding changes to the types of interactions with students due to teacher participation in this project, it is clear that the teachers are not yet able to reflect critically about their own instruction.

Group Reflection

While the teachers reported that they found the group reflection helpful, it, too, was mired at what the teachers themselves reported was an unhelpful level. The teachers reported on the post-project surveys that they would be much more likely to consult other teachers to solve general problems (mean of 4.7) and, overall more likely to consult teachers on specific types of problems. This willingness, however, did not appear to translate into either increased frequency of discussion – except where mandated by the project – or increased depth of reflection, and, in fact, resulted in a decreased sense that this discussion was valuable, as seen in comparison between pre- and post-project surveys.

The commentary from the peer reviewed lessons reflected the difficulties teachers had in reflecting critically about their own practice. Rather than looking deeply for

underlying causes, either in themselves or their students, the teachers fell back to the familiar arena of classroom management, pointing out obvious issues and suggesting tools and tricks on which all teachers at the school had received training, with 31.0% of comments related to classroom management and only 4.6% on themes related to improved instruction.

That the level or quality of instruction was not frequently referenced - just 8.0% of the total references found in peer reflections - supports the mistaken belief that academic rigor, as seen by the teachers, was not a part of our failure to succeed academically. Throughout the references made to academic rigor, all were congratulatory in tone, rather that questioning or demonstrating concern.

Final Notes

Both individual and group reflection struggled under the weight of two main issues. First, the teachers appear to be consumed with the most basic difficulty that all teachers face: how can I develop a management style that works for me, my students and the overall school culture? This concern is not about what many urban schools deal with: violence, gang activity, outright antipathy for school and its teachers, sexual harassment, etc. Instead, the concern is about minor things, like student socializing and failure to follow teacher-developed procedures. While this is a low-level concern, it is also problematic enough to forestall most other innovations and, indeed, even teacher consideration of deeper issues. This concern over management issues persisted at a constant depth of discussion throughout the project.

The second area, which they termed “academic rigor” is likely a response to the

achievement worries presented to them each year and the growing concern that the school is not succeeding in its mission. While the goal is admirable, there are crucial components missing from the teachers' understanding of true rigor which, in some respects, turn this focus into a drain on achievement rather than step towards academic success. Without concern for the students' prior understanding, their ability to make meaning from the content, or the methods by which a high level of student understanding might be guaranteed for all students, this concern for high academic levels may actually harm students, rather than help them.

More than that, both of these concerns share an anti-reflective component: the idea that the issue is centered somewhere other than with the person reflecting and is most likely fixed by someone else. Despite efforts to show the teachers how their actions and beliefs impact their classroom culture, the difficulties discussed were nearly always the *students'* problem. This might be contrasted with the successes noted, which were nearly always a change implemented by the *teacher*.

While it is clear that the teachers did not demonstrate the personal growth or the changes to departmental culture that the project intended, it is hoped that these new ways of relating to themselves, their colleagues and their own practice will continue to develop and, with the coming of the new school year, they may indeed begin to show the growth that was intended.

VALUE

For the past five years, I have tried to develop new programs and to support the teachers in their attempts to achieve our school's mission: to graduate students prepared to succeed in science at the post-secondary level. For those same five years, I and my department have largely failed in our efforts to improve using almost any metric one can find: flat-lined ACT scores, nearly imperceptible growth on the state standardized tests, constant graduation rates, few students choosing STEM careers or studies after graduation, etc. Throughout those five years, I have been at a loss for the cause of these issues.

Upon accepting my current role as departmental supervisor, I recall discussing with my staff my commitment to program evaluation and my guarantee that only programs that could definitively prove their worth would continue to receive funding. My commitment to and my faith in my own reflective practice as a teacher-leader was unshakeable. In this spirit over the intervening five years, I have both implemented and removed a number of small-scale programs based on my understanding of their value as demonstrated either on site or in articles or by respected authorities. I believed that this commitment to objective results would turn our department and our school around. I have found through this process, however, that my commitment was both incomplete and limited in scope in ways I had not suspected.

This project has changed the way that I will perform my duties in a fundamental way: it has forced me to reflect on the many unnoticed, and therefore unquestioned, assumptions that I have maintained about our work as a department and my work as its leader. It has more fully aligned the scientist and educator in me around this framework

of reflection. While it is difficult not to see these results, at least in part, as a criticism of my work, the process has left me feeling both more positive about my ability to improve things and more hopeful that a solution exists.

I have also learned a great deal about my department and my teachers through this process. They, in turn have learned a great deal about themselves. The discussion has begun with the teachers about their focus on rigor and its detrimental effects on their practice. While I realize that this road may be a long one for most of the department, I feel we have, at last, taken a few tentative steps towards our goal.

A second discussion has begun, this time with the administrators, about their singular focus on classroom management and its potentially harmful effects on the academic culture of the school. While I do not foresee them abandoning their efforts to more fully implement the Lemov strategies, I have reason to hope that a more balanced view of student engagement at the administrative level will result in allocation of resources towards their support and professional development of all teachers with a target of practice worthy of the claim to academic rigor.

I feel, with this project, I finally have a starting point for my own support and professional development efforts for the next five years. Just as I ask the teachers to meet the students where they are academically, now that I know more about it, I must meet the teachers where they are. I will use these findings to develop short professional development courses on management in the science classroom. I will also use the Next Generation Science Standards as a focus to begin the discussion about rigor as a commitment to all students' ability to think scientifically, rather than the more illusory commitment to advanced content at all costs.

Finally, I will attempt to provide more opportunities for inclusion of other departments in projects. I see now that my subconscious intent in developing this project was the idea that our department could become, as it were, an island of thoughtful and informed practice amidst the rougher seas of the school as a whole. It was naïve to believe that a firewall could be built between the cultures of the department and the school. Only as a healthy and coherent whole will true progress be made. Valli (1997) highlighted this when she wrote:

> Helping individual teachers become reflective is not sufficient. Schools must have reflective cultures. Each teacher's thinking needs to be confirmed, modified, or stimulated to new levels of understanding by reflecting aloud in groups or through shared journals. This can only occur in open, supportive communities of learning… Reflection can help individuals become better teachers. It can help individual teachers break out of unthoughtful habit that are not in their students' best interests. But it can serve the broader goal of improving schools, human relations, and educational policy. For these important transformations to occur, reflection must be a collective undertaking (p 86).

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APPENDICES

APPENDIX A

SCHOOL DATA

Trends in School Achievement Data

The following tables sum up the gains in science achievement as gauged by state and national measures. The first table, table A1, charts the increases in science achievement on the science portion of the state mandated exam. It notes that, while there have been significant strides made towards decreasing the gap between MAS and state percentages of science proficient students – particularly in the middle school – the overall difference remains quite large. The achievement problem is further indicated by students' scores on the Explore-PLAN-ACT series of tests found in table A2. Over the past three years, student scores have not increased significantly in any of the high school years, despite mandating that all students take at least five years of science coursework to earn their diploma from MAS.

Table A1.
Trends in the percentage of students scoring either proficient or advanced on the state mandated science portion of the Wisconsin Knowledge and Concepts Examination, as compared with similar percentages from the state.

	Years	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
8th Grade	MAS	35%	51%	18%	47%	63%	71%
	Wisconsin	64%	65%	75%	76%	80%	77%
	Difference	30%	14%	57%	29%	18%	6%
10th Grade	MAS	19%	29%	20%	37%	22%	35%
	Wisconsin	71%	72%	72%	72%	72%	74%
	Difference	52%	43%	52%	35%	50%	39%
All Secondary Students	MAS	31%	43%	19%	44%	48%	53%
	Wisconsin	68%	68%	73%	74%	76%	76%
	Difference	36%	26%	55%	29%	28%	22%

Table A2.

Trends in both the science sub-scores and the comprehensive scores on the Explore-PLAN- ACT series of exams over three years. As a part of the MAS charter agreement, all students must take all three exams.

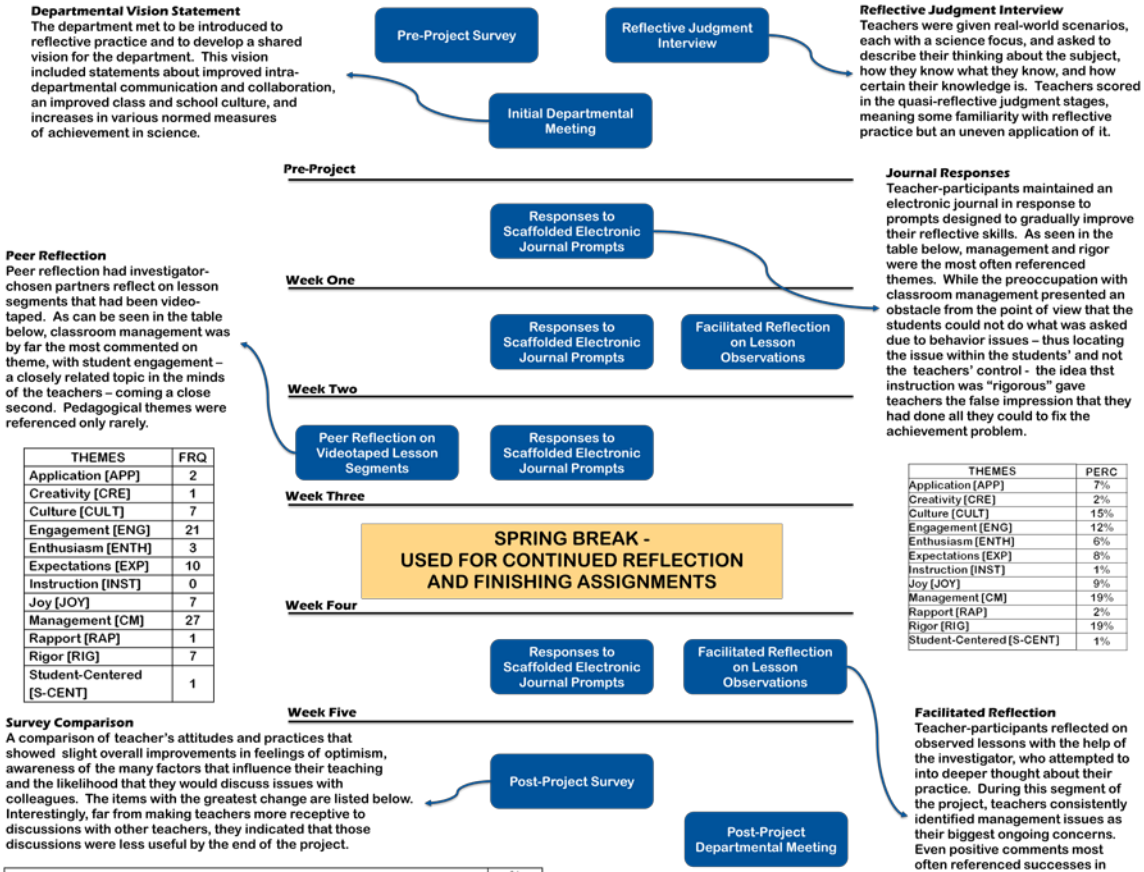
		Years	2009	2010	2011
Explore (9th)	**Local**	**Science**	15.5	14.2	14.5
		Comp	13.6	12.5	12.9
	National	**Science**			17.1
		Comp			16.2
Plan (10th)	**Local**	**Science**	15.2	15.3	15.7
		Comp	13.7	14.2	14.1
	National	**Science**			17.8
		Comp			17.2
ACT (11th & 12th)	**Local**	**Science**	15.2	16.9	16.8
		Comp	13.8	15.5	15.4
	National	**Science**	20.9	20.9	20.9
		Comp	21.1	21	21.1

APPENDIX B

LOGIC MAP

Logic Map

This logic map shows the inputs, actions, products and outcomes of this project.



THEMES	FRQ
Application [APP]	2
Creativity [CRE]	1
Culture [CULT]	7
Engagement [ENG]	21
Enthusiasm [ENTH]	3
Expectations [EXP]	10
Instruction [INST]	0
Joy [JOY]	7
Management [CM]	27
Rapport [RAP]	1
Rigor [RIG]	7
Student-Centered [S-CENT]	1

THEMES	PERC
Application [APP]	7%
Creativity [CRE]	2%
Culture [CULT]	15%
Engagement [ENG]	12%
Enthusiasm [ENTH]	6%
Expectations [EXP]	8%
Instruction [INST]	1%
Joy [JOY]	9%
Management [CM]	19%
Rapport [RAP]	2%
Rigor [RIG]	19%
Student-Centered [S-CENT]	1%

Prompt	% Diff.
How often do you attempt to identify the problem with an emotional student before attempting to solve it?	+ 10%
How often do you consciously note the effect of school culture on student attitudes?	+ 10%
How often do you discuss behavior issues with other teachers	+ 10%
How often do you discuss educational research with other teachers?	+ 10%
How often do you discuss issues with teachers outside of our school?	+ 24%
How often do you find other teachers' opinions about management issues useful?	- 14%

APPENDIX C

TEACHER SURVEY OF ATTITUDES AND EXPERIENCES

Pre- and Post-Intervention Teacher Survey

The following surveys were implemented through the Forms feature of Google Documents.

Pre-Project Reflective Teaching Survey

NOTE: Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time.

This survey attempts to determine your background in some of the area that will be addressed in this project. Reflective teaching often requires the practitioner to consider, with full mindfulness, judgments, values and experiences that are usually left in the background, yet have a great influence on the nature of the educational experience in the classroom. Please consider each item carefully and answer honestly. As always, your responses will be kept anonymous and will only be used to find themes and to develop activities for the project.

Thank you in advance for your participation!

Your name:

Attitudes

For the following, please click the radio button indicating the frequency with which you have experienced or have performed the item described.

	Never	Very Rarely	Occasionally	Somewhat Often	Very Often
How often do you check students' attitudes to the content after a lesson?	○	○	○	○	○
How often do you check students' attitudes about an assessment?	○	○	○	○	○
How often do you change lessons based on previous student attitude information?	○	○	○	○	○
How often do you alter your plans					

in the middle of a lesson based on student attitude information?	○	○	○	○	○
How often do you notice that students' emotional states affects their ability to work in your class?	○	○	○	○	○
How often do you attempt to identify the problem with an emotional student before attempting to solve it?	○	○	○	○	○
How often to do you discuss your own attitudes with the students?	○	○	○	○	○
How often do you change your plans based on your attitude rather than objective data?	○	○	○	○	○
How often do you assess students' confidence with subjects?	○	○	○	○	○
How often do you consciously note the effect of school culture on student attitudes?	○	○	○	○	○

Fellow Teachers

For the following, please click the radio button indicating the frequency with which you have experienced or have performed the item described.

	Never	Very Rarely	Occasionally	Somewhat Often	Very Often
How often do you discuss behavior issues with other teachers?	○	○	○	○	○
How often do you discuss					

instructional strategies (not management-related) with other teachers?	○	○	○	○	○
How often do you discuss content with other teachers?	○	○	○	○	○
How often do you discuss educational research with other teachers?	○	○	○	○	○
How often do you discuss classroom culture issues with other teachers?	○	○	○	○	○
How often do you discuss school culture with other teachers?	○	○	○	○	○
How often do you discuss issues with teachers outside of our school?	○	○	○	○	○
How often do you find other teachers' opinions about management issues useful?	○	○	○	○	○
How often do you find other teachers' opinions about instructional issues useful?	○	○	○	○	○
How often do you alter some aspect of your classroom or your teaching based on what you have heard from another teacher?	○	○	○	○	○

Self-Analysis

Using the prompts below, rate yourself on a scale of 1 to 5, with 1 being "Very Low" and 5 being "Very High".

	Very Low	Low	Medium	High	Very High
My average level of optimism about my students' success is…	○	○	○	○	○
My average level of optimism about my ability to find the right instructional tool for my students is…	○	○	○	○	○
My average level of optimism about my ability to connect with my students on a personal level is…	○	○	○	○	○
My average level of optimism about my ability to connect with my students on a professional level is…	○	○	○	○	○
My average level of energy at the beginning of the day is…	○	○	○	○	○
My average level of energy at the end of the day is…	○	○	○	○	○
On an average day, my understanding of my students' points of view is…	○	○	○	○	○
On an average day, my understanding of my students' emotional states is…					
On an average day, my understanding of my students' academic struggles is…	○	○	○	○	○
At the end of an average day, my feeling of success with my students is…	○	○	○	○	○

○

Your Top Teaching Priority

What are your priorities as a teacher? Select one and only one from the following list that represents your most important educational goal…

- o My students should know the maximum amount of content.
- o My students should be extremely proficient with lab procedures.
- o My students should be able to think critically and problem solve.
- o My students should be able to succeed in a rigorous academic environment.
- o My students should love science.
- o My students should be well-rounded.
- o My students should be happy and feel successful.

Your Second Teaching Priority

What are your priorities as a teacher? Select one and only one from the following list that represents your second most important educational goal…

- o My students should know the maximum amount of content.
- o My students should be extremely proficient with lab procedures.
- o My students should be able to think critically and problem solve.
- o My students should be able to succeed in a rigorous academic environment.
- o My students should love science.
- o My students should be well-rounded.
- o My students should be happy and feel successful.

[SUBMIT]

Post-Project Reflective Teaching Survey

NOTE: Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at anytime. This survey attempts to determine your background in some of the areas that will be addressed in this project. Reflective teaching often requires the practitioner to consider, with full mindfulness, judgments, values and experiences that are usually left in the background yet have great influence on the nature of the educational experience in the classroom. Please consider each item carefully and answer honestly. As always, your responses will be kept anonymous and will only be used to find themes and develop activities for the project. Thank you in advance for your participation!

* Required

Your Name *Please type your name in the blank.

Attitudes *For the following, please click the radio button indicating the frequency with which you have experienced or have performed the item described.

	Never	Very Rarely	Occasionally	Somewhat Often	Very Often
How often do you check students' attitudes to the content after a lesson?	●	●	●	●	●
How often do you check students' attitudes about an assessment?	●	●	●	●	●
How often do you change lessons based on previous student attitude information?	●	●	●	●	●
How often do you alter your plans in the middle of a lesson based on student attitude information?	●	●	●	●	●
How often do you notice that students' emotional state affects their ability to	●	●	●	●	●

	Never	Very Rarely	Occasionally	Somewhat Often	Very Often
work in your class?					
How often do you attempt to identify the problem with an emotional student before attempting to solve it?	●	●	●	●	●
How often do you discuss your own attitudes with your students?	●	●	●	●	●
How often do you change your plans based on your attitude rather than objective data?	●	●	●	●	●
How often do you assess student confidence with subjects?	●	●	●	●	●
How often do you consciously note the effect of school culture on student attitudes?	●	●	●	●	●

Fellow Teachers *For the following, please click the radio button indicating the frequency with which you have experienced or have performed the item described.

	Never	Very Rarely	Occasionally	Somewhat Often	Very Often
How often do you discuss behavior issues with other teachers	●	●	●	●	●
How often do you discuss instructional strategies (not	●	●	●	●	●

	Never	Very Rarely	Occasionally	Somewhat Often	Very Often
management-related) with other teachers?					
How often do you discuss content with other teachers?	●	●	●	●	●
How often do you discuss educational research with other teachers?	●	●	●	●	●
How often do you discuss classroom culture issues with other teachers?	●	●	●	●	●
How often do you discuss school culture issues with other teachers?	●	●	●	●	●
How often do you discuss issues with teachers outside of our school?	●	●	●	●	●
How often do you find other teachers' opinions about management issues useful?	●	●	●	●	●
How often do you find other teachers' opinions about instructional issues useful?	●	●	●	●	●
How often do you alter some aspect of your classroom or your teaching based on what you have heard from another	●	●	●	●	●

	Never	Very Rarely	Occasionally	Somewhat Often	Very Often
teacher?					

Self-Analysis *Using the prompts below, rate yourself on a scale of 1 to 5, with 1 being "Very Low" and 5 being "Very High".

	Very Low/Minimum	Low	Medium	High	Very High/Maximum
My average level of optimism about my students' success is...	●	●	●	●	●
My average level of optimism about my ability to find the right instructional tool for my students is...	●	●	●	●	●
My average level of optimism about my ability to connect with my students on a personal level is...	●	●	●	●	●
My average level of optimism about my ability to connect with my student professionally is...	●	●	●	●	●
My average level of energy at the beginning of the day is...	●	●	●	●	●
My average level of energy at the end of the day is...	●	●	●	●	●
On an average day, my understanding of my students' points of view is...	●	●	●	●	●

	Very Low/Minimum	Low	Medium	High	Very High/Maximum
On an average day, my understanding of my students' emotional states is...	●	●	●	●	●
On an average day, my understanding of my students' academic struggles is...	●	●	●	●	●
At the end of an average day, my feeling of success with my students is...	●	●	●	●	●

Your Top Teaching Priority *What are your priorities as a teacher? Select one and only one from the following list that represents your most important educational goal..

Your Second Teaching Priority *What are your priorities as a teacher? Select one and only one from the following list that represents your second most important goal..

Your Most Pressing Issue *Which of the following represents the MOST pressing issue in your classroom? Select one and only one of the following.

- ● The need for better organization, class- and/or school-wide
- ● The need for better communication with administrators, parents and other teachers
- ● The need for better classroom management
- ● The need for better content-specific professional development
- ● The need for more support from other teachers and/or administrators
- ● The need for more equipment and/or supplies

Your Second Most Pressing Issue *Which of the following represents the SECOND most pressing issue in your classroom? Select one and only one of the following.

- ● The need for better organization, class- and/or school-wide
- ● The need for better communication with administrators, parents and other teachers
- ● The need for better classroom management

- The need for better content-specific professional development
- The need for more support from other teachers and/or administrators
- The need for more equipment and/or supplies

Changes in Activity *As a result of our work together in the past seven weeks, please indicate how likely it is that you will engage in the following activities. Please remember to be honest

	Much Less Likely	2	No Change	4	Much More Likely
Have discussions with other teachers about content					
Have discussions with other teachers about management					
Have discussions with other teachers about specific students					
Have discussions with other teachers about research findings					
Have discussions with other teachers about trade books and professional development					
Have discussions with parents about their students					
Have discussions with students about their academic performance					
Have discussions with students about their behavior					
Have discussions with					

	Much Less Likely	2	No Change	4	Much More Likely
students about their feelings about the content or the class					
Conduct formative assessments of student prior knowledge	●	●	●	●	●
Conduct formative assessments of student likes and dislikes	●	●	●	●	●
Conduct formative assessments of student levels of confidence	●	●	●	●	●
Modify instruction based on discoveries of academic levels	●	●	●	●	●
Modify instruction based on discoveries of student attitudes	●	●	●	●	●
Modify instruction based on discoveries of student confidence levels	●	●	●	●	●
Seek out research findings to solve a problem	●	●	●	●	●
Seek out trade books to solve a problem	●	●	●	●	●
Seek out colleagues to solve a problem	●	●	●	●	●

Lessons Learned *What would you say was the most important item you will take away from this project?

Future Work *What would you like to see more of in our department in the future?

Continue »

APPENDIX D

STAGES OF REFLECTIVE JUDGMENT

Stages of Reflective Judgment

These stages, developed by King and Kitchener (1994), will be used to quantify teacher reflective thought both before and after the intervention.

Pre-Reflective Thinking

Stage One:
View of Knowledge - Knowledge is assumed to exist absolutely and concretely; it is not understood as an abstraction. It can be obtained with certainty by direct observation.
Concept of Justification - Beliefs need no justification since there is assumed to be an absolute correspondence between what is believed to be true and what is true. Alternate beliefs are not perceived.
"I know what I have seen."

Stage Two:
View of Knowledge - Knowledge is assumed to be absolutely certain or certain but not immediately available. Knowledge can be obtained directly through the senses (as in direct observation) or via authority figures.
Concept of Justification - Beliefs are unexamined and unjustified or justified by their correspondence with the beliefs of an authority figure (such as a teacher or parent). Most issues are assumed to have a right answer, so there is little or no conflict in making decisions about disputed issues.
"If it is on the news, it has to be true."

Stage Three:
View of Knowledge - Knowledge is assumed to be absolutely certain or temporarily uncertain. In areas of temporary uncertainty, only personal beliefs can be known until absolute knowledge is obtained. In areas of absolute certainty, knowledge is obtained from authorities.
Concept of Justification - In areas in which certain answers exist, beliefs are justified by reference to authorities' views. In areas in which answers do not exist, beliefs are defended as personal opinion since the link between evidence and beliefs is unclear.
"When there is evidence that people can give to convince everybody one way or another, then it will be knowledge; until then, it's just a guess."

Quasi-Reflective Thinking

Stage Four:
View of Knowledge - Knowledge is uncertain and knowledge claims are idiosyncratic to the individual since situational variable (such as incorrect reporting of data, data lost over time, or disparities in access to information) dictate that knowing always involves an element of ambiguity.
Concept of Justification - Beliefs are justified by giving reasons and using evidence, but the arguments and choice of evidence are idiosyncratic (for example, choosing evidence that fits an established belief).
"I'd be more inclined to believe evolution if they had proof. It's just like the pyramids; I don't think we'll ever know. Who are you going to ask? No one was there."

Stage Five:
View of Knowledge - Knowledge is contextual and subjective since it is filtered through a person's perceptions and criteria for judgment. Only interpretations of evidence, events, or issues may be known.
Concept of Justification - Beliefs are justified within a particular context by means of the rules of inquiry for that context and by context-specific interpretations of evidence. Specific beliefs are assumed to be context specific or are balanced against other interpretations, which complicates (and sometimes delays) conclusions.
"People think differently and so they attack the problem differently. Other theories could be as true as my own, but based on different evidence."

Reflective Thinking

Stage Six:
View of Knowledge - Knowledge is constructed into individual conclusions about ill-structured problems on the basis of information from a variety of sources. Interpretations that are based on evaluations of evidence across contexts and on the evaluated opinions of reputable others can be known.
Concept of Justification - Beliefs are justified by comparing evidence and opinion from different perspectives on an issue or across different contexts and by constructing solutions that are evaluated by criteria such as the weight of the evidence, the utility of the solution, or the pragmatic need for action.
"It's very difficult in the life to be sure. There are degrees of sureness. You come to a point at which you are sure enough for a personal stance on the issue."

Stage Seven:
View of Knowledge - Knowledge is the outcome of a process of reasonable inquiry in which solutions to ill-structured problems are constructed. The adequacy of those solutions is evaluated in terms of what is most reasonable or probable according to the current evidence, and it is reevaluated when relevant new evidence, perspectives, or tools of inquiry become available.
Concept of Justification - Beliefs are justified probabilistically on the basis of a variety of interpretive considerations, such as the weight of the evidence, the explanatory value of the interpretations, the risk of erroneous conclusions, consequences of alternative judgments, and the interrelationships of these factors. Conclusions are defended as representing the most complete, plausible, or compelling understanding of an issue on the basis of the available evidence.
"One can judge an argument by how well thought-out the positions are, what kinds of reasoning and evidence are used to support it, and how consistent the way one argues on this topic is as compared with other topics."

APPENDIX E

INTERVIEW QUESTIONS

Interview Questions

The Reflective Judgment Interview (RJI)

The teachers' reflective thought or judgment will be assessed before and after the project, using the following scenarios and the probe questions located below. This interview process is taken from the Reflective Judgment Interview (RJI), developed by King and Kitchener (1994, Resource A, loc 3083).

RJI instructions to the interviewee:

NOTE: Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time.

During this [interview] we will be talking about several issues which are of general concern and about which most people are at least vaguely familiar. I am not concerned with how much information you have about any issue, but how you think about them. In order to standardize what we talk about, I will be asking the same series of questions for each issue; I am not repeating the questions because I am looking for a particular answer. For each issue, I will read a statement out loud while you follow along on a card. After I finish reading the statement, I'll give you a minute or so to think about the issue and then we will talk about it. Are there any questions before we begin?

Pre-Project Scenarios:

1. There have been frequent reports about the relationship between chemicals that are added to foods and the safety of these foods. Some studies indicated that such chemicals can cause cancer, making these foods unsafe to eat. Other studies, however, show that chemical additives are not harmful, and actually make the foods containing them more safe to eat.

2. Many religions of the world have creation stories. These stories suggest that a divine being created the Earth and its people. Scientists claim, however, that people evolved from lower animal forms (some of which were similar to apes) into the human forms known today.

Reflective Judgment Interview - Standard Probe Questions

Probe Question	Purpose
What do you think about these statements?	To allow the participant to share an initial reaction to the problem presented. Most respondents state which point of view is closer to their own...
How did you come to hold that point of view?	To find out how the respondent arrived at the point of view, and whether and how it has evolved from other positions on the issue.
On what do you base your point of view?	To find out about the basis of the respondent's point of view, such as a personal evaluation of the data, consistency with an expert's point of view, or a specific experience. This provides information about the respondent's concept of justification.
Can you ever know for sure that your position on this issue is correct? How or why not?	To find out about the respondent's assumptions concerning the certainty of knowledge (such as whether issues like this can be known absolutely, what the respondent would do in order to increase the certainty, or why that would not be possible).
When two people differ about matters such as this, is it the case that one opinion is right and one is wrong? If yes, what do you mean by "right"? If no, can you say that one opinion is in some way better than the other? What do you mean by "better"?	To find out how the respondent assesses the adequacy of alternative interpretations; to see if the respondent holds a dichotomous either/or view of the issue (characteristic of the early stages); to allow the participant to give criteria by which she or he evaluates the adequacy of arguments (information that helps differentiate high- from middle-level stage responses).
How is it possible that people have such different points of view about this subject?	To elicit comments about the respondent's understanding of differences in perspectives and opinions (what they are based on and why there is such diversity of opinion about the issue).

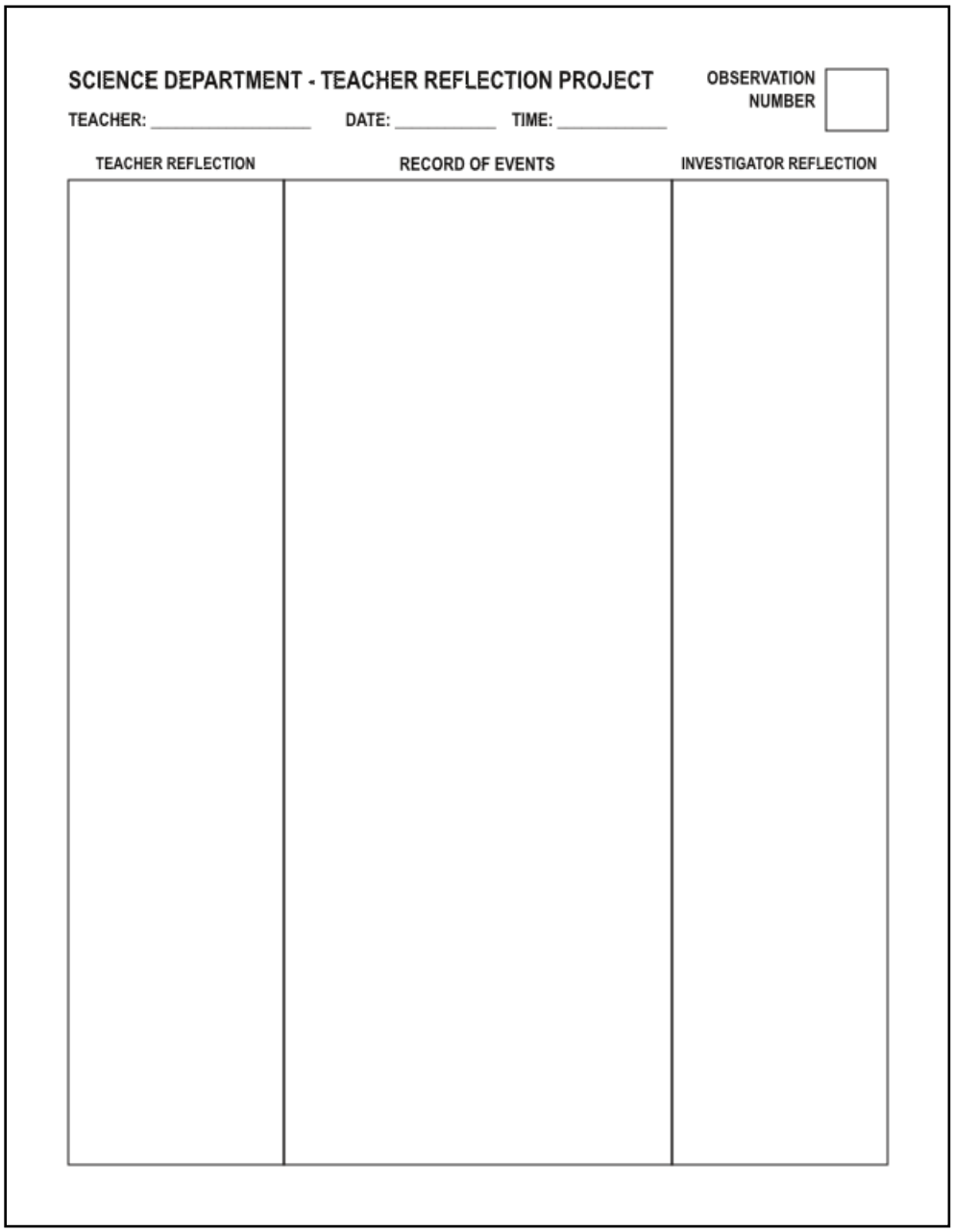
Probe Question	Purpose
How is it possible that experts in the field disagree about this subject?	To elicit comments about the respondent's understanding of how he or she uses the point of view of an expert or authority in making decisions about controversial issues (such as whether experts' views are weighted more heavily than others' views, and why or why not).

APPENDIX F

OBSERVATION FORM

Observation Form

The following form will be used to record classroom observations. The center column will be used to describe the events in the class. The right-hand column will be used by the investigator to record reflective responses to those events, and then folded down so that they cannot be seen immediately. The left-hand column will be used by the teacher to make his or her reflective responses. Both sets of reflections will be used to guide teacher-investigator reflection meetings.



SCIENCE DEPARTMENT - TEACHER REFLECTION PROJECT

OBSERVATION NUMBER

TEACHER: _____ DATE: _____ TIME: _____

TEACHER REFLECTION	RECORD OF EVENTS	INVESTIGATOR REFLECTION

Observation – Teacher Prompts

Round One

1. Put yourself in the mind of an average student in that class. What would he/she say were the strengths in that lesson?
2. How could you redesign the lesson to maximize those strengths?
3. In your own opinion, what were the strengths in that lesson?
4. Are they the same as the student-identified strengths?
5. If not, could they be aligned?
6. As a whole, what are the strengths of that class?
7. How could the lesson be modified to play to the strengths of that class?

Round Two

1. Identify something about the lesson that went particularly well from your point of view. Would your students agree?
2. Identify something about the lesson that represents an ongoing issue.
3. What was done during the lesson to address this issue? Were you successful from both the teacher and the student point of view?
4. What has been done outside of class to address this issue? How effective has this been?
5. What do you believe is the root cause of this issue? What evidence do you have for your belief?
6. How could you test your belief to see if it is the root cause?

7. Would you be willing to consider other causes if the one you believed to be true proved false? Where would you go to find other causes?

APPENDIX G

WEEKLY ELECTRONIC JOURNAL PROMPTS

Weekly Electronic Journal Prompts

The following prompts will be used promote more frequent and deeper reflective entries into teacher electronic journals each week.

Week	Prompt
One	This journal is meant to assist you in your progress toward becoming a more reflective practitioner. As discussed previously, the contents of this journal are confidential. Broad themes and quotes will be used for the project's final analysis, but these instances will be kept anonymous. It is *not* meant to be a journal in which you record only your struggles, as reflection is inherently a positive and creative activity. Please record any thoughts, feelings, questions or experiences - both positive and negative - which you would like to explore further. Each week you will also be given a prompt. Use this prompt as a lens through which you can view these experiences and, in the process, develop a deeper understanding and broader perspective. To begin, use the space to record your thoughts and experiences. At some point in the week, identify one or two of your strengths as a teacher. Describe that strength and how it affects your instructional environment. Put yourself in the place of a particular student and imagine how he or she would observe and describe this strength. Consider the following: • Would the student see it as a strength? • What evidence would he or she have for this strength? • Do both views match? • Would all students agree with this assessment?

Week	Prompt
Two	It is often noted that one hallmark of reflective thought is the ability to reframe situations. It requires teachers to see situations from perspectives other than their own. To do this, a teacher must first be aware of his or her background, values and priorities and how these affect every decision he or she makes. In addition to your general thoughts about the week, please consider the following two points: • All teachers have a person or experience in their past that made them the kind of teacher they are. This experience can be either positive or negative. These experiences often define their practice, either consciously or unconsciously. Describe this person or experience. How is your current practice similar or dissimilar? • How would your students have performed with that teacher or in that experience? What would they have needed to succeed? Would they have found it as inspirational or aggravating as you did? Why or why not?
Three	How teachers and students act (or react) in situations is often governed by the classroom and school culture. All teachers have been in classrooms in which the teacher, the students and the curriculum are all in perfect accord, like the parts of an orchestra coming together to play a symphony. This shared culture is often dominated by a small number of agreed upon themes, such as a certain style of humor or a sense of friendly academic competition. To be able to reframe situations, the reflective practitioner needs to account for the classroom and school cultures, and see those cultures from the perspectives of the other stakeholders involved in the situations. For this week's prompt, select two descriptors or facets of your classroom culture. Describe those facets from your point of view. Did you put them in place consciously or did they grow organically from stakeholder interactions? Describe those facets from the point of view of the students. Would all students agree on how they are seen? Is this culture always positive from their point of view?

Week	Prompt
Four (OPTIONAL)	As much as we would like to stay positive, problems do arise in our classes. Often these problems seem to arise from nowhere, persist for a while, then disappear into the background again. Reflective teachers are not satisfied with this ignorance. They strive to root out issues in the hopes that that knowledge can lead to the construction of a better, more efficient classroom culture. Identify a problem, similar to the type described above, that has arisen sometime in the past month. Try to describe it as thoroughly as possible, including what you believe to be the cause. Next, identify the unknowns in the situation, including those from outside of the classroom. Be thorough and ruthlessly honest as you consider these variables. For each, consider their relative importance from the students' point of view. Could these unknowns become known? If so, how? How would this knowledge affect the way you handle the situation?
Five	A reflective teacher gives problems a significant amount of thought, attempting to get at the root cause. Often teachers settle for the most expedient explanation because it allows them to move forward with minimal interruption to the flow of instruction. These types of solutions, however, rarely "fix" problems in the long run, as they "treat the symptom and not the illness," so to speak. This week, select a problem that has been difficult to solve. Record a description of this problem and your initial explanation of its cause. Under this explanation, write "Why?" and attempt to find a cause for that initial cause. Again, write "Why?" below this second explanation and attempt to describe its cause. Continue this process until you have recorded five explanations. What does this last cause tell you about the initial problem?

** Adapted from Haigh (2000).*

APPENDIX H

JOURNAL PROMPT THEMES

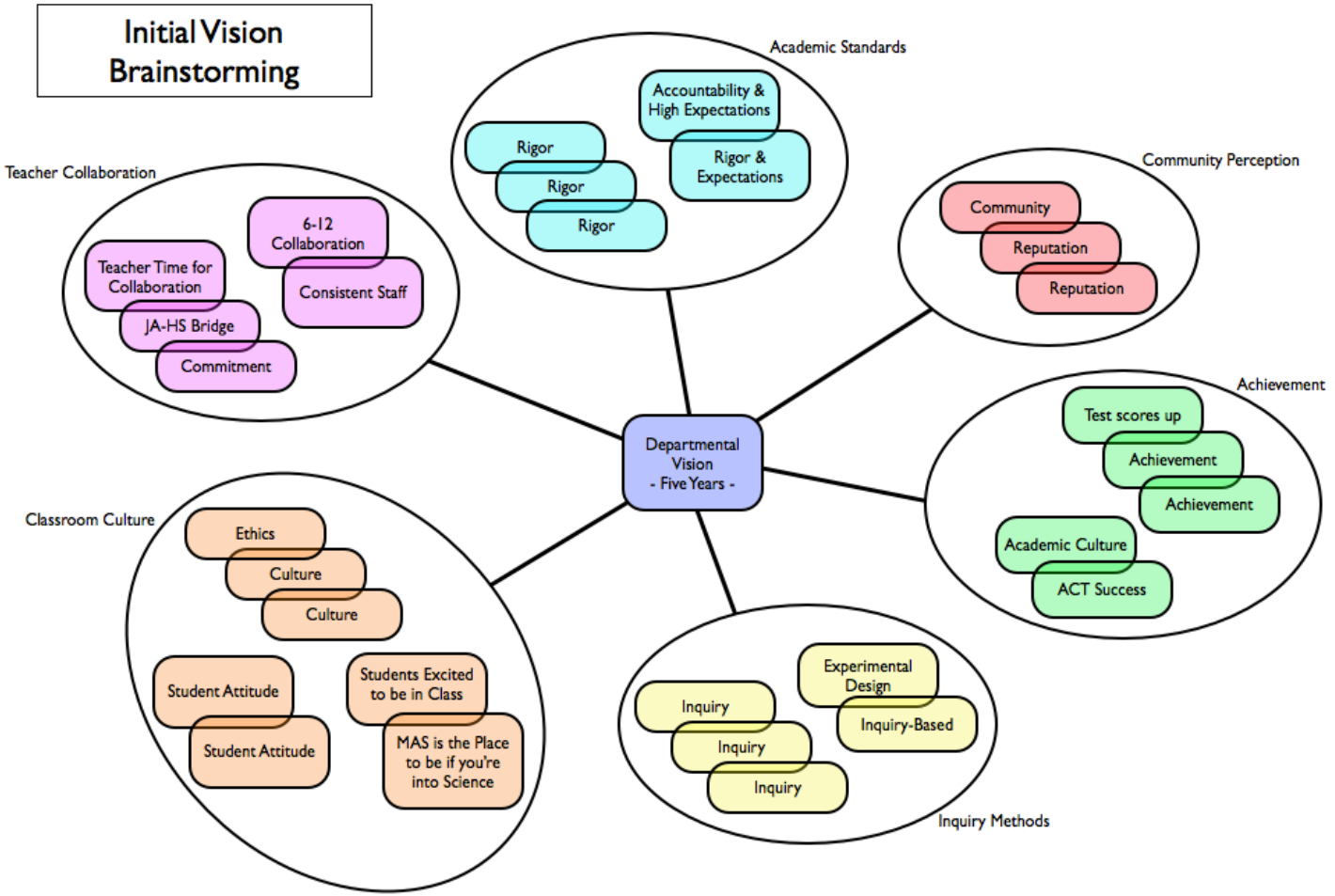
Journal Themes

Theme	Application	Creativity	Culture	Engagement	Enthusiasm	Expectations
Definition	Engaging students in the application of science knowledge	Development of unique, teacher-generated lessons	The overall feel of the school or classroom	Getting the maximum number of students to buy into the process	Generating or demonstrating excitement and passion	Teacher demands for student performance
Example	...constantly challenge the students with lectures, discussions, labs and activities.	I think I do a fairly good job of designing creative and original lessons that engage students...	My patience sets the tone for [the] classroom, in that I am not going to overreact.	I need to make sure that I am able to still engage those students that are completely lost in the content...	[I] use my passion for a topic to make it accessible for students that would otherwise be uninterested.	I [have] been trying to be more deliberate with my expectations adn clear with student requirements...
Theme	Instruction	Joy	Management	Rapport	Rigor	Student-Centered
Definition	Practices that lead to better presentation of content	An overall outlook that is positive and welcoming	Dealing with behavioral issues	Teacher-student personal relationships	Raising the overall level of content presented*	Allowing students greater control in the classroom
Example	All students learn differently and should be challenged accordingly.	My happiness, joy, and humor all reflect on this ability to stay positive.	In essence, multiple disciplinary distractions upset the classroom environment.	...I see a lot of my one-on-one rapport with students in the way he interacted with me.	...they would be amazed by their growth and willingness to attack difficult content without a problem.	...I think of ways that the students can lead the class...

** This definition of "rigor" represents the shared teacher misconception and not the definition commonly accepted by outside sources.*

APPENDIX I

RESULTS OF VISION STATEMENT BRAINSTORM


Initial Vision Brainstorming
Academic Standards
Accountability & High Expectations
Rigor & Expectations
Rigor
Rigor
Rigor
Teacher Collaboration
6-12 Collaboration
Consistent Staff
Teacher Time for Collaboration
JA-HS Bridge
Commitment
Community Perception
Community
Reputation
Reputation
Departmental Vision - Five Years -
Achievement
Test scores up
Achievement
Achievement
Academic Culture
ACT Success
Classroom Culture
Ethics
Culture
Culture
Student Attitude
Student Attitude
Students Excited to be in Class
MAS is the Place to be if you're into Science
Inquiry Methods
Experimental Design
Inquiry-Based
Inquiry
Inquiry
Inquiry

APPENDIX J

PRE- AND POST-PROJECT SURVEY - COMPLETE RESULTS

	Pre-Project Assessment						Post-Project Assessment						
Question	**1**	**2**	**3**	**4**	**5**	**AVE**	**1**	**2**	**3**	**4**	**5**	**AVE**	**DIFF**
How often do you check students' attitudes to the content after a lesson?			2	2	2	**4.0**				4	2	**4.3**	**0.3**
How often do you check students' attitudes about an assessment?				5	1	**4.2**				3	3	**4.5**	**0.3**
How often do you change lessons based on previous student attitude information?		1	2	2	1	**3.5**		1	1	3	1	**3.7**	**0.2**
How often do you alter your plans in the middle of a lesson based on student attitude information?		2	2	1	1	**3.2**	1		2	3		**3.2**	**0**
How often do you notice that students' emotional state affects their ability to work in your class?				2	4	**4.7**					6	**5.0**	**0.3**
How often do you attempt to identify the problem with an emotional student before attempting to solve it?			2	3	1	**3.8**				4	2	**4.3**	**0.5**
How often do you discuss your own attitudes with your students?		1	2	1	2	**3.7**		1	1	2	2	**3.8**	**0.1**
How often do you change your plans based on your attitude rather than objective data?	2		3	1		**2.5**		3	1	2		**2.8**	**0.3**
How often do you assess student confidence with subjects?			2	2	2	**4.0**		1		4	1	**3.8**	**- 0.2**
How often do you consciously note the effect of school culture on student attitudes?		2		2	2	**3.7**			1	3	2	**4.2**	**0.5**
How often do you discuss behavior issues with other teachers		1		1	4	**4.3**				1	5	**4.8**	**0.5**
How often do you discuss instructional strategies (not management-related) with other teachers?				5	1	**4.2**			1	4	1	**4.0**	**- 0.2**
How often do you discuss content with other teachers?			1	2	3	**4.3**		1		3	2	**4.0**	**- 0.3**
How often do you discuss educational research with other teachers?		4	2			**2.3**		3	1	2		**2.8**	**0.5**
How often do you discuss classroom culture issues with other teachers?		1	1	3	1	**3.7**			2	3	1	**3.8**	**0.1**
How often do you discuss school culture issues with other teachers?		1		3	2	**4.0**				5	1	**4.2**	**0.2**
How often do you discuss issues with teachers outside of our school?		3	2		1	**2.8**			2	2	2	**4.0**	**1.2**

How often do you find other teachers' opinions about management issues useful?				5	1	**4.2**			3	3		**3.5**	**- 0.7**
How often do you find other teachers' opinions about instructional issues useful?			1	5		**3.8**				5	1	**4.2**	**0.4**
How often do you alter some aspect of your classroom or your teaching based on what you have heard from another teacher?		1	1	4		**3.5**		1	1	4		**3.5**	**0**
My average level of optimism about my students' success is...			3	2	1	**3.7**			1	5		**3.8**	**0.1**
My average level of optimism about my ability to find the right instructional tool for my students is...			3	3		**3.5**			2	4		**3.7**	**0.2**
My average level of optimism about my ability to connect with my students on a personal level is...			2	2	2	**4.0**				4	2	**4.3**	**0.3**
My average level of optimism about my ability to connect with my student professionally is...			2	3	1	**3.8**				6		**4.0**	**0.2**
My average level of energy at the beginning of the day is...			1	1	4	**4.5**				2	4	**4.7**	**0.2**
My average level of energy at the end of the day is...		2	1	1	2	**3.5**		1	1	4		**3.5**	**0**
On an average day, my understanding of my students' points of view is...		1	2	3		**3.3**			3	3		**3.5**	**0.2**
On an average day, my understanding of my students' emotional states is...		1	2	3		**3.3**		1	2	3		**3.3**	**0**
On an average day, my understanding of my students' academic struggles is...		1	2	3		**3.3**		1	1	4		**3.5**	**0.2**
At the end of an average day, my feeling of success with my students is...			3	3		**3.5**			2	4		**3.7**	**0.2**

	Pre-Project Frequency	**Percent of Responses**	Post-Project Frequency	**Percent of Responses**
My students should know the maximum amount of content.		**0.0%**		**0.0%**
My students should be extremely proficient with lab procedures.		**0.0%**		**0.0%**
My students should be able to think critically and problem solve.	4	**66.7%**	4	**66.7%**
My students should be able to succeed in a rigorous academic environment.	2	**33.3%**	1	**16.7%**
My students should love science.		**0.0%**		**0.0%**
My students should be well-rounded.		**0.0%**	1	**16.7%**
My students should be happy and feel successful.		**0.0%**		**0.0%**
My students should know the maximum amount of content.		**0.0%**		**0.0%**
My students should be extremely proficient with lab procedures.		**0.0%**		**0.0%**
My students should be able to think critically and problem solve.	1	**16.7%**		**0.0%**
My students should be able to succeed in a rigorous academic environment.	2	**33.3%**	2	**33.3%**
My students should love science.	1	**16.7%**	1	**16.7%**
My students should be well-rounded.	1	**16.7%**		**0.0%**
My students should be happy and feel successful.	1	**16.7%**	3	**50.0%**
The need for better organization, class- and/or school-wide			2	**33.3%**
The need for better communication with administrators, parents and other teachers				**0.0%**
The need for better classroom management			2	**33.3%**
The need for better content-specific professional development			1	**16.7%**
The need for more support from other teachers and/or administrators			1	**16.7%**
The need for more equipment and/or supplies				**0.0%**
The need for better organization, class- and/or school-wide			2	**33.3%**
The need for better communication with administrators, parents and other teachers			1	**16.7%**
The need for better classroom management			2	**33.3%**
The need for better content-specific professional development				**0.0%**
The need for more support from other teachers and/or administrators			1	**16.7%**

The need for more equipment and/or supplies				**0.0%**

	Less Likely	2	Neutral	4	More Likely	**AVE**
Have discussions with other teachers about content	0	0	1	4	1	**4.0**
Have discussions with other teachers about management	0	0	1	2	3	**4.3**
Have discussions with other teachers about specific students	0	0	1	4	1	**4.0**
Have discussions with other teachers about research findings	0	0	2	3	1	**3.8**
Have discussions with other teachers about trade books and professional development	0	0	2	3	1	**3.8**
Have discussions with parents about their students	0	0	3	2	1	**3.7**
Have discussions with students about their academic performance	0	0	1	4	1	**4.0**
Have discussions with students about their behavior	0	0	2	3	1	**3.8**
Have discussions with students about their feelings about the content or the class	0	0	2	3	1	**3.8**
Conduct formative assessments of student prior knowledge	0	0	2	3	1	**3.8**
Conduct formative assessments of student likes and dislikes	0	0	2	3	1	**3.8**
Conduct formative assessments of student levels of confidence	0	0	2	2	2	**4.0**
Modify instruction based on discoveries of academic levels	0	0	1	2	3	**4.3**
Modify instruction based on discoveries of student attitudes	0	0	2	3	1	**3.8**
Modify instruction based on discoveries of student confidence levels	0	0	2	2	2	**4.0**
Seek out research findings to solve a problem	0	0	4	2		**3.3**
Seek out trade books to solve a problem	0	0	4	2		**3.3**
Seek out colleagues to solve a problem	0	0		2	4	**4.7**

APPENDIX K

PEER VIDEO REFLECTION PROMPTS

Peer Video Reflection Prompts

When you're watching your partner's lesson, consider the following. You may wish to use some from this list in your reflection.

1. What was a real strength of the teacher?
2. What was a real strength of the class?
3. How would you describe the classroom culture?
4. What evidence did you find for your response to #3?
5. How do you think a student in this class would describe the classroom culture?
6. Are #3 and #5 different? Why?
7. How did the teacher respond to issues/problems?
8. One technique that is often helpful in reflective practice is called "Five Whys". It asks you to generate what you think is the cause of a problem, then to ask yourself for the cause of that cause. After a few iterations, teachers are often surprised by the causes they identify that ultimately trigger a problem. Can this be done for a problem identified in this lesson?