ELEMENTS OF REFLECTIVE AND NON REFLECTIVE DISCOURSE IN AN ONLINE INDUCTION PROGRAM FOR EXPERIENCED AND NOVICE SCIENCE TEACHERS

by

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ABSTRACT

Reflection is frequently cited in the literature as integral to the type of learning in which professionals engage. However, throughout the literature the concept of reflection has been ill-defined and shown to be difficult to operationalize in studies. Beginning with a comprehensive review of the literature, this study sought to develop a research based way to operationalize reflection. Once reflection was defined and operationalized, a discourse analysis rubric was designed to identify elements of non reflective and reflective discourse used by participants in an online content-based mentoring and induction professional development program, e-Mentoring for Student Success (eMSS). The rubric was used to conduct a content analysis of online discourse between novice and experienced science teachers participating in the eMSS program. Coders determined which elements of non reflective and reflective discourse, including levels of discourse, were used by different types of participants in the various online discussion areas of the eMSS program.

The results of this study showed a higher percentage of novice science teachers' messages were coded as containing overall higher levels of reflective discourse. This difference was partly attributed to the different roles experienced and novice science teachers have in this program. The different eMSS online discussion areas had varying percentages of messages identified as containing different levels of reflective discourse. Different discussion area curriculums, including types of discussion prompts and methods of facilitation, partly attributed to these differences. This study showed the importance of being intentional in the wording or modeling of what is expected from participants as they compose their messages. This study also showed that eliciting reflective thought processes from program participants depends on a variety of factors and can be contextual. No single factor stood out as essential to consistently encouraging reflective thought processes. Recommendations are made for designing program curriculums and facilitating the type of learning that results in the use of reflective thought by program participants.

CHAPTER ONE

INTRODUCTION

Introduction

Science teachers, as well as other professionals, have jobs in which a mastery of a specific body of knowledge is a prerequisite for success. Some would argue that this "professional knowledge is mismatched to the changing character of the situations of practice" (Schon, 1983, p.14). Professional development literature frequently recommends the use of reflection to fill the gap between professional knowledge and the changing situations of practice in which professionals find themselves. Schon (1983) explains reflection is a process to be used by professionals to examine situations whose complexity "and uncertainty are not removed or resolved by applying specialized knowledge to well-defined tasks" (p.19).

The significance of reflection, in educating adults, is indicated by its frequent inclusion in professional development program goals or standards (Rhoton & Bowers, 2001; Moon, 1999). Numerous studies examining reflection and its role in adult education have been published in the past (Bain, Packer, & Mills, 1999; Day, 2000; Kember, Jones, Loke, McKay, Sinclair, Tse, Webb, Wong, Wong, & Yeung, 1999; Trumbull & Slack, 1991). The literature frequently admits that the term has been ill-defined (Hatton & Smith, 1995; Hussein, 2006; Place, 2005; Russo & Ford, 2006; York-Barr, Sommers, Ghere, & Montie, 2006) which is a key reason why it is difficult to operationalize in studies (Moon, 1999; Peltier, Hay, & Drago; 2005). A need

to develop and refine instruments used to determine the existence of reflection and the role it plays in professional development programs has been identified (Kember et al., 1999).

This study will identify both reflective and non reflective dialogue in the context of asynchronous online discourse between novice and experienced science teachers in a professional development program. This study will provide information about the levels and frequency of use of non reflective and reflective discourse found in messages written by different participants and submitted to various discussion areas. This study will also examine the issues about which participants are writing. Additionally, this study will add to the paucity of literature describing methods of identification and analysis of reflective online discourse in professional development programs.

Background

Reflection as a means to modify and enhance science teachers' practice is listed in various teacher education standards (The Interstate New Teacher Assessment and Support Consortium, 2002; National Board for Professional Teaching Standards, 2006; The National Council for Accreditation of Teacher Education, 2007; National Research Council, 1996). These standards recommend incorporating reflection into professional development for teachers at the preservice, induction, and experienced levels. At least three National Science Teacher Association (NSTA) position statements write of the significance of being a reflective practitioner (NSTA, 1992; NSTA, 2007; NSTA, 2007). The NSTA (2007) position statement for Induction Programs for the

Support and Development of Beginning Teachers of Science specifically states that mentors should be exemplary in their ability to reflect upon their practice.

Reflection is frequently found in the professional development literature for beginning teachers and is often described as a tool to help beginning teachers work through the unique challenges they face. Zeichner (1992) explains that reflection is considered one of the primary tools for facilitating the development of competence and ultimately expertise in novice teachers. Hussein (2006) cautions however, that it is inappropriate to expect beginning teachers to be reflective simply because they have been asked to reflect on some topic. Rather, beginning teachers should be provided a support structure in which a variety of formats and opportunities for reflection are made available.

This support structure can be in the form of professional development. Professional development is critical for beginning teachers' survival in the early years of their career (Sterling, 2004; Veenman & Denessen; 2001) and also for their retention in the profession. After reviewing the literature on mathematics teaching and learning for the National Council of Teachers of Mathematics, Hiebert (1999) provided a description of key factors, reflection is included, necessary for high quality professional development:

> Research on teacher learning shows that fruitful opportunities to learn new teaching methods share several core features: (a) ongoing (measured in years) collaboration of teachers for the purposes of planning with (b) the explicit goal of improving students' achievement of clear learning goals, (c) anchored by attention to students' thinking, the curriculum, and pedagogy, with (d) access to alternative ideas and methods and opportunities to observe these in action and to reflect on the reasons for their effectiveness… (p.15).

Electronic Mentoring for Student Success (eMSS) is a web based professional development program designed to provide Hiebert's aforementioned fruitful opportunities and support, primarily in the form of mentoring, to beginning science and mathematics teachers (mentees). In the eMSS program mentors are experienced teachers who are assigned primarily to an individual or a small group of three to four mentees. Mentors respond to mentees' questions, concerns, and requests for help and guide mentees through the eMSS curriculum found formerly in a WebCT platform and currently in a Sakai platform. Both are common types of online learning management systems. Along with mentors, content experts and discussion group facilitators also provide support and guidance to mentees as they manage their online learning environment.

The eMSS program began in 2002 after the National Science Foundation awarded a five-year grant to Montana State University Science / Math Resource Center in Bozeman, the National Science Teachers Association, and the New Teacher Center at the University of California at Santa Cruz to develop the program. eMSS, which was created in response to the need to retain and to provide ongoing learning opportunities for mathematics and science teachers, is unique in its web based format and its focus on improving "novice teachers' content knowledge and pedagogical content knowledge, in addition to improving their survival skills and general pedagogical knowledge, the traditional focus of characteristic mentoring programs" (Taylor, 2007, p. 2). Taylor (2007) further explains the designers of eMSS:

> … recognized the need for providing early career support closely connected to the science and mathematics subjects and grade levels taught by beginning teachers.

> Realizing that access to trained mentors of the same discipline and grade level is not available to beginning teachers in many states, the partnership designed the distance mentoring program using a web-based model. (p.2)

Much of the learning in eMSS takes place in the structured online discussion areas: Inquiries, Dilemmas, Topic of the Month, and Content areas. In these discussion areas participants, including mentors, mentees, research scientists, content specialists, and discussion facilitators 'meet' to engage in a dialogue intentionally designed to "further beginning teachers' *progress along a professional continuum* from survival to focused problem solving to critical reflection on teaching practice" (eMSS Guidelines for Online Learning and Facilitation found in Appendix A). eMSS discourse is facilitated by trained program staff who try to stimulate and then nurture discourse that "promotes reflection, conceptual growth, and change, and improvements in professional practice" (eMSS Guidelines for Online Learning and Facilitation) for mentees as well as all other participants.

Problem of Study

Within the description of its program as well as in both the eMSS Guidelines for Online Learning and Facilitation and the eMSS Design Principles, found in Appendix B, there is an emphasis on the importance of the role of reflection in high quality discourse as a means to promote teacher growth that improves practice and positively impacts student achievement. The eMSS Guidelines for Online Learning and Facilitation leads off with:

> A central goal of eMSS is to promote reflection, conceptual growth and change, and improvements in professional practice through rich online dialogue. We believe that online learning environments, when carefully designed and

> moderated by trained facilitators, can be singularly effective places for meaningful dialogue leading to teacher growth, accompanied by changes in classroom practice and student learning gains.

Reflection is also written about in the handbooks for eMSS mentors and mentees. Reflection by participants, attending the eMSS Advanced Mentor Institute, was seen as an integral part of this curriculum as participants focused on gaining skills in strategies to lead, advance, deepen, and identify high quality online discussions.

The online discourse that eMSS participants construct, submit, and read is a primary medium through which participants are to learn and reach program goals. 'Meaningful, rich, quality, or intentional dialogue' is specifically mentioned in four of the fourteen eMSS Guidelines for Online Learning and Facilitation. Guideline number seven states:

> Through systematic design and facilitation, eMSS online experiences will use dialogue intentionally to further beginning teachers' progress along a professional continuum from survival to focused problem solving to critical reflection on teaching practice.

One of the eleven eMSS Design Principles specifically addresses reflection in the online environment:

> Each eMSS on-line or face-to-face learning experience will be explicitly designed to foster reflection on *classroom practice* or *mentoring practice* by providing participants with frameworks or models of good practice, along with opportunities to do reflection (individual, pair, and small group).

These examples support the premise that the eMSS program views the concepts of high quality discourse and reflection as being intricately related to each other. It is a primary ambition of the eMSS program to have participants, in the preparation of their discourse, reflect on their teaching practice in such a way that informs and improves their practice and positively impacts student achievement. It stands to reason that high quality

discourse engaged in by participants is an essential component of reaching program goals.

Part of a second year report of the eMSS program, submitted in June 2004 by Brent Ford of Horizon Research Inc. (HRI), evaluated the program's success in promoting high quality online discourse between program participants. The content analysis of eMSS online discourse showed that only a very low percentage of messages pertained to science content, pedagogical content knowledge in science, or thoughtful reflections on general pedagogy (Ford, 2004). In response to this report, an intervention, which included an online facilitator development seminar as well as face-to-face sessions on improving discourse for mentor and mentee participants in eMSS, was piloted (Taylor, 2007).

Ford (2005) did not report any statistically significant improvement in discourse quality from the 2003-2004 to the 2004-2005 program years. Ford (2005) reported that discourse in the eMSS program tended to be focused on logistics, experience sharing, lesson sharing, or responses to assignments rather than on content or student thinking. Ford (2005) further explained "conversations that were aligned with project goals were often of low quality, in many cases due to either a lack of sense making within the conversation, with little attempt to relate the conversation to broader issues of high-quality mathematics or science instruction and/or missed opportunities within the conversations" (p.23). In order to effect the desired levels of growth in beginning teachers' practices, Ford suggested this professional development program should continue to provide support to discussion area facilitators, mentors, and university content experts, focused on developing strategies for moving beginning teachers toward conversations that are more aligned with project goals (Ford, 2005).

Partly in response to the Ford 2005 report, Taylor (2007) explains that two online facilitator and advanced mentor training sessions were designed and implemented during the summer of 2005. The sessions included pieces on discourse quality and leading online discussions. Additionally, an ongoing facilitator forum in a specified discussion area allowed for additional training and support for eMSS facilitators throughout the 2005-2006 program year.

Following this intervention, a four year report for the eMSS program was submitted in September 2006 by Joan Pasley, Lauren D. Madden, and Brent Ford of HRI. For this report, a qualitative content analysis of eMSS online discourse was conducted using the eMSS Conversation Rubric, developed by HRI and found in Appendix C. Conversations were rated holistically (on a five-point Likert scale) on the extent to which the dialogue was likely to enhance the capacity of the participant to provide high quality mathematics/science instruction or to be an effective mentor and/or facilitator charged with helping to move mentees forward in their practice.

A rating of 1 indicated that dialogue did “not at all” enhance the capacity of the of the participant to provide high quality mathematics/science instruction or to be an effective mentor and/or facilitator charged with helping to move mentees forward in their practice. A rating of 5 indicated that the dialogue enhanced the capacity of the participant to provide high quality mathematics/science instruction, or to be an effective mentor and/or facilitator charged with helping to move mentees forward in their practice “to a great extent”. Only 8% of the conversations received a rating of a 4 and 0% received the highest rating of a 5. Yet, in the same report 45% of the 2005-2006 mentees reported that participation in the Content Area discussion improved their understanding of science

content. Additionally, 42% of mentees made ‘Due to participation in eMSS’ the second most common answer as to why there were changes in their teaching.

Using a modified version of the HRI rubric, found in Appendix D, Taylor (2007) reported some statistically significant improvement in dialogue quality between November 2004 and November 2005. These results seemed to indicate that participants are learning and making changes in their teaching during and as a result of participating in the eMSS program. It seems participants may be learning more than is indicated by the dismal percent of 4 and 5 HRI conversation quality ratings. These results could possibly indicate that the conversation rubric developed by HRI is inadequate for measuring quality dialogue in the eMSS program.

The five year evaluation report of the eMSS program submitted in August 2007 by Joan Pasley and Lauren D. Madden of HRI compared 2005-2006 and 2006-2007 results of the qualitative content analysis of eMSS online discourse using the eMSS Conversation Rubric. The proportion of conversations rated 3 or higher in 2007 was significantly higher ($p<0.05$) than similarly related conversations in 2006 (Pasley & Madden, 2007). Like the 2006 results, the 2007 report has mentees reporting that they are learning. When 2006-2007 mentees were asked to rate their preparedness in basic teaching and management skills, after involvement in eMSS, in a pre and post survey (Pasley & Madden, 2007) there was a significant ($p<0.05$) increase in composite scores from the beginning to end of the school year. When responding to whether participating in the inquiries and mini-inquiries was highly likely to enhance their ability to teach science, the proportion of mentees selecting “Highly Likely” was significantly higher in 2006-2007 than in 2005-2006. However, like the 2005-2006 results, only a very small percentage (6%) of the 2006-2007 eMSS conversations were rated at a four or five.

The conversation rubric used by HRI considered nine points when assessing the quality of dialogue and holistically rated conversations on a five point scale. Using this rubric, it would be possible for conversations to show evidence of reflection but score low in the other eight areas resulting in a low rating for that conversation. The opposite scenario, as well as many others, is also possible using the HRI conversation rubric with its holistic rating system. A conversation could show little evidence of reflection but score high in the other areas resulting in a high rating for a conversation that contains little evidence of reflection. Furthermore, even though reflective content of dialogue is one of the nine points in the HRI rubric, the term reflection is not defined or operationalized in the rubric or elsewhere in these reports. This lack of explanation is common in reflection research and makes it difficult to assess whether or not participants are indeed reflecting. With the content analyses performed thus far on eMSS online discourse, it has been difficult to determine if participants are indeed reflecting on their practice.

Using an explanation of types of reflection from Hatton and Smith (1995), Taylor (2007) modified the HRI conversation rubric in order to better analyze the reflective content of dialogue. Her conversation rubric is found in Appendix D. Reflection is one of four points on which she rated the quality of online dialogue. However, the online discourse in eMSS discussion areas as well as the end of Inquiry Self-Reflections (referred to as Self-Assessments for the 2009 program year) in the Inquiry discussion area of the program have never been analyzed specifically for only their reflective content.

Purpose of Study

The purpose of this study is to identify the elements of non reflective and reflective discourse used by facilitators, mentors, and mentees in various discussion areas of eMSS and on the end of Inquiry Self-Reflections. A content analysis of online discourse will be used to answer the following research questions:

1. Which elements of non reflective and reflective discourse are found in the types of discourse that experienced science teachers, participating in a professional development program, write? Which elements of non reflective and reflective discourse are found in the types of discourse that novice science teachers, participating in a professional development program, write? How can any observed differences be interpreted?

2. Which elements of non reflective and reflective discourse, written by participants in an online professional development program, are seen in discussion areas varying in content and format? How can any observed differences be interpreted?

3. To what extent are issues prominent in the National Science Education Standards present in the teachers' discourse, and is there a relationship between the presence of particular standards-based issues and the level or type of reflection?

Significance and Benefits of Study

Discourse and Reflection Rubrics in General

A rubric, based on the reflection literature, was designed and used to identify the elements of non reflective and reflective discourse found in online discussion areas of this professional development program. A primary goal of this research was to develop a research supported definition and operationalization of reflection, and a rubric, aligned with these two, for identifying and ranking different elements of non reflective and reflective discourse within online dialogue. This study will add to the paucity of

literature (Rucinski, 2006) describing tools used to identify and/or rate reflection in general and more specifically, to classify reflective and non reflective online discourse in higher education.

eMSS Program Discourse

The HRI conversation rubric analyzed nine aspects of discourse when assigning a single ranking to discourse quality. Taylor (2007) examined program discourse in four areas: content accuracy, community building, whether the discourse is on task and moving forward, and the reflective nature of the conversation when assigning a singular ranking to discourse quality. Neither of these rubrics, Taylor's (2007) and the HRI conversation rubric, in the way that they were used, allowed for the examination of discourse focusing primarily on the reflective or non reflective content of the dialogue. Taylor (2007) recommended a breakdown of these rubrics for further analysis of discourse partly in response to the Pasley, et al. (2006) recommendation to continue to improve the quality of eMSS program discourse.

This breakdown could allow for an intense examination of a singular aspect of the eMSS discourse. In this study the reflective and non reflective content of the dialogue will be the focus of the analysis and should provide data to program designers and facilitators regarding the presence and types of reflective and non reflective dialogue used by its participants in their online discourse. The results of future studies, which could focus on other specific aspects of the online discourse such as community building and content accuracy, could be compared to the results of this study and provide program

designers information on the specific strengths and weaknesses of program discourse as it relates to program goals.

eMSS Discussion Areas

Discussions in the eMSS program can occur in several different areas. Because this study will analyze discourse in the Inquiry, Content, Dilemma, and Topic of the Month discussion areas, the results may provide program designers with a better understanding regarding where in the program participants are using reflective discourse as well as data concerning the frequency of different types of non reflective and reflective discourse being used in the different discussion areas. This data can then be used in the program evaluation process to show how and where participants are engaging in reflective processes. Once it is known where reflective discourse is occurring more frequently, strategies used by facilitators and mentors in these areas can be analyzed for the purpose of possibly improving the reflective content in other discussion areas or discussion threads.

Generalizability

Due to the large sample size of messages examined for this study and the robust research based rubric developed for this analysis, the results of this study may be broadly useful in face-to-face as well as online professional development programs which consider reflection to be a component of their program. Programs may use the rubric to identify types of non reflective and reflective discourse in their participants' writing.

Reflection and Learning

Pasley & Madden (2007) report that it was only in the Inquiry discussion area that mentees' responses to whether participating in this discussion area would be highly likely to enhance their ability to teach science showed a significant increase from the 2005-2006 to 2006-2007 program year. The same could not be said for the Content and Dilemma discussion areas. If the results of this study indicate participants are learning more by participating in the Inquiry discussion area compared to other discussion areas and more and / or higher levels of reflective discourse is found in the Inquiry discussion areas, the link between reflection and learning as written about in the literature may be stronger there.

Individual Message Units

Previous content analysis of eMSS discourse has focused on conversations or "threads". These threaded conversations include multiple messages from various program participants (mentors, mentees, facilitators, content experts). This method of analysis has been used to get an overall picture of how training affects the dialogue in the program as a whole" (Taylor, 2007, p.279). Taylor (2007) proposes the possibility of analyzing each message in order to develop a different understanding of the dynamics involved in high quality discourse.

This study will consider each individual message as a single unit of analysis. Using this approach, this study may be able to provide data which more richly describes an individual participant's ability to show reflection in the form of online discourse as well as that individual's impact on the reflective and non reflective content

of a discussion thread. Which facilitators or mentors have more reflective mentees? What do they do differently than others? What type(s) of interaction between participants promote the development of reflective discourse? Are mentors or mentees more reflective in their discourse? Answers to these questions can guide future training and curriculum development for professional development programs involving early career and experienced teachers such as the eMSS program.

Definitions

Discourse:	A type of dialogue in which participants engage with others whom they believe to be informed, objective, and rational to assess reasons that justify problematic beliefs (Imel,1998).
Dialogue:	For this study this term and discourse can be used interchangeably.
Professional Development.	An ongoing learning process in which teachers engage to learn how best to adjust their teaching to the learning needs of their students. An evolving process of professional self-disclosure, reflection, and growth that yields the best results when sustained over time in communities of practice and when focused on job-embedded responsibilities (Diaz-Maggioli, 2003).
Reflection:	A mental process, with a purpose or outcome (such as knowledge generation), associated with learning at a deep level and often involves justifying what one knows, feels, believes, or acts upon. It is especially applied when examining issues, situations, or experiences that produce a sense of uncertainty or doubt, or are complicated with no obvious solution for a given participant. This definition was developed as a result of analyzing and synthesizing many different definitions, frameworks, or ways of looking at reflection. The process by which this definition was created is explained in detail in Chapter 3.

Technical Rationality:	A model that posits that professional activity requires problem solving made rigorous by the application of scientific theory and technique (Schon, 1983). This model sees professional practice as a process of problem solving that occurs when "problems of choice or decision are solved through the selection, from available means, of the one best suited to established ends" (Schon, 1983, p. 40-41).
Instrumental Learning:	A type of learning that is focused on determining cause-effect relationships, that occurs when learner attempt to control and manipulate the environment or use task-oriented problem-solving approaches (Mezirow, 1991).
Communicative Learning:	A type of learning that occurs when learners "with particular aims communicates with another person in order to arrive at an understanding about the meaning of a common experience so that they may coordinate their actions in pursuing their respective aims" (Mezirow, 1991, p.65). A type of learning that occurs when learners listen to, write, or read what others have written in order to answer questions similar to: "How do you see this?" and "How do you experience this?" (Cranton, 1996, p.19).
Deep Learning:	A type of learning that can be seen when the learner has the intention to understand ideas for themselves (Moon, 1999). The learner may do this by making judgments using thoughtful reasoning by using problem solving skills such as deduction that require an understanding of the elements involved in an issue or as they look for patterns and underlying principles associated with the issue. Or by summarizing facts, as they relate to ideas, as supporting evidence for justifying a belief about an issue or manipulate meaningful knowledge towards an end, such as clarification of thoughts on some issue (Moon, 1999). Or by being actively interested in course content by seeking alternatives, challenging assumptions, and identifying areas for improvement (Peltier, Hay, & Drago, 2005).

Surface Learning:	A type of learning that can be seen when a learner has the primary intention to merely cope with course requirements (Moon, 1999). The learner may do this by studying without reflecting either on purpose or strategy, by treating courses as unrelated bits of knowledge, or by memorizing facts and procedures.
Elements of Reflection:	Element number one: Issue identification. Issues of interest to eMSS participants were gleaned from the material of learning. Element number two: Determining a participant's approach to learning while preparing their discourse. Surface and deep approaches to learning were considered. Element number three: Determining the highest level of discourse in a message. Seven different levels of discourse were considered. Element number four: Identifying if participants write about further action.

Potential Limitations of the Study

Sampling the Population

During the two year time frame from which discourse was analyzed tens of thousands of messages were posted to the various structured and unstructured discussion areas. The time and resources necessary to analyze all messages limited this study to using a sample of messages. For this study various discourse samples taken from different discussion areas for the last two years were analyzed. This sampling process may have precluded an accurate reporting of the presence and types of reflective and non reflective discourse in the online discussion areas.

Outside Communication

In this study only online discourse between participants was analyzed in order to determine the reflective and non reflective discourse in which participants engage.

Reflective discourse that may have occurred between participants via private e-mail or in face-to-face settings was not identified or analyzed.

Reflection Operationalized

In this study reflection was operationalized in the context of written discourse, rather than an oral expression or an individual's private thought processes. Researchers have yet to agree on a definition of reflection much less on a way to operationalize it for studies. Other professional development programs may operationalize the term differently.

Silent Participants

Participants may have reflected on their teaching practice but not have written their reflective thoughts in the form of discourse in the eMSS discussion areas. In this case, the identification of reflective processes in which participants engage while enrolled in the program was not documented.

Different Interpretations of Participant Discourse

Measures of interrater reliability were used to determine internal consistency in the identification and classification of the types of reflective and non reflective discourse. However, as Taylor (2007) explained in her study, because rating discourse does require the coder to make a personal judgment the extent to which meanings are understood may have been limited.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

This literature review is organized into three main sections:

1. Science Teachers as Professionals
2. Reflection Described
3. Reflection and Learning

The first section explains the recommended changes in emphasis in science teacher professional development as described by the National Science Education Standards. These changes help to explain why science teaching is a profession requiring more than a defined set of technical skills in order to experience success. This section also provides a broad framework supporting the use of reflection by eMSS participants. The second section examines how the literature attempts to define, describe, and operationalize reflection. The third section describes the roles of reflection typically seen in adult learning. An appreciation for Habermas's domains of learning, the impact of the learners' view of knowledge, and the learners' approach to learning add to a better understanding of the role of reflection in learning.

Science Teachers as Professionals

Science teachers engage in professional activity each day as they make decisions

that influence their actions in the often complex and dynamic environment of a science classroom. A profession is defined as an occupation requiring a specialized knowledge base and considerable training which can last a long time (Woolf, 1974). A knowledge base is composed of the technical, values-identification, problem-setting, decision-making, and problem solving capabilities necessary to function within the demands of a profession (Lang, 2004). In order to be successful, science teachers need a well developed knowledge base including knowledge about content, pedagogy, different types of learners, what learning looks like, curricular issues, and the system in which they work. However, what the complete knowledge base 'looks like' for science teachers is unclear (Strom, 1991).

Part of the confusion has to do with the development of the National Science Education Standards (National Research Council, 1996) which view science teaching in a These standards were designed "to describe an educational system in which all students demonstrate high levels of performance, in which teachers are empowered to make the decisions essential for effective learning, in which interlocking communities of teachers and students are focused on learning science, and in which supportive educational programs and systems nurture achievement. The *Standards* point toward a future that is challenging but attainable…" (p.2) These challenging standards build on the best of current practice but at the same time "aim to take us beyond the constraints of present structures of schooling toward a shared vision of excellence" (National Research Council, 1999, p.12). In order to improve student achievement in a manner aligned with the National Science Education Standards it is recommended that science teachers approach teaching and learning in a way that values the individual student and views them as active participants in a learning process. Table 1 shows the changes in emphasis in science

teaching as envisioned by the National Science Education Standards.

Table 1. Changes in Emphasis in Science Teaching as envisioned by the National Science Education Standards (Adapted from National Research Council, 1996).

Less Emphasis On:	More Emphasis On:
Treating all students alike and responding to the group as a whole.	Understanding and responding to individual student's interests, strengths, experiences, and needs.
Rigidly following curriculum	Selecting and adapting curriculum
Focusing on student acquisition of information	Focusing on student understanding and use of scientific knowledge, ideas, and inquiry processes
Presenting scientific knowledge through lecture, text, and demonstration	Guiding students in active and extended scientific inquiry
Asking for recitation of acquired knowledge	Providing opportunities for scientific discussion and debate among students
Testing students for factual information at the end of the unit or chapter	Continuously assessing student understanding
Maintaining responsibility and authority	Sharing responsibility for learning with students
Supporting competition	Supporting a classroom community with cooperation, shared responsibility, and respect
Working alone	Working with other teachers to enhance the science program

Ball & Cohen (1999) make clear if teachers are to do the type of teaching and facilitate the type of learning that the reform literature promotes, their knowledge base must include more than the simple acquisition of several types of knowledge.

Ball & Cohen (1999) explain:

> (The type of teaching encouraged in the reform literature) would require the capability to attend to and learn about individual students' knowledge, ideas, and intentions. It would also require (teachers to have) the capability to stand back from and analyze their own teaching, to ask and answer such questions as: What is working? For whom are certain things working or not working? ... teachers would need to use what they learn to correct, refine, and improve instruction. This implies that practice cannot be wholly equipped by some well-considered body of knowledge. Teaching occurs in particulars-particular students interacting with particular teachers over particular ideas in particular circumstances. Despite the significance of the (aforementioned knowledge types), no amount of such knowledge can fully prescribe appropriate or wise practice. (Hence) much of what (teachers) need to learn must be learned in and from practice rather than in preparing to practice. Or, perhaps better, they would have to learn, before they taught and while teaching, how to learn in and from practice. (p.10)

Clearly, as a result of the changes in emphasis for science teaching, Ball & Cohen (1999) would support recommending changes in emphasis in science teacher professional development in an attempt to assist teachers in learning in and from practice so that they may come to develop and use teaching strategies aligned with the recommended changes in emphasis in science teaching. The designers of the National Science Education Standards (National Research Council, 1996) advise creators of professional development for science teachers to move away from approaches relying on fragmented experiences and external expertise which view the teacher as a technician. The standards approach to professional development recognizes the need for coherence, collegiality, inquiry, and reflection in professional development. Table 2 displays the changes in emphasis in professional development for science teachers as envisioned by the National Science Education Standards.

Table 2. Changes in Emphasis in Science Teacher Professional Development as envisioned by the National Science Education Standards (Adapted from National Research Council, 1996).

Less Emphasis On:	More Emphasis On:
Transmission of teaching knowledge and skills by lecture	Inquiry into teaching and learning
Learning science by lecture and reading	Learning science through investigation and inquiry
Separation of science and teaching knowledge	Integration of science and teaching knowledge
Separation of theory and practice	Integration of theory and practice in school settings
Individual learning	Collegial and collaborative learning
Fragmented, one-shot sessions	Long-term coherent plans
Course and workshops	A variety of professional development settings
Reliance on external expertise	Mix of internal and external expertise
Staff developers as educators	Staff developers as facilitators, consultants, and planners
Teacher as technician	Teacher as intellectual, reflective practitioner
Teacher as a consumer of knowledge about teaching	Teacher as a producer of knowledge about teaching
Teacher as follower	Teacher as leader
Teacher as an individual based in a classroom	Teacher as a member of a collegial professional community
Teacher as a target of change	Teacher a source and facilitator of change

Schon (1983) would maintain these changes in emphasis as they encourage a movement away from a model of learning based on Technical Rationality. This model, which has had tremendous influence on the view of professional knowledge and practice in teaching as well as in other professions, posits that professional activity requires problem solving made rigorous by the application of scientific theory and technique (Schon, 1983). Schon (1983) explains that "from the perspective of Technical Rationality, professional practice is a process of problem solving" (p.39) and professionals involved in problem solving are seen as participating in a technical process that occurs when "problems of choice or decision are solved through the selection, from available means, of the one best suited to established ends" (p. 40-41).

However, in science teaching as well as in other professions, problems frequently do not present themselves as givens and means and ends are not necessarily known or understood. Schon (1983) describes the lapses in the model of Technical Rationality:

> Technical Rationality depends on agreement about ends. When ends are fixed and clear, then the decision to act can present itself as an instrumental problem. But when the ends are confused and conflicting, there is yet no "problem" to solve. A conflict of ends cannot be resolved by the use of techniques derived from applied research. It is rather through the non-technical process of framing the problematic situation that we may organize and clarify both the ends to be achieved and the possible means of achieving them. (p.41)

In these situations science teachers find they must first engage in the process of problem setting prior to problem solving. In this process science teachers make decisions concerning what they will treat as the "things" (Schon, 1983) of the situation. Decision making in the problem setting process is fundamental to the professional work of science teachers. Loke and Chow (n.d.) go further in describing the process of problem setting. They submit that problem setting can involve "making a taken-for-granted situation

problematic and raising questions regarding its validity" (p.2).

Problem setting requires that teachers set the boundaries of their attention to the things of the situation, determine what is wrong, and how the situation needs to be changed (Schon, 1983). The process of problem setting has science teachers determining the decisions to be made, the ends to be achieved, and the means to arrive there. Those who design professional development for science teachers should be attentive to the unique and complex situations in which science teachers frequently find themselves. Designers of the eMSS program, partly by collaborating with a wide variety of professionals including educational researchers and leaders, college professors, university science content specialists, technology experts, and current and retired classroom teachers, embraced the concept that facilitating high quality science teaching is indeed complex and the situations of practice are multifaceted and dynamic.

High quality teaching can make a difference in student achievement (Darling-Hammond, 1997; Marzano, 2003; Suh & Fore, 2002; Wenglinsky, 2002). Darling-Hammond (1997) explains the connection between high-quality science teaching and student achievement. When the goal of professional development is to improve science achievement for students, improving the quality of science teaching is an obvious area on which to focus efforts (Leitch & Day, 2000; McCombs, 2003). In science teaching advanced and complex skills are required to improve practice. Schon (1983) describes this complexity:

> In real-world practice, problems do not present themselves to the practitioner as givens. They must be constructed from the materials of the problematic situations which are puzzling, troubling, and uncertain. In order to convert a problematic situation to a problem, a practitioner must do a certain kind of work. He must make sense of an uncertain situation that initially makes no sense…It is this sort

> of situation that professionals are coming to increasingly see as central to their practice. (p. 40)

A considerable body of research supports reflection as a tool to assist professionals, including teachers, in doing the 'certain kind of work' of which Schon (1983) writes (Allen & Casbergue, 2000; Atkins & Murphey, 1993; Bain, Packer, & Mills, 1999; Costa & Garmston, 2002; Dewey, 1933; Fernsten & Fernsten, 2005; Gimenez, 1999; Hatton & Smith, 1995; Place, 2005; Van Mannen, 1977). Reflection, which has a long established role in the development of professionals in several fields including medicine, law, engineering, social work, and education (Morgan, Rawlinson, Weaver, 2006) has been recommended as a means to assist practitioners in becoming serious learners in and around their practice (Ball & Cohen, 1999).

Reflection Described

In the past two decades the subject of reflection has been increasingly studied and written about. However, or perhaps as a result of this heightened interest in reflection, the term is ill defined (Hatton & Smith, 1995; Kember, 1999) and has been described by many persons to mean different things (Kraft, 2002; Moon, 1999). In the literature, reflection has been seen as a form of problem solving, as an intuitive process, as a developmental process, and as playing a role in transformative and experiential learning, (Cranton, 1996). The term critical reflection has also been loosely used in the literature (Hatton & Smith, 1995).

Reflection has been described as a process which may be cyclic (Atkins & Murphey, 1993; Costa & Garmston, 2002; Johns, 2000). Dewey (1933) views reflection

as a process. He has been recognized as the "Father of Modern Education" and is frequently referenced by those whose research involves reflection. In his book, "How We Think" (1933), he painstakingly explains the specific role and place of reflective thinking in learning. It is fitting to look, in some detail, at his interpretation of reflection as a process. Dewey (1933) views reflection as a five step process that occurs between the time when a person experiences a perplexed, confused, or troubled situation and the time when they come to a cleared-up, unified, resolved situation in the end.

The first of Dewey's (1933) five steps has a learner leap to possible solutions. Dewey (1933) explains why this first step is important. After a person first experiences an aforedescribed experience, the:

> 'natural' thing for anyone is to go ahead; that is to say *act* overtly. The disturbed and perplexed situation arrests such direct activity temporarily. The tendency to continue *acting* nevertheless persists. It is diverted and takes the form of an idea or suggestion. The *idea* of what to do when we find ourselves 'in a hole' is a substitute for direct action. It is a vicarious, anticipatory way of acting, a kind of dramatic rehearsal. Were there only one suggestion popping up, we should undoubtly adopt it at once. But where there are two or more, they collide with one another, maintain the state of suspense, and produce further inquiry….Some inhibition of direct action is necessary to the condition of hesitation and delay that is essential to thinking. (p. 107-108)

Next, the person intellectualizes the problematic experience into a problem to be solved. Schon (1983) would support Dewey's second step as a key component of professional activity. Dewey (1933) explains:

> If we knew just what the difficulty was and where it lay, the job of reflection would be much easier than it is. As the saying truly goes, a question well put is half answered. In fact, we know what the problem *exactly* is simultaneously with finding a way out and getting it resolved. Problem and solution stand out *completely* at the same time. Up to that point, our grasp of the problem has been more or less vague. (p.108)

The third step of Dewey's (1933) reflective process occurs as people "get a better idea of the kind of solution that is needed. The facts or data set the problem before us, and insight into the problem corrects, modifies, expands the suggestion that originally occurred" (Dewey, 1933, p.109-110). The suggestion becomes a hypothesis which is used to guide further observation and information gathering.

The fourth step of Dewey's (1933) reflective thought process occurs as the person reasons. He explains that "Given a fertile suggestion (from step three) occurring in an experienced, well-informed mind, that mind is capable of elaborating it until there results an idea that is quite different from the one with which the mind started" (p.111). This elaboration on ideas forms a reasoned supposition. In the last step, the person tests the supposition by either overt or imaginative action. They deliberately arrange conditions in accordance with the requirements of their reasoned supposition to see whether the results theoretically indicated by the supposition actually occur. If verification does not occur a reflective mind sees this failure not as mere failure but rather, as instructive. In fact, Dewey (1933) explains:

> The person who really thinks learns quite as much from his failures as from his successes. For a failure indicates to the person whose thinking has been involved in it, and who has not come to it by mere blind chance, what further observations should be made. It suggests to him what modifications should be introduced in the hypothesis upon which he has been operating. It either brings to light a new problem or helps to define and clarify the problem on which he has been engaged. Nothing shows the trained thinker better than the use he makes of his errors and mistakes. (p. 114-115)

Dewey views these five steps of thinking as reflection. These steps are the components of a thought process requiring reflection. It is clear that Dewey associates reflection with problem solving. Others who view reflection as a process frequently

reference Dewey in their explanations of reflection.

Boud, Keogh, and Walker (1985) see reflection as a process playing a role in all three steps of their learning cycle which includes learners returning to experience, attending to feelings, and reexamining the experience while integrating new knowledge. Gibbs (1988) suggests reflection is a cyclic process which involves describing a situation, acknowledging one's feelings, evaluating and then analyzing the situation, drawing conclusions, and developing an action plan which will create new situations on which to reflect. Kolb (1984) also suggests reflection is a cyclic process, integral to experiential learning, which begins with determining what has happened (concrete experience), analyzing the experience (reflective observation), making generalizations (abstract conceptualization), and planning for future action which provides new experiences on which to reflect again.

When reflection is seen as a learning cycle or as connected to some or all stages of a learning cycle, it becomes difficult to determine how reflection differs from learning. Certainly all learning cannot require reflective thought processes. From a research perspective, when this blurred relationship between learning cycles and reflection occurs it becomes difficult to define, identify, and analyze reflection.

The literature also describes different types or levels of reflection (Bain, Packer, & Mills, 1999; Day, 2000). Hatton & Smith (1995) list four types of reflection: Technical, Descriptive, Dialogic, and Critical Reflection. Van Mannen (1977) describes three types of reflection: Practical, Process, and Critical Reflection. Jay & Johnson (2002) list three types of reflection: Descriptive, Comparative, and Critical reflection.

Mezirow (1991) identifies three types of reflection: Content, Process, and Premise reflection. Yet, Irvin (2005) states there are not different types of reflection. Rather, reflection is a mental process or more specifically a metacognitive process. Moon (1999) elaborates on Irvin's description of reflection as a mental process adding that it is the framework or roles of reflection in certain contexts that differ as opposed to the existence of different types of reflection. Agreement on the identification of different types or levels of reflection is not found in the literature.

Many sources do agree reflection is an active cognitive process (Ghere, & Montie, 2006; Hatton & Smith, 1995; Irvin, 2005; Leitch & Day, 2000; York-Barr, Sommers, Ghere, & Montie, 1996) the results of which are influenced by underlying beliefs and knowledge. Mezirow (1995) defines reflection as "the apperceptive process by which we change our minds, literally and figuratively. It is the process of turning our attention to the justification for what we know, feel, believe and act upon" (p.46). Dewey (1933) envisioned reflection as mainly an individual enterprise in which a person gives "active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it and the further conclusions to which it attends" (p. 9). Dewey saw reflection as a problem-solving process complete with hypothesis formation and testing. Boud, Keough, and Walker (1985), Dewey (1933), Habermas (1971), Moon (1999) view reflection as being involved in the knowledge generation process.

York-Barr et al. (2006) explain that reflective processes or actions contrast from the routine which derives from impulse, tradition, and authority. Gimenez (1999) and Russo & Ford (2006) agree that because most teachers, at some level think about what they are doing, reflection must be defined as a more systematic way of looking at one's work. It should be no surprise that the literature yields no single agreed upon definition of

reflection (Hatton & Smith, 1995; Place, 2005; Russo & Ford, 2006; York-Barr, et al. 2006).

Part of the confusion involved with defining and ultimately operationalizing reflection for research purposes may occur when researchers have not made explicit the nature of the learning domain or the area of knowledge generation (Habermas, 1977) in which the role of reflection is to be analyzed. Kembler (1999) explains "perhaps surprising, in spite of the cult status of reflection and the volumes written about it, is that the concept is ill defined… that the concept has now become so widely used means that is applied within different philosophical frameworks and in diverse contexts" (p.22). Moon (1999) agrees with Kembler (1999) and partly attributes the lack of an agreed upon definition to the fact that the literature on reflection emanates from so many different sources. These sources include distinct academic disciplines such as education, psychology, philosophy, and sociology as well as studies on experiential learning, transformative learning, or the training of the reflective practitioner. Additionally, problems of vocabulary hinder the study and defining of reflection. Moon (1999) explains:

> The ability to be precise in academic reasoning on cognitive activities, such as knowledge, knowing, teaching, and learning-and reflection- is itself marred by a vocabulary that is either overly extensive or not extensive enough. For example, the following words can apparently be synonymous with reflection-reasoning, thinking, reviewing, problem solving, inquiry, reflective judgment, reflective thinking, critical reflection, reflective practice (Kitchener, 1983). A term such as 'critical thinking' may be either allied with reflection or reflective thinking (Barnett, 1997; Dewey, 1933) or defined separately, as in King and Kitchener (1994). The problem may be rooted in the relatively few efforts of those engaged in these studies to move outside their disciplines to see how others have applied the terms. (p.viii)

Even with a lack of a clear definition or understanding of reflection, reflection has been promoted as a 'tool' to facilitate learning. Atkins and Murphey (1993) write of its importance in the integration of theory and practice. Using reflection to help improve practice is found in three of the four National Science Standards (National Research Council, 1996) for the Professional Development of Science Teachers. In the National Science Standards for Science Teaching (National Research Council, 1996), reflection by science teachers is recommended in the context of assessment as it relates to guiding and changing instruction. Schon (1983) supports reflection as a tool to help teachers develop their craft as they face unique and complex situations each day which are not necessarily solvable by technical rational approaches alone. Zeichner (1992) explains that reflection is considered one of the primary tools for facilitating the development of competence and ultimately expertise in novice teachers.

The literature clearly supports the inclusion of objectives, which encourage and support reflection, into professional development programs for teachers. As stated in the introduction, within the description of its program, designers of both the eMSS guidelines for Online Learning and Facilitation and the eMSS Design Principles emphasize the importance of using reflection in online discourse as a means to promote teacher growth that improves practice and positively impacts student achievement. However, the literature has also shown it may be difficult for program designers, including eMSS program designers, to define what is meant by the term reflection and to explain how they will assess its existence and effect. Before the term reflection is defined for this study, it is important to attempt to either clear up the distinction between reflection and learning or describe how the two are related and may work together to

facilitate the generation of new knowledge for learners. The latter will be the focus of the next section.

Reflection and Learning

The complicated nature of defining and operationalizing reflection for research purposes has been established in the literature and described previously. Because reflection seems closely linked to learning in the literature, describing the roles of reflection in the learning process to be studied may perhaps be as essential as reaching a consensus, through a synthesis of literature, on its definition when studying reflection. Influences from Moon's (1999) common sense definition of reflection, which directly links reflection with parts of the learning process, will be seen in this study. Moon (1999) defines reflection as "a mental process with purpose and / or outcome in which manipulation of meaning is applied to relatively complicated or unstructured ideas in learning or to problems for which there is no obvious solution" (p.161). Mezirow (1990) would add that complicated or unstructured ideas or problems are those which require learners to attend to correcting or validating their reasoning, beliefs or attitudes.

The first part of this section of the literature review begins with a description of Habermas's two domains of learning and three areas of knowledge generation and how these lend themselves to the different ways, depending on the intention of the learner, in which reflection can be viewed and studied. The second part explains the impact of learners' view of knowledge and approach to learning in their use of reflection when writing online dialogue. The last part describes the role reflection can play in the learning process typically associated with adult learning.

Habermas' Domains of Learning

Mezirow (1991) explains that Habermas's (1971) work provides a "foundation for understanding adult learning and the function and goals of adult education" (p.65). More specifically, Cranton (1996) uses Habermas's (1971) types of human interests and knowledge as a framework for "furthering our understanding of how we learn to teach" (p.16-17). Habermas's (1971) work focuses on intentional learning in the context of adult learning. Reflection is associated with intentional learning (Moon, 1999). Habermas (1971) explains that intentional learning is an approach used by adults when they choose what and how to learn as they explicate meaning from experience. The eMSS program provides a structure for this aforementioned explication of meaning by encouraging participation in a curriculum designed around partaking in online discourse. As such, an overview of Habermas's domains of intentional learning, including the role of reflection in supporting learning in both domains, should be included as a part of the theoretical framework for this study.

Habermas (1971) describes two domains of intentional learning: instrumental and communicative and three broad areas in which human interest generates knowledge: the technical, the practical, and the emancipatory. Reflection can play a role in generating knowledge in all three interest areas.

Whether the process is sustained or a mere brainstorming, when participants attempt to determine cause-effect relationships, when they attempt to control and manipulate the environment, or when they use task-oriented problem-solving approaches, they are involved in instrumental learning. Mezirow (1991) explains and Schon (1983) would concur "Instrumental learning always involves predictions about observable events, physical or social, which can prove correct or incorrect. Such (learning) action is

based upon empirical knowledge and is governed by technical rules" (p.73). Instrumental learning involves hypothesis development and testing to determine the best course of action in order to best control a cause-effect relationship. If one views Dewey's (1933) reflective process as a largely solitary experience in which a person uses a data set, insight, and reasoning to generate a supposition which is then tested, the influence of instrumental learning in his explanation of reflective thinking is evident.

We can measure changes, influenced by participating in instrumental learning in order to solve problems, by looking at changes in productivity, performance, or behavior (Mezirow, 1990). For example, a teacher is partaking in instrumental learning when they conduct a science lab with their students and find that students are unable to make the appropriate calculations after collecting lab data even though the teacher had taught students how to do the calculations in a lecture on a previous day. The teacher surmises that students are not making the connection between lecture content and lab experiences and therefore she tries a different approach to teaching lecture content she knows is associated with upcoming labs. If, after this change in teaching approach, students are able to better make the connection between lab and lecture and their performance in lab improves, this change could be measured by the generation of better lab grades or by less students needing help with their lab calculations. Habermas (1971) would say this teacher is generating knowledge in the 'technical' area of human interest.

Reflection supports instrumental learning when participants look back on content or procedural assumptions guiding their problem-solving process in order to assess the efficacy of their strategies and tactics used. Mezirow (1990) explains reflection plays a role in supporting instrumental learning when:

> We look back to check on whether we have identified all the relevant options for action, correctly assessed the consequences of alternative hunches or hypotheses, controlled the right variables, used the best methods of problem solving and used them correctly and carefully, made inferences warranted from the evidence and as free from bias as possible, generalized from a dependably representative sample, and correctly interpreted the feedback on actions taken. We may also look to make sure that our actions have been consistent with our values, to see how well we are doing in relation to our goals, whether our attitude has been objective and our interpretations of the results convincing. This is how we reflect on the process by which we have learned meaning through instrumental problem solving. (p. 7-8)

Cranton (1996) explains that while instrumental learning and the quest for technical knowledge has its place in adult education, including the education of teachers, it has become a problematic pervasive ideology:

> We look to explain human relationships, human learning,…in terms of instrumental knowledge. Many educators express technical interests in the world around them, including their practice; however, when talking about their work, they also recognize the unscientific nature of people working and learning together… Instrumental knowledge is, of course, invaluable, but does it address our interests in human learning. Is our interest in understanding our (teaching) practice a technical one? Kincheloe (1991) writes: "Positivism assumes that the personal histories of individuals and social histories of their contexts are not germane to an appreciation of the educational setting and its significance. Such contextual information is invariably ambiguous and thus complicates the reductionism, the attempt to simplify the cause and effect relationships… But the rub is that human activities like education are rarely free of ambiguity, and to miss their complexity is to miss the point (p.56)." (p. 18-19)

Communicative learning "occurs whenever an individual with particular aims communicates with another person in order to arrive at an understanding about the meaning of a common experience so that they may coordinate their actions in pursuing their respective aims" (Mezirow, 1991, p.65). eMSS online discussion areas provide a place for this interaction.

Mezirow further explains (1991) and Schon (1983) once again would support "the distinction between instrumental and communicative learning is extremely important to

point out because instrumental learning has been too commonly taken as the model of all learning….. Nonetheless, this differentiation should not be understood as an attempt to establish a dichotomy ... instrumental learning occurs within a context of communicative learning; most learning involves both instrumental and communicative aspects" (p.80). This is especially seen in the eMSS program.

Habermas (1971) associates communicative learning with generating knowledge in the practical area of human interest. Generating knowledge in the practical interest area occurs when people want to understand others and be understood by listening to, writing, or reading what others have communicated (Cranton, 1996). Participants pursue practical knowledge when they ask: "How do you see this?" and "How do you experience this?" (Cranton, 1996, p.19).The knowledge obtained through a pursuit of practical interest includes knowledge about values, ideals, traditions, and feelings (Mezirow, 1990). Cranton further explains the connection between educating educators, communicative learning, and generating practical knowledge:

> It seems clear that knowledge of education is practical knowledge. Education is a social activity. It involves communication among individuals with the aims of mutual understanding, meeting the needs of individuals and groups, and social change. If we hope to develop our roles as adult educators and to grow and develop within our practice, we are interested in improving our communication with and our understanding of learners as well as the social context in which we work. Educational goals are not so definitive to be measured by a ruler, as we measure the height of wheat in a field receiving fertilizer X. Similarly, the strategies by which we reach these goals are not clear-cut. Every practitioner continually makes judgments while in action (Schon, 1983); these judgments are often intuitive, perhaps not even conscious, and are based on a continuously changing set of criteria and circumstances. In order to understand this process, we need to observe what we do, critically question ourselves, and reflect on our actions within their context. (p.19)

As the description of communicative learning implies, participating in discourse with others, both written and spoken, is a primary modality through which

communicative learning occurs. Communication is important because as Mezirow (1991) explains “In the absence of empirical tests, we learn what is valid in the assertions of others and gain credence for the validity of our own ideas by either relying on tradition, authority, or force or relying on as broad a consensus possible of those who are most informed, rational, and objective” (p.76). The eMSS program supports the use of online discourse as a means by which participants can communicate with the aforementioned informed, rational, and objective colleagues.

Reflection can be used to support communicative learning in eMSS when, while participating in an online dialogue, participants make “either implicit or explicit claims regarding the justification or validity of what is said, implied, or presupposed” (Mezirow, 1991, p.66) or look for assistance from other participants in finding “themes and metaphors by which to fit the unfamiliar into a meaning perspective, so that an interpretation in context becomes possible” (Mezirow, 1990, p. 8-9). Mezirow (1990) defines this as reflective dialogue and explains “In communicative learning, we determine the justification of a problematic belief or understanding through rational discourse to arrive at a tentative best judgment” (Mezirow, 2000, p.86-87).

Dialogue between eMSS participants who are learning in the instrumental domain will focus on hypothesis formation and testing to determine cause-effect relationships. Learning in the communicative domain will involve the identification and validation or justification of explanatory constructs, including beliefs that are guiding the aforementioned hypothesis formation and resultant problem solving processes discussed while engaged in instrumental learning. Can both types of discourse have reflective aspects? The answer to this question can be unclear in research involving reflection and depends on how reflection is operationalized for a given study.

Habermas's (1971) third area of knowledge generation, 'emancipatory', refers to "knowledge gained through critical self-reflection, as distinct from the knowledge gained from our "technical" interest in the objective world or our "practical interest" (Mezirow, 1991, p.87) embedded in and realized through social interaction. Mezirow (1991) explains that the emancipation in Habermas's emancipatory learning is emancipation from "misconceptions, ideologies, and psychological distortions in prior learning that produce or perpetuate unexamined relations or dependence" (p.87). Clearly emancipatory learning depends on the process of critical reflection.

Terhune (2006) explains critical reflection helps a learner to uncover and deconstruct inconspicuous beliefs, perceptions, and experiences in order to understand hidden values and biases not previously in the fore of their thinking. Using the topic of race Kegan (1994) provides examples of questions that could facilitate critical self-reflection. Examples include questions similar to: Is what I know about others based on stereotypes and myths? Am I afraid to be myself around someone who is not like me? Why should educators ask and answer such questions? An eMSS participant showed evidence of engaging in critically reflective thought processes when she wrote in an online discussion area:

> I used to think that if I just treated everyone equally, it would be enough. But I [have learned] that I need to "proactively" incorporate all the many cultures at my school into my classroom, through building relationships as well as through my design of curriculum and choice of learning activities. When I recognize my students for their diversity, instead of trying to erase its presence, then I am able to make progress. When my minority students see that I understand some of their obstacles and will help them take on the challenges of science, they respond with energy and engagement.

The relationship between reflection and learning in the instrumental and communicative domains while generating knowledge in the technical, practical, or emancipatory interest areas is complex. Habermas (1971) would caution those studying reflection to be mindful of the different roles reflection plays in instrumental as opposed to communicative learning as well as when a participant is generating knowledge in either the technical, practical, or emancipatory areas. Leitch & Day (2000) would concur with Habermas (1971), "Teachers may reflect in different ways at different times… It is important to recognize the …effects of the organizational and cultural contexts in which (teachers) work if opportunities for their professional growth is to be maximized" (p. 183).

Reflection and Learner Characteristics

The tendency of a person to participate in and exude reflective behaviors, including writing and participating in reflective discourse, can be linked to many variables including their view of the nature of knowledge and their approach to learning.

View of Knowledge.

The manner in which one views the nature of knowledge can influence a learner's ability to be reflective or to exude reflective behaviors. In the context of this study 'being reflective' means to be writing and participating in reflective online discourse. Whitmire (2004) describes three levels of knowing: absolute knowing, transitional and independent knowing, and contextual knowing. These levels of knowing can be aligned with different types of non reflective or reflective discourse in which an eMSS participant would engage.

If a learner views knowledge as certain and absolute, they believe there are right and wrong answers and only authorities know the right answers. These learners will

likely not participate in discourse that extends upon being able to describe one's own concrete classroom experience or provide additional details about one's own experience. Whitmire (2004) describes this as pre-reflective discourse.

Learners who view knowledge as transitional or independent believe that knowledge is partially certain and partially uncertain or view all knowledge as uncertain because everyone has their own beliefs. These learners will begin to question previously held assumptions and realize that authorities can be wrong or biased. These learners realize there can be more than one correct answer to a problem. They evaluate or refute without supplying developed justifications. Whitmire (2004) describes this learner as participating in quasi-reflective discourse.

Whitmire (2004) explains that it is only when learners see knowledge as contextual and believe it should be judged on the basis of evidence in context, is a learner able to participate in reflective thinking and reflective discourse. These learners will participate in discourse designed to provide or ask for justifications, both implicit and explicit, concerning why others believe or act the way they do. This type of discourse can be evaluatory while providing or responding to justifications. It will assess adequacy in problem solving processes with the aim of improvement.

For these types of learners, Peltier, Hay, and Drago, (2005) add critical reflection as another level of reflective thinking and discourse in which learners may participate. Learners, who are seeking a better understanding of the underlying, perhaps unconscious, assumptions which guide their belief system in order to understand, at a very fundamental level, why they think, perceive and act the way they do will be engaged in critical reflection.

Approach to Learning. The nature of a learner's intent or approach in the learning process can play a role in their ability and / or willingness to participate in reflective discourse (Moon, 1999; Peltier, Hay, & Drago, 2005). Moon (1999) summarizes Entwistle's (1996) three approaches to intentional learning which include a deep approach, surface approach, and strategic approach. A participant's approach to learning has implications for the retention and representation of learning and therefore is an important factor to consider when discussing professional development.

A learner with a deep approach to learning makes judgments using thoughtful reasoning. This may occur as a learner uses problem solving skills such as deduction that require an understanding of the elements involved in an issue or as they look for patterns and underlying principles associated with the issue. It may occur when they use a summary of facts, as they relate to ideas, as supporting evidence for justifying a belief about an issue or manipulate meaningful knowledge towards an end, such as clarification of thoughts on some issue (Moon, 1999). A deep approach to learning can be seen when a learner has been actively interested in course content by seeking alternatives, challenging assumptions, and identifying areas for improvement (Peltier, Hay, & Drago, 2005). When "learners become aware of why they think, perceive, or act as they do" (Peltier, Hay, & Drago, 2005, p.253) they are likely engaging in a deep approach to learning. When learners examine how they performed the functions of perceiving, thinking, feeling, or acting or assess their efficacy in performing these things they are involved in a deep approach to learning (Kember et al., 1999).

Surface learners find difficulty in making sense of new ideas, feel undue pressure,

and worry about the work involved. A learner with a surface approach to learning attempts to cope with course or program requirements by studying without reflecting either on purpose or strategy, treating the course as unrelated bits of knowledge, and memorizing facts and procedures. When eMSS participants do not connect their thoughts about an issue to deeper or broader meanings possibly because they are treating their experiences while in the eMSS program as pieces of unrelated knowledge, they are involved in a surface approach to learning (Moon, 1999). eMSS participants, who see writing discourse as a task or as a demand to be met or as an imposition to reaching a goal such as completing an assignment (Peltier, Hay, & Drago, 2005), will likely be engaged in a surface approach to learning. When participants merely describe an issue / event as they have remembered it (Moon, 1999) or when they have used minimal thought or engagement (Peltier, Hay, Drago, 2005) in the preparation of their online discourse, they are using a surface approach to learning. When they write how they think or feel about an issue without any attempt to justify their thoughts or feelings or re-examine the validity of knowledge they had prior to the issue(s) they have written about they are engaged in a surface approach to learning (Kember et al., 1999).

A learner with a strategic approach to learning attempts to achieve the highest grade possible by putting consistent effort into studying, finding the right conditions and material for studying, managing time and effort effectively, being alert to assessment requirements and criteria, and gearing work to the perceived preferences of course or program teachers.

While different learners are probably more inclined to a certain learning approach, a learner is not bound to a singular approach; even within a singular discussion thread

Course or program content and requirements may play a role in a learners approach. For example, when faced with uninteresting, not applicable, and / or overwhelming course content a learner may take a surface approach to learning. The same learner however, is more likely to take a deep approach to learning when course content is interesting, applicable, and / or covers a topic in which they feel they can or want to contribute to in a discussion area.

Many definitions of reflection including Moon's (1999) definition as "a mental process with purpose and / or outcome in which manipulation of meaning is applied to relatively complicated or unstructured ideas in learning or to problems for which there is no obvious solution" (p.161) implies that reflection and learning at higher levels are associated. Peltier, Hay, and Drago (2005) use the terms higher level learning and reflection synonymously. Learners will probably not experience or participate in reflective thought processes including reflective discourse when engaged in a surface approach to learning. Learners with a strategic approach to learning can be compelled to use reflection in their learning process. Through facilitating high quality discourse which encourages reflection, eMSS facilitators and mentors can assist participants, who are surface or strategic learners, in engaging in reflective dialogue and help move these learners down a path towards participation in a deep approach to learning. When learners have a deep approach to learning, the likelihood that they will engage in reflection during the preparation of their online discourse, is enhanced.

Designers of professional development programs for science teachers which have 'reflection by participants' as a goal of their program should consider, in their design and

implementation process, ways to encourage a deep approach to learning. This cannot be an easy task for eMSS program designers. eMSS has hundreds of participants with various intentions and motivations for participating in the program. However, by providing participants with a variety of discussion inquires to choose from, by providing different discussion area formats in which to engage in discourse, by providing contact with trained mentors, as well as committing to being responsive to the unique pressures and situations in which induction level teachers find themselves, eMSS has taken some steps in the right direction to promote an environment supportive of a deep approach to learning. There remains, however, the potential to create an even better learning environment in the online discussion areas by further modifying what takes place in the discussion areas. When these modifications include changes which are conducive to a deep approach to learning, participants will be more likely to engage in reflective thought processes as they prepare their online discourse.

Reflection in the Process of Learning in eMSS

Dewey's and Moon's Influence.

Most, if not all, learning requires some form of thinking. The word 'think' has over 17 meanings (think, n.d.). It is germane to this study to distinguish the differences between reflective thinking and the many different other ways thinking is defined. To determine if a given thought process, as represented by online discourse, required reflective thinking in its preparation is a goal as well as a challenge for this study.

Dewey (1933) attempts to explain the differences between thinking and reflective thinking. He explains that in our waking hours our minds are occupied with a "stream of

consciousness" (p.3) in which our thinking is automatic and unregulated with thoughts that include but are not limited to random recollections, pleasant but unfounded hopes, half-developed and flitting mental impressions and pictures, and inconsequential mental images. Many times our thoughts or ideas are a succession of mental pictures of things that not actually present or sensed (Dewey, 1933). He explains that while this type of thinking may be at times entertaining, it rarely leaves much worthwhile behind.

Reflective thinking by contrast involves not simply a sequence of ideas, but "a consecutive ordering (of thoughts) in such a way that each thought determines the next as its proper outcome in turn leans back on, or refers to, its predecessors. The successive portions of a reflective thought grow out of one another and support one another…There are in any reflective thought definite units that are linked together so that there is a sustained movement to a common end" (p.4-5). Dewey further compares thinking and reflective thinking:

> Reflective thinking has a purpose beyond the entertainment afforded by the (succession) of agreeable mental inventions and pictures. The (succession) must lead somewhere; it must tend to a conclusion that can be substantiated outside the course of images. A story of a giant may satisfy merely because of the story itself; a reflective conclusion that a giant lived at a certain date and place on the earth would have to have some justification outside of the chain of ideas in order to be a valid or sound conclusion… There is a goal to be reached, and this end sets a task that controls the sequence of ideas. (p. 5-6)

Moon (1999) agrees with Dewey that reflective thought should have a purpose, goal, or outcome as a guiding principle. The eMSS is designed to provide participants with goals to attend to as they participate in the program by requiring participants to produce and participate in online discourse. During participants' time of production and participation in online discourse it is expected or at least hoped, that participants will

engage in reflective thought processes. This is associated with what is seen as both a challenge and goal for the eMSS discussion areas: “to promote reflection, conceptual growth and change, and improvements in professional practice through rich online dialogue” (eMSS Guidelines for Online Learning and Facilitation).

Additionally the eMSS program “believes that online learning environments, when carefully designed and moderated by trained facilitators, can be singularly effective places for meaningful dialogue leading to teacher growth, accompanied by changes in classroom practice and student learning gains” (eMSS Guidelines for Online Learning and Facilitation). If the aforementioned rich and meaningful online dialogue is associated with a deep approach to learning then it is likely associated with reflective thought processes (Moon, 1999). Both Dewey (1933) and Moon (1999) would support participation in online discussion areas as a means to encourage the development of participants’ reflective thought processes which in turn may be represented in the form of high quality online discourse. Dewey because the discussion areas provide a place where thought units can be linked together and a sustained movement to understanding can occur. Moon because the discussion areas provide a place for the manipulation of meaning, the “representation of learning” (p.153), and the upgrading of learning.

In his book, Dewey (1933) continues to compare thought and reflective thought by explaining how the terms belief and thought have been used synonymously and by clarifying how this has implications for defining reflective thinking. A belief can be defined as a mental acceptance of something as being true or real (Woolf, 1974). However, Dewey (1933) explains:

> There is nothing in the mere fact of thought as identical with belief that reveals whether the belief is well founded or not. Two different men say, "I believe the world is spherical." One man, if challenged, could produce little or no evidence for thinking as he does. It is an idea that he has picked up from others and that he accepts because the idea is generally current, not because he has examined into the matter and not because his own mind has taken any active part in reaching and framing the belief. Such 'thoughts' grew up unconsciously. They are picked up-we know not how…Tradition, instruction, imitation-all of which depend upon authority in some form, or appeal to our own advantage, or fall in with a strong passion-are responsible for them. Such thoughts are prejudices; that is, prejudgments, not conclusions reached as a result of personal mental activity…Even when they happen to be correct, their correctness is a matter of accident as far as the person who entertains them is concerned. (p.6-7)

Beliefs require some type of an intellectual commitment. This commitment can be based on laziness, custom, or absence of courage and energy in investigation (Dewey, 1933). However, at times, due to certain circumstances, beliefs can eventually require our examination in order to find out upon what grounds they rest. When these exploratory thoughts spring forward from an orderly chain of ideas with a purpose in mind and when there is personal examination, scrutiny and inquiry about the belief, the thought and consequently the learning process requires reflection. Dewey defines reflection as the "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 conclusions to which it tends" (Dewey, 1933, p.9).

Moon's (1999) definition of reflection associates reflection with certain learning processes which may be seen in the eMSS discussion areas. Moon's (1999) definition of reflection as "a mental process with purpose and / or outcome in which manipulation of meaning is applied to relatively complicated or unstructured ideas in learning or to problems for which there is no obvious solution" (p.161) implies that reflection is associated with learning, especially at higher levels, where it is intimately linked to the

learning process. Moon (1999) proposes that reflection has three roles in learning: reflection involved in initial learning, the representation of learning, and the upgrading of learning.

Learning how to improve one's teaching with the overarching goal of improving student achievement is or should be the main reason why participants enroll in the eMSS program. eMSS participants partake in the learning process as they create their representations of learning, which may describe what they have learned about teaching or a description of science content they have learned for example, in the form of online discourse. Not all learning requires one to engage in reflective thought processes. Determining when the process of learning includes or is a result of reflective thought processes is complicated and provides challenges for this study.

In part because reflection is an ill-defined concept and also because reflection proceeds in a manner likely indicative of the framework guiding the process (Moon, 1999), a synthesis of the literature supports and this author agrees that it is important to understand the framework directing how reflection is being used, guided and applied within the program to be studied. In order to better analyze online discourse for evidence of reflection it is important to understand how the basic assumptions, values, and practices at the core of the eMSS program support the process of reflection as participants prepare online discourse. These include a constructivist learning approach to learning and Moon's (1999) map of learning in the context of surface and deep approaches to learning.

Constructivist Approach to Learning. Influences from both a cognitive and social constructivist approaches to learning are seen in the eMSS program. Cognitive constructivism asserts that knowledge systems of the cognitive structure are actively constructed by learners through the process of assimilation and accommodation of new information, gleaned from experience. Atherton (2005) explains that assimilation and accommodation are two processes through which awareness of the outside world is internalized. He would posit that eMSS participants assimilate their experiences when complex but familiar material of learning fits into pre-existing categories or knowledge systems within their cognitive structure. Accommodation occurs when eMSS participants are forced to change preexisting knowledge systems in their cognitive structure in order to fit the material of learning into it.

Atherton (2005) infers that children find accommodation of new knowledge no more problematic than assimilation. However, he explains that while adult learners have little trouble assimilating new knowledge and ideas that fit into pre-existing knowledge systems, accommodating new knowledge becomes increasingly difficult because a cognitive problem of aging can be a "hardening of the categories" (Atherton, 2005, p. 2). Or, it could be that adults have far more elaborate knowledge systems into which new knowledge must be accommodated. Regardless, reflection is usually seen as more important in and more closely associated with the type of learning in which adult professionals engage compared to the learning in which children partake.

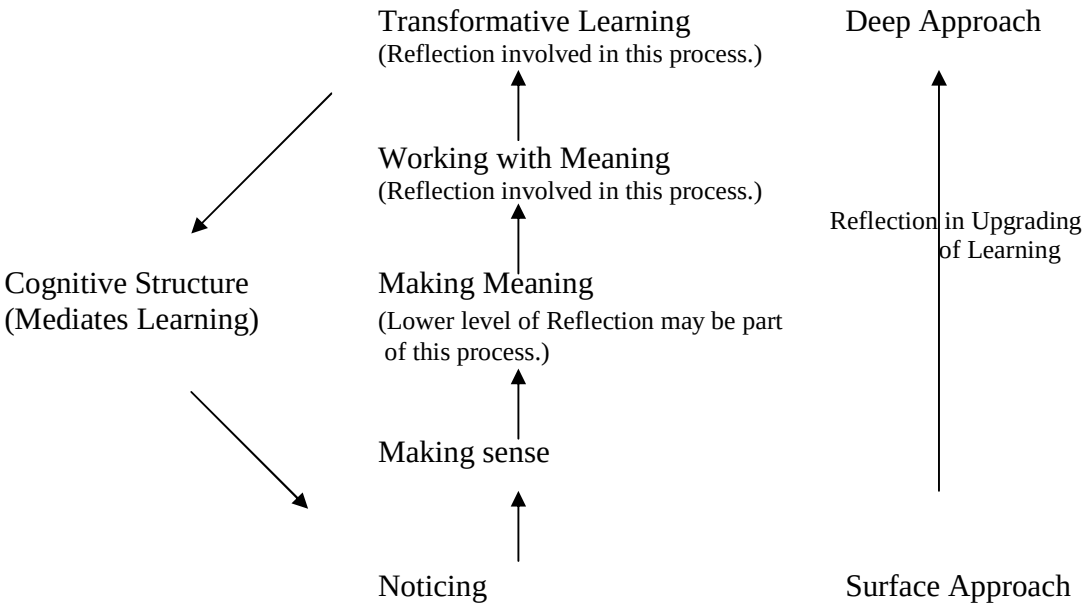
Social constructivism receives more emphasis than cognitive constructivism in the framework guiding the eMSS learning process. Although both approaches to learning would support facilitation as a means to encourage learning, social constructivism differs

from cognitive constructivism in that the former emphasizes the social aspect of knowledge building and supports an integration of students into a knowledge building community thereby allowing the processes of assimilation and accommodation to be collaborative. The latter views assimilation and accommodation primarily as individual enterprises. Costa & Garmston's (2002) explanation of social constructivism alludes to influences from Moon's (1999) meaning-making and Cranton's (1996) earlier explanation of communicative learning. It also includes a function for reflection in social constructivist learning and aligns well with the manner in which the eMSS program views a social constructivist approach to learning.

> Constructivist learning is a reciprocal process of the individual's influence on the group and the group's influence on the individual. Meaning making is not only an individual operation. The individual also constructs meaning interactively with others to construct shared knowledge…An empowering way to change conceptions is to present one's own ideas to others as well as to hear and reflect on the ideas of others. Discourse with others, particularly with peers, activates the meaning-making process. The constructivist environment encourages questioning of each other and rich dialogue within and among groups and teams of learners as they resolve differences in perceptions and styles and synthesized alternative viewpoints. (p.393)

Moon' Map of Learning. Moon's (1999) map of learning provides a framework in which to better understand and study the role of reflection as it relates to surface and deep approaches to learning. An explanation of Moon's map of learning, found in Figure 1, is followed by a description of the roles of reflection in learning in the eMSS program.

Figure 1. Map of learning (adapted from Moon, 1999).



Cognitive Structure. White (1979) defines the cognitive structure as the knowledge someone possesses and the manner in which it is arranged" (p.3). The cognitive structure, in the view of constructivism, is constructed by the learner. It is located on the left hand side of Moon's (1999) map of learning. eMSS sees the cognitive structure as taking in new knowledge primarily gleaned from experiences in the participants' classroom and from their participation in online dialogue. Assimilation and accommodation of new learning occurs in the cognitive structure as the learner moves through the stages of learning. The cyclic nature of the cognitive structure and its connection to the stages of learning implies that movement through the stages of learning both relies on and contributes to the development of the cognitive structure partly because it plays a regulatory role in guiding new learning. What we already know and

how it has been previously accommodated within the cognitive structure can act as a gatekeeper to learning or a means of selection for what or how to learn in the future (Moon. 1999).

Stages of Learning. In the center column of the map of learning, Moon (1999) lists the hierarchal stages of learning with the highest stage of learning at the top. The stages of learning include, noticing, making sense, making meaning, working with meaning, and transformative learning. As a participant moves up through the stages of learning, their approach to learning moves along a continuum from that of a surface to a deep approach to learning. The stage of learning a participant attains can depend on several factors including participation in, or lack thereof, reflective thinking (Moon, 1999).

Moon believes that the first two stages of learning, 'noticing' and 'making sense', occur when the learner is in direct contact with the material of learning and does not involve the use of reflective thought process. Learners' "best possible representations" (BPR) (Moon, 1999, p.137) of learning representing these stages of learning can be created and submitted later. In the eMSS program the BPR's of learning, at any stage, will be in the form of online discourse submitted to discussion areas by participants.

Although reflection likely does not play a role in the 'making sense' stage of learning, this stage of learning is important to the reflective process because this is where an initial understanding of the material of learning must occur. If this initial understanding, or perhaps misunderstanding, occurs in such a way that the new information is not assimilated into the cognitive structure then ongoing accommodation

of the cognitive structure and reflection on this new knowledge in the higher stages of learning cannot occur. When an eMSS participant represents their learning at the 'noticing' or 'making sense' stage of learning, the BPR of learning will not show evidence of reflection in its preparation. (If a BPR shows evidence of reflection then the learner is participating in a higher stage of learning.) This type of discourse was likely coded as thoughtful discourse in this study.

Unlike the first two stages of learning, the stage of 'making meaning' does not require direct contact with the material of learning. For eMSS participants learning at the 'making meaning' level occurs after participants 'notice' and 'make sense' of some online discourse they have read or of different experiences in their classroom. Moon (1999) calls these instances the "material of learning" (p.143).
Whether or not reflection is involved in 'making
meaning' is an area of uncertainty in Moon's (1999) model. She makes the point that because 'making meaning' involves a relatively minor accommodation of the cognitive structure and does not involve a reconsideration of the material of learning prior to accommodation, reflection plays little if any role in initial learning in the 'making meaning' stage, in the preparation of BPRs to represent this stage of learning, or in the process of upgrading learning from 'making sense' to 'making meaning' stage of learning This type of discourse was likely coded as quasi-reflective discourse in this study.

However, the process of preparing and submitting BPRs representative of the 'noticing', 'making sense' and 'making meaning' stages of learning is not necessarily undesirable or useless. In fact it is necessary. One could argue that by posting initial discourse, representative of these three stages of learning, the groundwork, for moving participants into a deeper approach to learning if proper conditions exist, is set. These

conditions include but are not limited to discussion area curriculum and appropriate facilitation in the discussion areas; a focus point, in the past (Taylor, 2007) for improvement in the eMSS program.

It is at this specific point within a discussion area, when participants are teetering on the brink of moving from the 'making meaning' stage of learning to the 'working with meaning' and 'transformative learning' stages of learning that the eMSS program can define as a potential target area for making an impact on participants' use of reflective thought processes as they prepare discourse to submit to discussion areas.

'Working with meaning' and 'transformative learning' are generally seen as stages of learning that occur later, when the participant is not in direct contact with the material of learning. Working with meaning "occurs when the learner reflects on, or reasons with new learning in the context of the cognitive structure and not necessarily in the physical presence of the new learning. This is a stage of greater accommodation of the cognitive structure. This stage could be a process of 'cognitive housekeeping', thinking things over until they make better meaning, or exploring or organizing and understanding towards a particular purpose" (Moon, 1999, p.139). By requiring participants to represent their own learning through the creation of online discourse while reading and responding to other participants online discourse, eMSS provides an environment where the aforementioned 'cognitive housekeeping' can occur.

Transformative learning is a stage of learning that is usually studied in the context of adult learning. Transformative learning is abstract, idealized, and grounded in the nature of human communication (Imel, 1998). Transformative learning is more likely to occur when learners want to understand the meaning of their experience by not blindly

relying on purposes, beliefs, judgments, and feelings of an authority figure but rather on their own interpretations based on analyzing and questioning their own beliefs and assumptions. Facilitating such understanding is the cardinal goal of adult education (Mezirow 1990).

However, Cranton (1996) explains that only when teachers move away from thinking about teaching in a technical and / or humanistic perspective to a perspective focused on social action will teachers be able to experience transformative learning. Professional development programs designed from a technical and humanistic perspective provide educators with opportunities to acquire skills and techniques for the efficient transmission of content to students (technical) and to develop ways to better at interact with learners, encourage participation, set up warm and inviting atmospheres for learning, and meet the needs of learners (humanistic). Designers of a professional development program grounded in a perspective based on social action would implement activities designed to encourage teachers to become aware of and question their assumptions and values as well as the systems around them. These thought processes are associated with critical reflection.

The eMSS program provides an environment that, theoretically, should be conducive to all three learning perspectives. However, because the content of the discourse in the discussion areas is partially mentee driven and because mentees are relatively new teachers likely teaching in traditional classroom situations, it should be of no surprise that their discourse will focus on issues encompassing the technical and humanistic perspectives of teaching. They need and want to know what to do, right now, in order to get through and /or better handle a particular situation in their classroom. It

should be of little surprise that while the eMSS program purports to encourage discourse in which there is evidence of participants engaging in critically reflective thought process, few instances of discourse showing this have been identified (Ford, 2004).

Table 3 explains relevant issues for each of Moon's stages of learning, describes when it occurs, aligns the stage with the learners approach to learning, explains the role of reflection in that stage, describes the best possible representation of learning for that stage, and aligns eMSS discourse activity for that stage.

Table 3. Alignment of Moon's map of learning with the eMSS program.

Noticing:	Acquisition of sensory data from the material of learning.
Determined by:	What the learner already knows-the content of their cognitive structure.
	The perceived and given purposes of learning.
	Emotions associated with the material to be learned
	What reaches their attention.
Facilitation:	None required.
Issues in learning:	"I will just hold this in my mind for the test tomorrow"
	"I'm anxious: I can't take in all these notes so close to an exam."
	"I've seen this before. I got really bored with it and I'm not going to bother with it."
When it Occurs:	While in contact with the original material to be learned
Approach to Learning:	Surface Approach
Role of Reflection:	None
BPR:	A memorized representation that is different from the original only because of inaccuracies and loss of recall.

Table 3 - Continued

eMSS:	This level of learning will very rarely if ever be represented in the discourse primarily because the aims of the eMSS program call for learning at a higher level.
Making Sense:	Process of becoming aware of coherency in the material of learning, organizing and ordering the material of learning and allotting ideas together. No requirement for substantial previous knowledge. Requires of view of material of learning in relation to self not to previous knowledge.
Facilitation:	None required
Issues in Learning:	"Does this stuff make sense?"
	"I just need to cram into my head as many facts as possible to do this test."
	"I think I have enough facts to work out the solution to this problem."
When it Occurs:	While in contact with the original material to be learned
Approach to Learning:	Surface Approach
Role of Reflection:	None
BPR:	A reproduction of ideas but the ideas are not well linked.
eMSS:	This level of learning can be represented in discourse when participants describe what has occurred in their classroom. Usually identified as thoughtful discourse.
Making Meaning:	The new material of learning is assimilated into the cognitive structure and, simultaneously, the cognitive structure accommodates it to make sense of the new learning and what is known.
Facilitation:	Not required but could help in the process
Issues in Learning:	"How does this idea match those that we considered in last year's course?"
	"So, for these reasons, I can see why I must do in this way."

Table 3 - Continued

	"This ties in with what I have been thinking." "I understand the reasoning behind this sequence now." "I am trying to get my head around this."
When it occurs:	Usually after contact with original material of learning.
Approach to Learning:	Surface to Deep Approach
Role of Reflection:	May or may not require reflection.
BPR:	Ideas linked together and evidence of a holistic view of subject matter. Material to be learned is well integrated and ideas are well linked.
eMSS:	This level of learning can be represented in discourse when participants restate what has already been said or write that they agree or disagree with an idea without explaining or justifying why or why not. Usually identified as quasi-reflective discourse.
Working with Meaning:	Does not need contact with original material. The original learning is now part of the cognitive structure itself, with the potential to guide more learning. Ongoing accommodation of the cognitive structure and, where representation of learning is required, the manipulation of meaningful knowledge towards a specified end, such as clarification of thoughts on some issue. Developing further understanding that cannot occur unless there is some understanding in the first place.
Facilitation:	Helpful
Issues in Learning:	"Putting these ideas together, I think I can work out how to present this argument." "I will need to analyse what this is really saying in order to criticize it fairly." "Let me sort out my thoughts on this matter and then I will give you an answer." "Taking everything into account suggests that I do this as my next move."

Table 3 - Continued

	"I am working out how to present my ideas so that they can understand."
Approach to Learning:	Deep Approach
Role of Reflection:	Content or Content/Process Reflection
BPR:	Because transformative learning is seen as an extension of this level of learning, Moon states it may not be helpful to suggest there is a limitation to the quality of this BPR
eMSS:	This level of learning can be represented in discourse when participants' discourse shows evidence of reflecting on the content or the content and process associated with an issue. Participants justify why they did something or think a certain way. These justifications show an intention on the part of the participant to engage in a deep approach to learning. Usually identified as discourse showing content or process reflection.
Transformative Learning:	
Facilitation:	Helpful-usually required
Approach to Learning:	Deep Approach
Role of Reflection:	Premise Reflection
BPR:	No limit on this quality.
eMSS:	This level of learning can be represented in discourse when participants' discourse shows evidence of reflecting on the underlying assumptions which guide their thought and action processes. Usually identified as discourse showing premise reflection.

Reflection in the Representing of Learning and in the Upgrading of Learning.

Moon (1999) suggests reflection has three roles in learning: reflection involved in initial learning, in the representation of learning, and in the upgrading of learning. The latter two are most germane to this study. In order to identify and study reflection, researchers

frequently look for evidence of reflection in the work required from participants in their study. This is to say they look for evidence of reflection in participants' representations of learning. Depending on the study, representations of learning may take the form of participants' journals, questionnaire answers, essays, or interview responses. For this study, the eMSS online discourse including the responses to the end of inquiry Self-Reflection prompts are the representations of learning.

When participating in any given stage of learning, a learner will only be able to represent their learning in a certain way or to a certain level called the best possible representation. For example, one cannot expect a learner, who has merely memorized the contributions of several scientists to the field of psychology and is therefore functioning at the making sense stage of learning, to write a paper explaining how the contributions of each scientist are interconnected and how this provides a sound knowledge base from which the field of psychology sprung forth. The BPR of learning one could expect to see from a person working at the 'making sense' stage of learning is a reproduction of ideas or facts with weak or no connections between ideas.

As eMSS participants prepare their BPR of learning in the form of online discourse, they have an opportunity to think about the ways in which bits of knowledge, perhaps previously expressed in the online discourse, relate together as well as to previous learning. If this thinking is applied to relatively complicated or unstructured ideas in learning or to problems for which there is no obvious solution as seen by the participant and /or is involved in moving participants from a surface to a deeper approach to learning, which is seen as an upgrading of learning, reflection is likely involved. In eMSS, reflection used in the process of representing learning can also be

used in the process of upgrading learning.

Moon (1999) explains that the upgrading of learning to the ‘working with meaning’ and ‘transformative learning’ stages involves a secondary and more fundamental accommodation of the cognitive structure, compared to the accommodation used for the ‘making meaning’ stage, and usually occurs without being in contact with the original material of learning (Moon, 1999). The upgrading of learning from ‘making meaning, to ‘working with meaning’ and to ‘transformative learning’ has previously been identified as an area where eMSS can play a role in developing the reflective tendencies of their participants. This upgrading is unlikely to be automatic. Learning at these stages and the resultant upgrading of learning requires “the intention of the learner to develop a deeper understanding of what has been a lower level of learning” (Moon, 1999, p.149). This supports the inclusion of Habermas’s (1971) research on intentional learning, discussed earlier, as part of the theoretical framework for this study.

In the eMSS program, the task in which learning is represented (online discourse) is a “deliberately designed tool to facilitate reflection” (Moon, 1999, p.154). In writing online discourse “Reflection is both the process and the purpose of the work” (Moon, 1999, p.155) and because reflection is associated with both an intentional and deep approach to learning, eMSS facilitators and mentors are charged with promoting discourse that sets the stage and then encourages participants to reflect as they prepare their BPRs of learning.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

This chapter describes the design of the study and provides information foundational to understanding the design and purpose of the study including a description of the eMSS program. The purpose of this chapter is to inform the reader of the context of the study and the research procedures including sampling, rubric development, data collection, and data analysis methods.

Background about the eMSS program, which is the intervention in this study, is explained in the context section. The structure of the program and a description of its participants is given. This is followed by an explanation of the different discussion areas from which discourse was analyzed for this study.

Next, the research procedures for this mixed-methods study design using both qualitative and quantitative techniques are explained. An in depth breakdown of the process used to design the discourse analysis rubric is presented partly to provide evidence to support the claim that the rubric is research based, but also because it is the primary tool used to collect and analyze data in this study. The rubric, in and of itself, can be considered one of the primary products of this research.

Context of Study

eMSS Program and Participant DescriptionProgram

The eMSS program began in 2002 after the National Science Foundation awarded a five-year grant to Montana State University Science / Math Resource Center in Bozeman, the National Science Teachers Association, and the New Teacher Center at the University of Santa Cruz, for program development. It was created in response to the need to retain and to provide ongoing learning opportunities for mathematics and science teachers. It is one of just a handful of mentoring and induction programs that is delivered on the web and focuses on improving novice teachers' content and pedagogical content knowledge. The Maine Study Group Network (2003) is an example of another program which provides online support, networking, and sharing opportunities for science and mathematics teachers while focusing on mathematics and science content. The eMSS program focuses on content and pedagogical content knowledge in addition to improving participants' "survival skills and general pedagogical knowledge, the traditional focus of characteristic mentoring programs" (Taylor, 2007, p. 2). Taylor (2007) further explains the designers of eMSS:

> recognized the need for providing early career support closely connected to the science and mathematics subjects and grade levels taught by beginning teachers. Realizing that access to trained mentors of the same discipline and grade level is not available to beginning teachers in many states, the partnership designed the distance mentoring program using a web-based model. (p.2)

eMSS is a web based professional development program designed to provide opportunities and support, primarily in the form of online mentoring, to beginning

science and mathematics teachers (mentees). Both platforms support a structured, computer-mediated asynchronous conferencing program "made up of many interactive components, including guided threaded discussions, private discussion areas for mentor-mentee pairs or small groups, modules for professional development, and content-specific discussion and information areas" (Taylor, 2007, p. 2).

Much of the learning in eMSS takes place in the structured online discussion areas: Inquiries, Special Topics areas which include Dilemmas and Topics of the Month, and Content areas. In these discussion areas participants, including mentors, mentees, content specialists, and discussion facilitators "meet'" to engage in a dialogue intentionally designed to "further beginning teachers' *progress along a professional continuum* from survival to focused problem solving to critical reflection on teaching practice" (eMSS Guidelines for Online Learning and Facilitation). Table 4 explains various features of the different online eMSS discussion areas.

Table 4. eMSS discussion area features.

Discussion Area	Structured/ Unstructured	Facilitated/ Nonfacilitated	Private/ Public	Duration & Requirement	Description
Inquiries	Structured	Facilitated	Public	Inquiries are offered three times a school year. Each inquiry lasts 6-8 weeks. Mentees are required to participate in two inquiries.	**Purpose: To deepen participants' teaching practice and boost their effectiveness with students.** Inquiries provide participants with readings, other resources, short assignments, and conversation guides designed to help mentees, with the guidance of a mentor participants to deepen their teaching practice. Mentees choose from a selection of inquiries that are best matched to their teaching situation.
End of Inquiry Self-Reflection / Self-Assessment	Structured	Facilitated	Private	Required assignment due at the end of any inquiry in which a mentee participates.	**Purpose: Participants are asked specifically to reflect on the inquiry in which they just participated.** These self-reflections (called self-assessments starting in 2009) have mentees answering 4 specific questions about the inquiry**.** It is hoped that in answering these questions mentees will be reflecting on their practice.
Dilemmas	Structured	Facilitated	Public	Three weeks Participation is optional.	**Purpose: Offers quick and interesting opportunities for participants to exchange, compare, and contrast perceptions.** Short, open-ended scenario that poses a question about a specific teaching issue. Mentors and mentees participate in online discussions that included offering possible solutions to a dilemma.

Table 4 - Continued

Content Area	Structured	Facilitated	Public	Entire program year. Participation is optional.	**Purpose: Provides participants with science resources to use in the classroom, and professional development opportunities.** Contains discussion areas facilitated to engage participants in science education including science content. Participants can post questions, comments, or concerns as they interact with established research scientists.
Topic of the Month	Structured	Facilitated	Public	Entire program year. Participation is optional.	**Purpose: Provides an opportunity for participants to offer advice and make suggestions concerning a wide variety of topics.** A wide variety topics germane to middle and high school science are discussed. Participants can discuss issues focused on pedagogy, classroom management, science standards, or communication with parents.

Program Participants

eMSS participants include mentors, mentees, discussion groups facilitators, and university content experts. Mentors are experienced teachers who are assigned to an individual mentee or a small group of two to four mentees. Mentors, discussion group facilitators, and university content experts respond to mentees' questions, concerns, and requests for help and guide mentees through the eMSS learning environment found formerly on a WebCT platform and currently on a Sakai platform. This study analyzed messages from as far back as the Fall semester of 2007 to as recent as the Spring of 2009 semester. During this time span there was between 144-169 mentors and 299-353 mentees participating in the program. Participants were from nine different states that are officially associated with the eMSS program. However because the eMSS program is part of the national Science Teacher's Academy, the program has been able to attract participants from the remaining 41 states and Department of Defense schools.

eMSS Program Discussion Areas

The eMSS program has participants creating and participating in online dialogue with other participants in the five different discussion areas described in Table 4. Figure 2 provides an example of the opening page to an Inquiry discussion area. Each boldfaced title represents a subdivision of that Inquiry discussion area. When a participant opens the subdivision titled Practice, they see the screen found in Figure 3. Figure 3 shows three different threaded discussion areas, called topics, into which a participant can choose to enter and participate. Each topic could then contain one to 40 or more different messages from individual participants. Upon entering into the Practice topic area or any other topic

area, participants will begin to read, write, and submit online discourse in accordance with the parameters set forth by the curriculum writers and facilitator for that discussion area. The Content, Dilemma, and Topic of the Month discussion areas do not contain subdivisions on their opening page. In this study the Dilemma and Topic of the Month discussion areas are grouped together and are referred to as the Special Topics discussion area. The opening page to these discussion areas and the Content discussion area do not contain subdivisions rather it just simply displays the available topics in that discussion area. The messages found in the Self-Reflection discussion area are not necessarily threaded discussions but rather answers to a four question assignment completed at the end of an Inquiry.

Figure 2. Inquiry discussion area opening page showing subdivisions.

Discussions	**Topics**	**Messages**
Inquiry Group A		
Plan This is the area where the mentees share their plan with the rest of the group.	8	137
Practice This is the place where the mentees share the implementation of their plan.	3	83
Reflect This is the place where the mentees share their experience with the practice section.	3	63
Mentor Tips	2	2

Figure 3. Three different topic areas to choose from in the practice subdivision.

Topic	Posts	Author
Week #4 [Go to Page: 1 , 2 , 3 , 4 , 5]	65	Facilitator
Week #5	12	Facilitator
Posting #3 - PRACTICE	3	Facilitator

Research Procedures

Sampling

Subjects involved in this study are eMSS participants who have been involved in the program anytime following and including the Fall of 2007. As described earlier in this chapter, participants create and submit discourse to various online discussion areas of the eMSS program. Each individual submission by a participant to a topic in any discussion area is considered a single message. In this study each message within a topic was used as a single unit of analysis. Various messages from all five different discussion areas described in Table 5 were analyzed for this study. An explanation of sampling follows.

It is estimated that approximately 55,000 messages were submitted to eMSS discussion areas during the 2007-2008 and 2008-2009 program years. A convenience sample (Gliner & Morgan, 2000) was used to create the accessible sample of discussion areas and their respective topics (threads of conversation) for this study. The accessible sample was selected on the basis of convenience because archiving issues allowed only certain discussion areas from various semesters of discourse to be available for analysis. The discussion areas that were available for analysis for this study are listed in Table 5.

Any message submitted by any mentor, mentee, facilitator, or university content expert to any of the discussion areas listed in Table 5 made up the accessible sample for this study.

Table 5. Discussion areas available for analysis.

Discussion Area	Semester
Content	Spring 2007 Spring 2008 Fall 2008
Special Topics: Topic of the Month	Fall 2008 Spring 2008 Spring 2009
Special Topics: Dilemmas	Spring 2009
Inquiry	Spring 2008 Fall 2008
Inquiry Self-Reflections	Fall 2008 Spring 2009

Stratified sampling was used to select different topics (threads of conversation) from the Content, Special Topics, and Inquiry Self-Reflection discussion areas listed in Table 5. Tables 6 through 8 show the name and number of topics and participant messages analyzed in each of these three different discussion areas. The topic names, especially those in the Dilemma, Topics of the Month, Reflect Section of the Inquiry discussion area, and the Inquiry Self-Reflection discussion areas, was usually created by eMSS facilitators or program designers. The topic names in the Content discussion area were frequently created by novice science teachers, as well as other eMSS participants, as

they determined a need for information and started a new topic. Once a topic was selected all messages within that topic were coded for their non reflective or reflective content. Tables 6 through 8 list the total number of topics and messages analyzed from each of the listed discussion areas.

Table 6. Topics and Messages in the Content discussion areas coded using the discourse analysis rubric.

Discussion Area	Year(s)	# of Topics	# of Messages
Content Area-Physics	2007 & 2008	11	56
Electromagnetic Spectrum			
Knowing What Your Students Don't Understand			
Mass vs. Weight			
Electricity from Wind			
Current Teaching Topic			
Rubrics			
Looking at Student's Understanding of Atoms			
Physics Text Books			
Heat vs. Temperature			
Scientific Controversies			
Conceptual Change in your Classroom			
Content Area-Life Science	2007 & 2008	9	90
Body Systems			
Are Viruses always Bad?			
X-Ray Crystallography			
Reflection			
Cell Labs			
Skin Cells			
Squid Dissection			
Darwin Day resources			
Do Animals have different Blood Types			

Table 6 - Continued

Discussion Area	Year(s)	# of Topics	# of Messages
Content Area-Chemistry	2007	9	59
White Glue and Liquid Starch			
Misuse of Science by the Media			
Compounds vs. Mixtures			
Chemical Change vs. Physical Change			
Biuret Solution Disposal			
Setting Up a Chem Lab			
Bohr and QMM			
Green Water			
Making Sense of Science Terminology			
Content Area-Earth Science	2008	5	82
Your Thoughts –We need them			
Educational Opportunities-conference et cetera			
What is Your Opinion of the Standard?			
What can you Add?			
Misconceptions Based Assessment Questions			

Table 7. Topics and Messages in the Special Topics discussion areas coded using the discourse analysis rubric.

Discussion Area	Year(s)	# of Topics	# of Messages
Topics of the Month	2008 & 2009	5	52
Math Skills			
Students Who Fail Taking the Next Science Class			
Differentiated Stoichiometry			
Suggestions for Hot Topics			
Questioning			

Table 7- Continued

Discussion Area	Year(s)	# of Topics	# of Messages
Dilemmas	2009	12	106
Spring Weariness-Week 1			
Spring Weariness-Week 2			
Spring Weariness-Week 3			
Expectations for Low Level Students-Week 1			
Expectations for Low Level Students-Week 2			
Expectations for Low Level Students-Week 3			
Pre-holiday Curriculum Planning Week 1			
Pre-holiday Curriculum Planning Week 2			
Pre-holiday Curriculum Planning Week 3			
Student Ineligibility-Week 1			
Student Ineligibility-Week 2			
Student Ineligibility-Week 3			

Table 8. Topics and Messages in the Self-Reflection sections of the Inquiry Discussion Areas coded using the discourse analysis rubric.

Discussion Area	Year(s)	# of Topics	# of Messages
Self-Reflection and Self-Assessment Sections of the Inquiry Discussion Area	2008 & 2009	N/A	109
Classroom Procedures			
Inquiry Based Labs			
Teaching with Scientific Articles			
Effective Labs			
Managing Student Behaviors			

Within the Inquiry discussion area, purposive sampling was used to create a sample of topics (conversation threads). This sampling technique allows a sample to be created that is “appropriate or especially informative for the purpose of the research” (Gliner and Morgan, 2000, p.154) and because it offers “useful manifestations of the phenomenon of interest” (Patton, 2002, p.40) The Inquiry discussion areas have three subdivisions: Plan, Practice, and Reflect. Subdivisions are only found in Inquiries. It is in the Reflect subdivision where participants are specifically asked to reflect on their classroom experience. The focus of this study is reflection and it seems appropriate to look for reflection, at a minimum, where it is specifically asked from participants. Choosing to limit the analysis of the Inquiry discussion areas to just the Reflect subdivision of the Inquiry discussion areas would allow a greater number of messages from the Reflect subdivision of the Inquiry discussion area to be analyzed.

After using purposive sampling to limit the sample of the Inquiry discussion area to only topics (conversation threads) found in the Reflect subdivision, stratified sampling of the Reflect subdivisions was used to select topics for analysis. Once a topic was selected all messages within that topic were coded for their non reflective or reflective content. Table 9 shows the name and number of topics and participant messages from the Reflect sections of the Inquiry discussion areas that were analyzed for this study.

Table 9. Topics and Messages in the Reflect Section of the Inquiry Discussion Areas coded using the discourse analysis rubric.

Discussion Area	Year(s)	# of Topics	# of Messages
Inquiry Reflect Section			
Effective Labs	2008	6	466
Effective Labs			
Using Technology to Improve Student Learning			
Diversity in Science			
Teaching with Scientific Articles			
Effective Labs			

Data Collection

Introduction. The eMSS program was the focus of this study designed to examine the research questions presented in Table 10. Essentially, it was the goal of this study to identify elements of non reflective and reflective discourse submitted by facilitators, mentors, and mentees to the various discussion areas in the eMSS program. Table 10 also includes an overview of the data collection methods used in this study.

Table 10. Research outline.

Research Questions	Data Collection And Analysis
1. Which elements of non reflective and reflective discourse are found in the types of discourse that experienced science teachers, participating in a professional development program, write? Which elements of non reflective and reflective discourse are found in the types of discourse that novice science teachers, participating in a professional development program, write? How can any observed differences be interpreted?	Discourse Analysis Statistical analysis
2. Which elements of non reflective and reflective discourse, written by participants in an online professional development program, are seen in discussion areas varying in content and format? How can any observed differences be interpreted?	Discourse Analysis Statistical analysis
3. To what extent are issues prominent in the National Science Education Standards present in the teachers' discourse, and is there a relationship between the presence of particular standards-based issues and the level or type of reflection?	Discourse Analysis Statistical analysis

The study used a mixed-methods (Creswell, 2003) research approach. Johnson and Onwuegbuzie (2004) define this approach as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (p. 17) in a way that offers the best opportunities for answering research questions. Patton (2002) explains "Inquiry strategies, measurement approaches, and analysis can be mixed and matched in the search for relevant and useful information" (p. 51). Additionally, this approach allowed the researcher to use both emerging and predetermined approaches to data collection and analysis (Creswell, 2003).

While both qualitative and quantitative approaches to data collection and analysis were used in this study, a qualitative approach was emphasized. A qualitative approach to research should be used when the study seeks to "describe what is going on" and when "topics need to be explored" (Creswell, 1998, p.17). Because this study sought to identify the elements of reflective and non reflective discourse that participants were using in online discussion areas and determine how discourse differed depending on the online discussion formats and teaching experience, a qualitative research approach was essential for answering the research questions.

To address issues of reliability in the content analysis of online discourse, a co-rater was used in this research. She is currently a high school science teacher but has a varied background including teaching online science courses and conducting research in several different biology labs. She pays attention to detail and although her only involvement in the eMSS program was as my co-rater, she was genuinely interested in providing valuable input in regards to rubric modification, described later. Once the rubric was in its final form, she was meticulous in her efforts while coding messages.
A quantitative approach to data collection and analysis was used when coding dialogue with the rubric, reporting descriptive statistics and using inferential statistics to determine if differences existed between groups.

Content analysis of online discourse used elements inherent to a grounded theory technique. In a grounded theory approach an abstract analytical schema of a phenomenon (elements of non reflective and reflective discourse), which relates to a particular situation (online discussion areas in a professional development program) is generated

(Creswell, 1998). From this, conclusions or a substantive-level theory was developed which can be subjected to further empirical testing (Creswell, 1998) but was seen as an endpoint for this study.

Literature Informing Rubric Development

Introduction. Content analysis of online discourse was the primary means of data collection andanalysis for this study. Content analysis of online discourse is crucial in understanding the learning that takes place in an online discussion area (Angeli, Bonk, & Hara,1998). A primary objective of this study was to select samples of online discourse found in the eMSS programs' discussion areas and determine whether or not participants used reflective thought processes in its preparation. Kember et al. (1999) explains in order "to determine whether students are engaged in reflective practice it is necessary to have some means of identifying reflective thought and a measure of the depth of reflective thinking" (p.18). In this study, a rubric, designed to identify various elements of reflective and non reflective discourse, was seen as the "means" referred to by Kember et al. (1999).

eMSS discourse has previously been analyzed using conversation rubrics or analysis tools designed to look for various features within the discourse. Bice (2005) used discourse analysis partly to explore teachers' awareness of student culture and learning characteristics. Grimberg (2006) examined argumentation patterns in eMSS online dialogue in order to analyze teachers' content and pedagogical knowledge construction. Taylor (2007) investigated the extent to which the dialogue was likely to enhance the

capacity of participants to provide high quality mathematics/science instruction or to be an effective mentor or facilitator charged with moving mentees forward in their practice. The rubric used by Taylor is found in Appendix D.

This study focused specifically on element four in Taylor's (2007) rubric, reflection and reflective practice, and followed a suggestion made by Taylor (2007) to break down the conversation rubric thereby allowing a more in depth study of the individual conversation factors found in the rubric. The rubric used for this study focused on identifying and classifying elements of reflection or the lack thereof used by eMSS participants as they represent their learning in online discourse.

Researchers have yet to develop a reliable tool or rubric, which can be used across studies with acceptable reliability, to identify and classify reflection in online discourse or other written media (Kember et al., 1999; Lee-Baldwin, 2005; Peltier, Hay, and Drago, 2005). This can partly be attributed to the idea that the concept of reflection "is a dense, multi-layered concept that can be examined from multiple perspectives and at multiple levels" (Roskos, 2001, p.1). Therefore, a major part of this study was the development of a rubric which could be used to identify and classify the elements of non reflective and reflective thought processes used by eMSS participants as they prepared their online discourse.

It was essential that the rubric be aligned in a manner consistent with how the concept of reflection was defined for this study while at the same time ensuring components of the rubric were supported by the research on reflection. Additionally, the rubric needed to be developed in such a way as to produce an acceptable level of internal

consistency when used by multiple coders. The rubric development process, explained in detail, included defining reflection for this study, studying the literature describing rubrics used to analyze reflection in conversations or in writing, determining which components of selected rubrics could inform the development of a rubric for this study, and finally developing a rubric for this study.

Definition of Reflection. Up until this point Dewey's (1933) and Moon's (1999) definitions of reflection have been a guiding force in the writing of this paper and will continue to be. However, their definitions do not do enough to operationalize reflection for this study. They, as well as others in the literature, do not give a clear picture as to what reflection "looks like". In order to identify and analyze the elements of reflection found in eMSS online discourse as this study requires, the author had to consider additional definitions of reflection in order to better inform the process of rubric development. This process helped to ensure that the rubric was supported by the general body of research on reflection, not just Dewey's (1933) and Moon's (1999) definitions of reflection. Table 11 lists various definitions of reflection as well as the rationale behind considering the definition as significant to this study.

Table 11. Definitions of reflection from various researchers.

Researcher	Rationale for Inclusion	Definition of Reflection	Field of Research
Dewey (1933)	Provided foundational information for the study of reflection. Commonly cited in journal articles about reflection.	A five step process that occurs between the time when a person experiences a perplexing, confused, or troubled situation and the time when they come to a cleared-up, unified, resolved situation in the end. It involves active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it and further conclusions to which it leads including a conscious and voluntary effort to establish belief upon a firm basis of evidence and rationality.	Studied reflection in the context of education. His first two books were written for teachers of students of all ages.
Moon (1999)	Her book is often cited as a good synthesis of the literature on reflection and its relationship to learning.	A basic mental process, related to thinking and learning, with either a purpose or outcome or both, that is applied in situations where material is ill defined or uncertain and where there is no obvious correct solution.	Wrote about reflection in the context of professional development for adult learners by explaining the interconnections between reflection and the processes of learning.
Boud, Keogh, & Walker (1985)	Includes the role of emotion in reflection and by using the term ‘activities’ shows that programs can and should design instructional situations that encourage reflection.	Reflection in the context of learning is a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations.	Wrote about reflection in the context of higher education and deliberate learning.

Table 11 - Continued

Boyd & Fales (1983)	Emphasizes the importance of an issue of concern in the reflective process and the metacognitive aspect of reflection.	Reflective learning is the process of internally examining and exploring an issue of concern, triggered by an experience, which creates and clarifies meaning in terms of self, and which results in a changed conceptual perspective.	Wrote about reflection in the context of humanistic psychology.
Habermas (1971)	The work of Habermas is a part of the theoretical framework for this study.	Associated with the development of particular forms of knowledge while engaged in different forms of learning. (Summary by this author)	Goal of writing was to develop a theory of knowledge comprehensive enough to encompass science, morality and art (Cranton, 1996)
Mezirow (2000)	Wrote extensively about the role of reflection in meaning making; in particular about its role in adult learning.	The apperceptive process by which we change our minds literally and figuratively in the process of turning our attention to the justification for what we know, feel, believe, and act upon.	Described the role of reflection in adult learning while describing different types of reflection as they are associated with Habermas's (1971) types of knowledge.
Schon (1983)	The work of Schon is foundational in creating a movement in the use of reflection for professional development.	Reflection involves demanding rational and moral processes in making reasoned judgments about preferable ways to act by learning to frame and reframe the often complex and ambiguous problems they are facing, to test out various interpretations, then modify their actions as a result rather than attempting to apply scientific theories and concepts to practical situations.	Describes the role of reflection in educating professionals in a variety of fields.

Next, Table 12 compares the components of the various definitions of reflection found in Table 11. When creating this Table 12 it was assumed, due to the contents of Table 11, that all of the authors associated reflection with a mental process.

Table 12. Contributions of researchers to the definition of reflection for this study.

	Mental Process	Purpose / Outcome	Examine Issues or Experiences	Associated with Learning or the Generation of Knowledge	Associated with a State of Doubt or Uncertainty	Involves Justifying Beliefs, Knowledge, Feelings, and Actions
Dewey (1933)	X	X	X		X	X
Moon (1999)	X	X	X	X	X	
Boud, Keough & Walker (1985)	X	X	X	X		
Boyd & Fales (1983)	X		X	X		
Habermas (1971)	X			X		
Mezirow (2000)	X					X
Schon (1983)	X	X	X		X	X

This table shows that four authors agree that reflection is a thought process that should have a purpose, or result in an outcome such as a conclusion (Dewey, 1933), new understandings or appreciations (Boud, Keough & Walker, 1985), or changes in actions (Schon, 1983). Five authors make a connection between reflection and the examination of an issue or experience of interest or concern to the learner. Dewey (1933) calls the issue a

perplexing situation. Moon (1999) defines it as a situation where the material is ill defined. Boyd and Fales (1983) associates reflection with an issue of concern that is triggered by an experience. If learning is defined as gaining knowledge, understanding or skill by study, instruction, or experience (learn, 2009) then one would be hard pressed to not associate any definition of reflection with learning. However, only three authors use the term learn(ing) in their definition; four if you include Habermas's (1971) definition of reflection which was summarized by this author. Three authors emphasize that reflection is associated with a sense of doubt or uncertainty. Dewey (1933) references a perplexing situation, Moon (1999) uncertain situations, and Schon (1983) writes of complex and ambiguous problems. Three authors associate reflection with justifying what one believes, knows, or does. Dewey (1933) writes of establishing a belief based on evidence. Mezirow (2000) explains reflection involves justifying what one believes, knows, feels, or acts upon. Schon (1983) has reflection involved in making reasoned judgments.

Using information from both Tables 11 and 12, a definition for reflection was generated for this study. Reflection is defined as a mental process, with a purpose or outcome (such as knowledge generation), associated with learning at a deep level and often involves justifying what one knows, feels, believes, or acts upon. It is especially applied when examining issues, situations, or experiences that produce a sense of uncertainty or doubt, or are complicated with no obvious solution for a given participant.

Viable Rubrics

Zeichner and Liston. Zeichner and Liston (1985) associated reflective discourse with four different levels of logic that students used in online discourse. In their analysis of online discourse they identified discourse as being factual, prudential, justificatory, or critical. In their study, which focused on discourse found in post observation supervisory conferences, factual discourse was discourse that described what occurred or what may occur in a teaching situation. Prudential discourse provides suggestions or evaluations about teaching situations. In justificatory discourse reasons for choices are given. Critical discourse provides an assessment of the adequacy of justifications for pedagogical activities or an examination of values and assumptions embedded in the curriculum and instructional activities.

In a pilot study by the author of this study 170 thought units from eMSS online discourse were analyzed using this rubric. The results were similar to those found by Zeichner and Liston (1985) when they analyzed 2215 thought units identified in discourse between university supervisors and student teachers during post-observation supervisory conferences in an elementary student teaching program. Table 13 compares the results of both studies.

Table 13. Comparison of results from pilot study with Zeichner and Liston (1985) study.

Type of Discourse	Explanation of Discourse	Pilot Study	Zeichner and Liston Study
Factual Discourse	Concerned with what has occurred in a teaching situation or with what will occur in the future	62.3%	63.2%
Prudential Discourse	Revolves around suggestions about what to do or around evaluations of what has been accomplished	27.1%	24.9%
Justificatory Discourse	Focuses on the reasons employed when answering questions of the form: “Why do this rather than that?” Can be pragmatic or in depth.	10.6%	11.3%
Critical Discourse	Examines and assesses the adequacy of the reasons offered for the justification of pedagogical actions or assesses the values	0%	.60%

The similarities between results of both studies initially generated a sense of optimism that the Zeichner and Liston (1985) rubric would be a viable tool for discourse analysis in this study. However, after further review and research into the concept of

reflection it was determined that this rubric did not make a distinction between reflective and non reflective discourse. In fact it could be argued that this rubric was classifying all discourse as being reflective on some level. Although the Zeichner and Liston (1985) rubric was not used for this study, its influence can be seen in the rubric that was eventually developed for this study. Aspects of both justificatory and critical discourse are found in the final rubric partly because both are extensively written about in the literature as being facilitated by reflection.

Peltier, Hay, and Drago. In the development of a rubric designed in part to measure four levels of learning in the context of reflection or the lack thereof, Peltier, Hay, and Drago (2005) based their work on Mezirow's (1991) explanation of the relationship between non reflective action and lower level learning, and reflective action and higher level learning. Their rubric characterizes elements of reflective and non reflective discourse and its design aligns with Moon's (1999) premise that reflection is closely associated with learning at a deep level.

Peltier et al. (2005) represent different types of learning, and their associated non reflective and reflective characteristics, as a continuum, acknowledges that although they used definite categories for classifying learning with respect to characteristics of reflection and non reflection, they were quick to acknowledge that there were areas of overlap between the four different learning categories. This is a concern where consistency between multiple coders is an issue, as in this current study. Their learning and reflection continuum is found in Table 14.

Table 14. The non reflection ←→ reflection learning continuum (adapted from Peltier et al., 2005).

←			→
Non reflection/Surface Learning			Reflection/Deep Learning
1.Habitual Action	2.Understanding	3.Reflection	4.Intensive Reflection
Engagement-specific tasks are treated as unrelated activities, memorization is emphasized, and embodies an attitudinal state of unreflectiveness referred to as non reflection in this study	Focuses on comprehension without relation to one's personal experience or other learning situations…Most of what is learned stays within the boundaries of preexisting perspectives.	Learning is related to personal experience and other knowledge. Reflection also involves challenging assumptions, seeking alternatives, identifying areas for improvement.	Learners become aware of why they think, perceive, or act as they do. Learner might alter or even change firmly held beliefs and ways of thinking. Intensive reflection is thus seen as involving a change in personal beliefs.

Lee-Baldwin. In their rubric, Peltier et al. (2005) emphasize a connection between higher level learning and reflection. This connection is frequently made in the literature. For example, Lee-Baldwin (2005) used a rubric based on Bloom's taxonomy to analyze online discourse for reflective thinking by preservice teachers in a science teaching methods course. In the Lee-Baldwin (2005) rubric, and in others like it, the terms reflection and critical reflection seemed to be used synonymously with higher level learning terms such as critical thinking, analysis, and evaluation. Lee-Baldwin (2005) hypothesized if teachers were synthesizing and evaluating information found in the online discussion areas, they were also reflecting. This "jump" is not uncommon in the literature. While there is evidence to support reflection as playing a role in thinking and

learning at higher levels (Moon, 1999; Mezirow, 1991) there is no conclusive evidence that higher level learning always involves reflection. It was a challenge in this research to better identify when the aforementioned upper level thought processes involved a reflective component.

Boyer, Maher, Kirkman. Boyer, Maher, and Kirkman (2006) used a rubric designed for the systematic content analysis of graduate students' reflective writings. These writings were found in an online class which had some design aspects similar to the eMSS program. Throughout the semester long class, students were encouraged to reflect and dialogue continuously using Blackboard. Four times during the semester students were asked to reflect on specific questions about their progress and the learning process. Boyer et al. (2006) used their rubric to analyze the answers to these specific questions, called reflections, during these four instances.

The Boyer et al. (2006) rubric was based on Mezirow's (2000) transformative learning process consisting of four phases: a disorienting dilemma, critical reflection, validating discourse, and reflective action. Each reflection paper was analyzed for the existence of all four phases. Table 15 summarizes this rubric.

Table 15. Summarized reflection rubric developed by Boyer et al. (2006).

	Disorienting Dilemma	Critical Reflection	Dialogue and Discourse	Action
Rating Type	Yes or No	3-Point Coding Scale	3-Point Coding Scale	None or Intention
Explanation	Does the learner write about a personal crisis, triggering event, or an experience that challenges their belief structure?	Does the learner reevaluate assumptions about themselves and/or learning?	Does the learner engage in online discourse with other students or the instructor seeking consensual validation or expertise?	Does the learner describe what they intend to do in the future as a result of identifying, critically reflecting on, and discussing a disorienting dilemma?
Coding	Coding regarding the existence of a disorienting dilemma in the reflection Yes- Reflection contains a disorienting dilemma No- Reflection does not contain a disorienting dilemma	Coding relates to either the depth or extent of reflection according to the following coding scale: 1- Brief comment indicating critical reflection associated with the need to make a change from preconceived ideas, beliefs, habits, or assumptions 2- Some discussion beyond a brief comment associated with the need to make a change from preconceived ideas, beliefs, habits, or assumptions 3- Extensive, elaborative, deep discussion associated with the need to make a change from preconceived ideas, beliefs, habits, or assumptions	Coding relates to either depth or extent of reflection according to the following coding scale: 1- Brief comment (aimed at the group, instructor, or both) indicating the initiation of dialogue and discourse in an attempt to validate the need for change in preconceived ideas, beliefs, habits, or assumptions 2- Some discussion beyond a brief comment (with the group, instructor, or both) representing dialogue in an attempt to validate the need for change in preconceived ideas, beliefs, habits, or assumptions Extensive, elaborative, deep discussion (with the group, instructor, or both) representing an attempt to validate the need for change in preconceived ideas, beliefs, habits, or assumptions	Coding regarding the existence of an intent for further action in the reflection None- no intention for further action is written Intention- reports the intention to take a new course of action as a result of a new perspective

The Boyer et al. (2006) rubric has researchers initially looking for the existence of a disorienting dilemma in writing samples before looking for evidence of elements of reflection in learners' writings. For the current study a disorienting dilemma is called an issue. This current study's rubric has issue identification placed towards the beginning of the rubric. In the Boyer et al. (2006) study, if a writing sample did not include a disorienting dilemma then it was not analyzed any further for evidence of reflection. This course of action supports the premise that reflection is more likely to be involved in the learning process when a person has an issue or a problem to discuss or write about. The Boyer et al. (2006) rubric supports the importance of identifying the issue when looking for evidence of reflection in participants' written online discourse. This had design implications for the rubric developed and used in this study.

After coders, using the Boyer et al. (2006) rubric, determined that students' reflections contained a disorienting dilemma, they coded for the level of critical reflection seen in the reflection, using a 3-point Likert scale. Their use of this ranking method supports the idea that a Likert-type coding system can be used for data collection in this context. However, a limitation of the Boyer et al. (2006) rubric does exist. It is designed to identify only one type of reflection: critical reflection. The literature on reflection has shown that critical reflection, sometimes known as premise reflection, is rarely seen in students' writings. A critical reflection low coding of 1 on the Boyer et al. rubric may be indicative of some type of reflection, perhaps quasi- or content reflection, but was still identified as critical reflection. It has been this researcher's experience that on the rare occasions where critical reflection is seen in writing it would

be difficult to classify it with any type of a low level code. Additionally, the Boyer et al. rubric did not operationalize what was meant by terms found in the rubric such as brief comment, some discussion beyond a brief comment, extensive, elaborative, deep discussion. This lack of explanation is common in rubrics designed to identify elements of reflection in writing. It is theorized that having specific definitions for these terms would facilitate agreement between dialogue coders.

When writing about their process of developing a rubric to assess the level of reflective thinking found in written journals of college students, Boyer et al. (2006) explain:

> To use any classification system consistently, even an individual classifier needs a clear well-defined definition of each category which provides sufficient detail to encompass the range of material to be classified. Where there are multiple judges or assessors, the need for adequate definitions becomes even more important. Individual coders can supplement the formal category definition with their own working guidelines. Multiple coders, however, inevitably derive a variety of interpretations and idiosyncratic operational definitions when the provided category definitions lack precision and detail. (p.20)

Herein lies the rub and challenge for this research. However, Kember et al. (1999) explains why the challenge of rubric development is a worthy one and why it should proceed. In the process of developing a rubric to assess the level of reflective thinking found in written journals of college students enrolled in undergraduate health profession programs, Kember et al. explain they were motivated by the fact that “programs frequently take as their main aim developing a reflective practitioner, but have no means of assessing whether students engage in reflective thinking in their courses or the periods of professional practice” (p.18).

They felt, if this aim is to be directly assessed the assessment should be based upon existing requirements of the program in order to add to the authenticity of the data and "the assessment should incorporate a process for determining whether students do reflect upon their practice and the depth of that reflective thinking" (p.19). They add that "such a measure would also be invaluable for course evaluation procedures" (p.19). The rubric used for this study follows these suggestions. It is designed to analyze online discourse, which is already a requirement for participation in the eMSS program. Additionally, this study's analysis of online discourse will likely be used, formally or informally, for eMSS program refinement.

Kember et al. Kember's et al. (1999) rubric made a distinction between reflective and non reflective action, a distinction not made in the Zeichner and Liston (1985) rubric. They developed distinct coding categories for different types and levels of reflective and non reflective writing. This is unlike the Boyer et al. (2006) rubric which either identified only critical reflection or all types of reflection as critical reflection, depending on the interpretation of the term critical reflection. This rubric is similar to the Peltier et al. (2005) rubric in that the distinct categories are arranged in a continuum from non reflective writings to reflective writings. The writings were classified as either showing evidence of reflection or not. The Kember et al. (1999) rubric is found in Table 16. The level of reflective thinking increases from bottom to top. Categories shown on the same horizontal level were regarded as being equivalent in their level of non reflective or reflective thinking. The italicized levels indicate non-reflective writings while the non italicized levels represent reflective writing.

Table 16. Coding scheme used by Kember et al. (1999) to determine the level of reflective thinking in students' written journals.

Types of Discourse →			
Level of Discourse ↑		7. Premise Reflection-writing that shows an awareness of why we perceive, think, feel or act as we do.	
		4. Content Reflection-writing that shows reflection on what we perceive, think, feel or act upon	5. Process Reflection-writing that shows an examination of how one performs the functions of perceiving, thinking, feeling, or acting and an assessment of efficacy in performing them	6. Content / Process Reflection
		2. Introspection-writing that refers to feelings or thoughts about oneself without any attempt to re-examine or test the validity of prior knowledge		*3. Thoughtful Action-writing that makes use of existing knowledge, without attempting to appraise that knowledge, so learning remains within pre-existing meaning schemes and perspectives*
			1. Habitual Action-action that has been learnt before and through frequent used becomes and activity which is performed automatically or with little conscious thought. Journals will not contain this type of writing or if they did the writings would cease to be so classified	
			0. Writings that do not fit any other categories	

Using this rubric to assess students' final reflection papers, assessors categorized each paper according to the highest level of reflection shown by the student. The four assessors reached a level of agreement indicated by a Cronbach alpha value of 0.74. In their conclusion Kember et al. (1999) write that the rubric:

> can be recommended as a tool in assessing students enrolled in courses which have as their aim of developing reflective practice and thinking…The process is also of value in the evaluation of such courses. It provides a means of determining whether the various teaching and learning strategies for encouraging reflective thinking are succeeding… We believe that we have developed an appropriate scheme for assessing the level of reflective thinking…Wider acceptance of the scheme obviously depends upon more extensive testing, preferably in other contexts and by those not involved in its development. (p.29)

The Kember et al. (1999) rubric had some important design implications for the rubric used in this study. Their explanation of introspection and thoughtful action as being important but not reflective thought processes, and their placement of premise reflection as the highest level of reflection, were valuable in the rubric development process for this study. Additionally, their description of reflective writing labeled as Content Reflection aligns with Cranton's (1996) and Mezirow's (1991) definition of content reflection and is used in the rubric for this study. Influence from their eventual development of the content/process reflection category is seen in the rubric for this study as well. However, the Kember et al. (1999) rubric cannot be used exactly as it was originally developed partly because the rubric for this current study needs to have a category for quasi-reflection which is frequently seen in eMSS discourse.

Taylor (2007)

Taylor. Using a modified version of the eMSS Conversation Rubric developed by HRI and found in Appendix C, Taylor used a Likert-type scale to code for evidence of participants' reflecting on their practice. This is seen in element four in the conversation rubric in Appendix D. She lists several types of reflection, including critical thinking, which is a term sometimes used synonymously for critical reflection. However, her analysis did not involve identifying different types of reflection, only indicating the degree to which there was evidence of some type of reflection in the eMSS discourse. As stated before, this research intends to follow Taylor's (2007) suggestion to break down the conversation rubric she used and thereby allow for a more in depth study of reflection in discourse in eMSS and similar programs.

Components of Viable Rubrics. Table 17 compares components of the six rubrics just discussed. The word "Present" was used if that component was explicitly found in the rubric designed for the given study.

Table 17. Comparison of components of various rubrics used for analyzing the reflective aspects of participant writings.

Component	**Component Explanation (The rubric…**	Zeich-ner and Liston (1985)	Lee-Baldwin (2005)	Peltier, et al. (2005)	Boyer et al. (2006)	Kemb-er et al. (1999)	Taylor (2007)
Learning	Relates reflection to a learning process		Present	Present	Present		
Non Reflection / Reflection	Has discourse or writing being labeled as			Present		Present	

Table 17 - Continued

	non reflective or reflective						
Problem	Relates reflection to a problem or issue that needs to be considered				Present		
Distinct Categories or Levels	Has discourse or writing being categorized into distinct categories with respect to reflection	Present		Present		Present	
Reflection Scaled along a Continuum	Has discourse or writing being coded according to a continuum			Present	Present		Present
Critical Reflection / Premise Reflection	Has listed this type of reflection as a category or level of reflection	Present		Present	Present	Present	Present
Outcome / Action	Was designed to identify if the participant had formulated and / or actually performed some type of action as a result of reflection				Present		

Data Analysis and Rubric Development

The rubric for this study should align with how reflection is defined for this study: as a mental process, with a purpose or outcome (such as knowledge generation), associated with learning at a deep level, and often involves justifying what one knows, feels, believes, or acts upon. It is especially applied when examining issues, situations, or experiences that produce a sense of uncertainty or doubt, or are complicated with no obvious solution for a given participant. Using this definition as a guide an explanation of the process of rubric development follows.

Unit of Analysis. The unit of analysis for this study is each individual message within a topic. Other units of analysis similar to the "thematic units" and "coherent ideas" were considered. The most commonly used unit of analysis in a review by Rourke et al. (2001) of 19 studies using content analysis was the thematic unit. Budd, Thorp, and Donohue (as cited in Rourke et al., 2001) describe a thematic unit as "a single thought unit or idea unit that conveys a single item of information extracted from a segment of content" (p.11). The use of thematic units can lead to low reliability as different coders may interpret a given segment of content differently when determining the thematic units for analysis (Creswell & Plano-Clark, 2007).

Kember et al. (1999) divided their students' one page written reflections into chunks they identified as coherent ideas. These chunks were determined before the reflections were given to individual assessors for coding. Although they received an acceptable level of agreement between coders, one could argue that different agreement may have resulted if individual coders were allowed to determine their own coherent

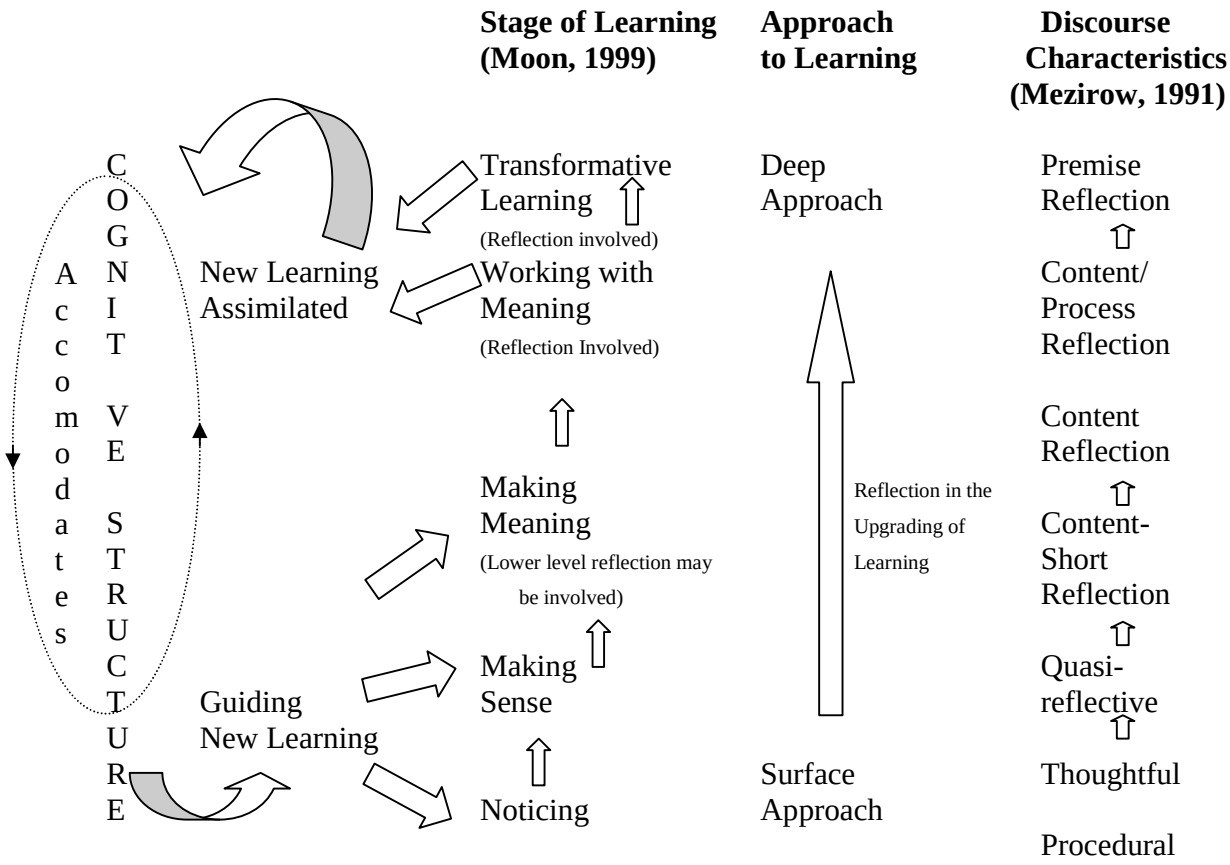
chunks. Sentences and paragraphs have been used as units of analysis in other studies. However, especially in electronic media, these can be difficult to determine.

Several factors were considered when choosing to use an individual message as a unit of analysis for this study. First, entire message units have been used with promising interrater reliabilities (Rourke, Anderson, Garrison, & Archer, 2001). Second, and related to the first reason, it is difficult to reach agreement between coders on how to chunk the online messages into coherent ideas, either within a message or across a discussion thread. Lastly, using entire conversations or thematic threads as a single unit of analysis was considered for this study. However, in a pilot study, the researcher saw negligible evidence of conversations leading to a highly reflective conclusion that would not have been identified when using individual messages as the unit of analysis.

Mental Process. As participants write discourse to submit to the various eMSS online discussion areas, the process requires some type of thinking. Determining whether or not this thinking as represented in online discourse, had non reflective or reflective elements associated with it, was a challenge and goal of this study. A framework used to guide the development of the rubric for this study is found in Figure 4. The cognitive structure is placed in the rubric framework to represent the mental processing component of the definition of reflection. Moon (1999) has the cognitive structure guiding, assimilating, and accommodating new learning as the learner moves through the stages of learning.

Moon (2004) sees assimilation as the processing of new material of learning such that learning occurs. “The process of assimilation is guided by the current internal experience (prior experiences in current state of cognitive structure)…of the object of learning, and any given current purposes for the learning” (p.231). She explains that accommodation follows the process of assimilation. Moon (2004) defines accommodation as a process of modifying new material of learning or current cognitive structure “in a learning process that results in a change of conceptions (i.e., understanding or state of knowledge)” (p.231). The cyclic nature of Moon’s (1999) cognitive structure would be supported by Driscoll’s (2000) explanation of the relationship between the two; “accommodation influences assimilation and vice versa” (p.195). What occurs during the process of accommodation will play a role in the way in which new material of learning is assimilated in the future. By placing the cognitive structure so that it extends from the top to the bottom of the rubric, we are reminded that thinking, both non reflective and reflective, is a mental process.

Figure 4. Rubric framework (adapted from Moon, 1999 and Panda, 2004)



Elements of Reflection. Previously cited studies have looked for reflection in participants' representations of learning such as journals, reflection papers, survey responses, etc… This process has been challenging primarily because researchers have had a difficult time operationalizing reflection. What reflection looks like is elusive, not unlike some other constructs which have been studied, self esteem for example. The complex nature of defining self-esteem can be described in this statement "You can't touch it, but it affects how you feel. You can't see it, but it's there when you look at

yourself in the mirror. You can't hear it, but it's there every time you talk about yourself" ("Self-esteem and Self-Esteem Issues", 2009, p.1).

Part of this elusiveness has to do with the complex nature of the self-esteem construct. Others, when describing self-esteem, frequently break the construct into smaller components. Branden (1994) describes six pillars of self esteem; living consciously, self-acceptance, self-responsibility, self-assertiveness, living purposefully, and personal integrity. The West Virginia Education Association (n.d.) lists the essential elements of self-esteem as security, belonging, competence, identity, and purpose. Shahar (n.d.) lists different types of self-esteem and just two elements of self-esteem, self-confidence and self-respect. Similar to reflection, agreement on describing self-esteem is lacking. The lesson to be gleaned from the self-esteem example for this study is valuable. Describing complex constructs by dividing them into different elements is acceptable and may be helpful.

What these elements are can differ depending on the context of the situation in which the construct is being studied or written about. Branden (1994) would assert that convincing evidence would exist for labeling a person as having self-esteem if the person is living consciously, is self-accepting, displays self-responsibility, is self-assertive, is living purposefully, and has personal integrity. The West Virginia Education Association (n.d.) would identify a person who has security, belonging, competence, identity, and purpose as having self esteem. The more elements a person has the more likely their chance of being labeled as having varying levels of self esteem.

This study would assert if a participant is writing about issues of interest or concern, taking a deep approach to learning as they prepare their online discourse, providing explanations for their beliefs or ideas as they write about the content, process,

or premises behind issues, and describing further actions then their messages show evidence of reflection. The more elements of reflection seen in a message, the more convincing the evidence that, in the process of preparing online discourse, the participant used reflective thought processes.

Identification of Issues-Element 1. We examined the online discourse found within each message for the non reflective or reflective thought processes associated with its development by identifying different elements of non reflective and reflective discourse. The first element focused on determining the issue(s) about which the participant wrote. The cognitive structure, in the rubric framework in Figure 4, is viewed as facilitating the selection of possible issues or aspects of issues participants decide to discuss. Issues of interest to eMSS participants are gleaned from the material of learning. The material for learning includes but is not limited to participants' classroom experiences as well as the topics they read about in the eMSS discussion areas. In this study, the term issue is an all encompassing term used to mean a problem, a disorienting dilemma, or an area of concern, curiosity, or interest.

Issues found in messages in the Inquiry discussion area are generally gleaned from current classroom experiences associated with an Inquiry topic. Examples of Inquiry topics include Effective Labs, Teaching with Scientific Articles, and Using Technology in the Science Classroom. Content, Dilemma, and Topic of the Month discussion area issues are sometimes generated by discussion area facilitators, and sometimes proposed by other participants. Examples of Content issues include teaching Bohr and the Quantum Mechanical Model of the Atom, Continental Drift, and

Examination of (Specific) Content Standards. Examples of Dilemma issues include Expectations for Low Level Students, Pre-holiday Curriculum, and Student Ineligibility. Common to all discussion areas is the fact that issues are discussed in an online environment as participants post, read, and respond to each other's messages and complete program requirements.

The literature on reflection supports the premise that in order for reflection to play a role in the learning process there needs to be an issue about which participants are writing. Dewey (1933) writes "The nature of the problem fixes the end of thought, and the end controls the process of thinking" (p.15). In order to best analyze discourse for evidence of reflective thought processes, it is suggested by this author and supported by Boyer et al. (2006) that being aware of the issue to which the discourse is referring may help in identifying the non reflective or reflective elements of the discourse.

Ball & Cohen (1999) make clear, as discussed in Chapter 2 that if teachers are to do the type of teaching and facilitate the type of learning that the reform literature promotes, there must be a change in emphasis in science teaching. To support science teachers in the process of augmenting or developing entirely new teaching strategies, professional development experiences must be designed with this focus. This study proposes that when participants are engaged in online discourse associated with the Changes in Emphasis in Science Teaching as set forth by the National Research Council (1996), then the program has taken a step in the right direction with respect to providing meaningful professional development to science teachers. The rubric, found in Appendix E, shows that the identification of the issue in each message was done in the context of

the Changes in Emphasis in Science Teaching (1996) by identifying which associated National Science Teaching Standard (1996) was the focus of the message. This approach was used to provide more specific options for issue identification in the form of the National Science Teaching Standards because the wording of the Changes in Emphasis in Science Teaching tended to be quite general.

The rubric was designed so one or more issues could be identified in each message. If an issue could not be identified in the context of the Changes in Emphasis in Science Teaching (National Research Council, 1996) or the National Science Teaching Standards (National Research Council, 1996), or if other issues existed in addition to those associated with the aforementioned standards, the coder wrote in a description of the issue(s) for that message in the section marked Other. If a message contained only discourse focusing on the aspects of the eMSS program such assignment explanation, technical issues, providing teaching resources or advice, and/or explaining science content the message was rated as non reflective discourse, in particular procedural discourse, and no further action was taken in the coding process.

Approach to Learning-Element 2. The second element of reflective and non reflective discourse found in the rubric focused on determining a participant's approach to learning while preparing their discourse. The literature strongly supports a link between a deep approach to learning and learning that requires reflective thought processes. Each message was read and identified as either indicating a surface, surface to deep, or deep approach to learning. Only the highest option was identified per message.

A deep approach would be considered higher than a surface approach. Table 17 provides descriptors of discourse associated with surface, surface to deep, and deep approaches to learning, and an example of online discourse representative of the descriptor. Moon's (1999) frequent inclusion in Table 18 highlights her influence in the part of the rubric development aligning a participants' approach to learning with different stages of learning. Her explanations of the different stages of learning, explained in detail in chapter two, helped to better operationalize the terms surface, surface to deep, and deep approach for this study.

Table 18. Descriptions of different approaches to learning and discourse representative of the descriptions.

		Example
Surface	Only described an issue / event as they have remembered it (Moon, 1999) or describe what they will do next time without any attempt to provide a rationale	"(next time) I would allow students to pick articles of interest for the next article activity I plan!"
	Used minimal thought and / or engagement (Peltier, Hay, Drago, 2005).	"I liked getting article ideas that I could use with the staff at my school! It was a good resource to check when I had topics posed to me for reading material!"
	Have not connected their thoughts about an issue to deeper or broader meanings possibly by treating their experiences while in the eMSS program as pieces of unrelated knowledge (Moon, 1999).	"…. (thanking her mentor and eMSS for their help this school year)… A far as the lab goes, I was successful and felt that the students understand the concepts and goals that I wanted them to achieve. Their assessments also demonstrated that they can apply the information that they have learned. My 7th graders are now ready to begin their dissection lesson."
	Explained how they think or feel about an issue without any attempt to re-examine or test the validity of knowledge they had	"So far this lab has gone very well. The students have taken two days to build their solar cookers and we will be testing them on Monday. The students will measure the water temperature for 20 minutes to see which cooker heats the water the most."

Table 18 - Continued

	prior to the issue(s) they have written about (Kember, et al., 1999).	
Surface to Deep	Made a judgment using simplistic or pragmatic explanation (Zeichner & Liston, 1985).	"I have more groups that are not working well together and I have to spend more time monitoring and correcting their behavior and less time helping them perfect their designs. It is so frustrating that while some students seem to be very interested in the project, there are some who I can not motivate no matter what techniques I use. At this point the best I am hoping for is to keep the classes under control and that the majority of the students are able to learn from the lessons and activities."
	Begun to take a more holistic view of the subject matter of the issue possibly by beginning the process of linking their thoughts together (Moon, 1999).	"First, this was an interesting lesson for me to work with for this assignment. By design, I had this lesson follow two others. The idea was reinforcement through differentiation and repetition. The first lesson was lecture type with over-head images of the atmosphere and its layers. I think it went well since each layer has its own interesting (fun) facts about it. But, it was still just a lecture format. I followed with a higher level (not that high) lesson where I the kids make a flip-chart of the layers of the atmosphere. I have used the flip chart for several lessons this year and the kids respond well to it. It's right at their level where they seem to enjoy it and they work it! They need to read for information to go along with their drawings. It's a nice project for my kids. Then, I moved up to this lesson which was more hands-on. I liked my progression of these lessons and I think it really hit home with these kids. This final lesson was a wonderful capper for them. So, I am pleased with how it worked out."
Deep	Made a judgment using thoughtful reasoning, or problem solving skills such as deduction that required the understanding of the elements involved in an issue, looking for patterns and underlying principles, or while using facts and ideas as evidence in an argument (Moon, 1999). Manipulated meaningful knowledge towards an end, such as a clarification of thoughts on some issue (Moon, 1999). Checked evidence and	"I chose a local newspaper story on evolution, the topic we were working on. I handed out a template with 3 clearly stated requirements for what and how the students were to write: 1. 30 points: Use and underline key terms: change, evolution, genetic, pollinators. 2. 30 points: Skip lines. Use proper paragraph form (Intro, Detail, Conclusion). 3. 40 points: Explain how evolution is relevant to this news story. I had each of 4 classes read the story aloud before writing about it. As I gained experience by trying the experiment with each class I gradually increased my scaffolding in an effort to aim students' focus at key paragraphs deep in the 2nd page of the story that few students differentiated from the rest of the text on their own: -that evolution is an on-going process, not only an ancient one; -that human impacts (global warming) are causing dramatic ecosystem changes (over 50% of flowers common to Thoreau's Walden are now gone or approaching extinction); -How symbiotic mutualism between flowering plants and their pollinators is the mechanism in play here; (Long comment about contrast triggers).

Table 18 - Continued

	related in to conclusions. Examined logic and argument cautiously and critically.	And my own speculation…: **I could easily devote more than the single class session I gave this activity, spending a 2nd (or further) sessions on revisions based on my written comments (Which were extensive but remain unshared because I am required to hold 3 samples per marking period of each student's writing. **Many students seem trapped by a need to 'tag base' (on the 4 key terms I asked them to use) at the expense of sense-making. **Many are still at an early phase in their concept of evolution and the term 'genetics' is completely unfamiliar to most of them (in the article it is used as a synonym for 'closely-related' as in 'flowering in response to the same trigger'). **I gleaned from ways they used the term genetics and evolution that the students may have been confused about the story because, although the contrast triggers themselves were not identified-a problem that led me to offer the 2 possibilities, temperature vs. day length. In summary, I thought it was good that students grappled with the problem of extracting sense from a topical news story. I found it problematic that my pressures (need to possess student work samples and cover material) led me to move on without mining the material more deeply. On the other hand, these are conceptual processes (genetics, evolution, textual analysis) that students will encounter elsewhere in their academic progression. I am actively seeking additional articles to analyze, and evolutionary and genetic activities for them to investigate, as we continue our coursework, now working through the vehicle of regional biogeography, or biomes, for the next 6 weeks leading into mid-January's exam."
	Become aware of why they think, perceive, or act as they do by making implicit thoughts explicit possibly resulting in a change of firmly held beliefs. (Peltier, Hay, Drago, 2005). When linking or analyzing current ideas while taking previously held knowledge and beliefs into consideration, participants' previously held beliefs may start to change or even be restructured (Moon, 1999).	"I used to think that if I just treated everyone equally, it would be enough. But I have certainly learned over the years, that I need to proactively incorporate all the many cultures at my school into my classroom, through building relationships as well as through my design of curriculum and choice of learning activities. When I recognize my students for their diversity, instead of trying to erase its presence, then I am able to make progress. When my minority students see that I understand some of their obstacles and will help them to take on the challenges of science, they respond with energy and engagement. And when I can engage all students in the learning process, they all benefit."

Table 18 - Continued

	Been actively interested in course content by seeking alternatives, challenging assumptions, and identifying areas for improvement (Peltier, Hay, Drago, 2005).	"I feel in my inquiry I have only scratched the surface of the problem. The Hispanic student population has multiple issues to deal with and I will need to try to understand the real causes of the often low performance in school a whole lot better. My students were very responsive to my questions and I have the impression that I got closer to them and they trust me more. It looks like especially Hispanic students are looking for an emotional connection with their teacher. So far my influence has not brought about a turn-around in grades. What I found out though was that parents of Latino background want the school to deal with their children, they do not want to be involved in school. It just so happens that our system especially is set up for parents to be very involved. Most Hispanic parents are backing me up and strongly encourage me to do to their child whatever I see fit. One even suggested corporal punishment. Well, I need to find alternative options. "
	Examined how they, eMSS participants, performed the functions of perceiving, thinking, feeling, or acting and an assessment of their efficacy in performing them (Kember et al., 1999).	"…Then I talked to Rae and she told me that she guides the inquiries and then turns them loose, but I thought I had. So I looked at what they were missing. (I do not want to send them to high school without having a clue on how to set up an experiment, collect data and then write a complete lab report). So I planned a step by step lab for them and put it on my laptop software for smartboard, and stepped through step lead them into the process of thinking and writing and collecting data and looking at it and revising, about the number of times and length of string for a pendulum washer. This was the most effective lab I feel they have done all year. …"
	Go beyond the given and begin to link material associated with the issue to existing ideas or knowledge.	Bohr and QMM: ..."There is a very good lead in to building up electron configurations in the book,...,The first section of the book deals with atomic structure and I have found that using experimental ionization energies coupled with a discussion of coulombic potential energy works very well in introducing the rules for putting electrons in quantum levels. I don't use many of these as student activities but essentially as jump offs for lecture. P.S. It is not hard to get students to understand the coulombic potential if you draw the clear analogy to magnets. It was fun to see their interest in trying to understand the trends in the numbers. Also, I have had good success in discussing spin by bringing the application of NMR or MRI."

Types of Discourse-Element 3. The primary purpose of elements one and two was to set the stage for the work to be done for element three. Element three has the coder determining the highest level of discourse in a message. If an issue has been identified along with a surface to deep or deep approach to learning prior to arriving at element three in the rubric then the coder had additional support for claiming a message showed evidence of reflection if indeed this was what they found for that message. On the other hand, if no issue is identified or an issue is identified along with just a surface approach to learning, the coder had additional support for claiming a message showed evidence of non reflective discourse if indeed this is what they found for that message.

Dewey's (1933) previously described work can be used as an overarching guide in the challenging task of differentiating between non reflective and reflective discourse. Whereas both non reflective and reflective discourse can articulate participants' thoughts about an experience or include descriptions of an issue or a participant's actions, in reflective discourse these thoughts will be expressed alongside well developed or supported justifications or explanations. The third element of the rubric focuses on differentiating between different types of discourse with respect to its non reflective or reflective content. The premise behind this element assumes that non reflective and reflective discourse will have different distinguishing features.

Discourse focused on aspects of the eMSS program such as assignment explanations, technical issues, discourse expressing encouragement or gratitude, explaining science content and miscellaneous discourse are types of non reflective

discourse. This type of discourse was identified in the Discourse Format section of the rubric.

Thoughtful discourse is a type of non reflective discourse and is associated with a surface approach to learning. It focuses on describing issues or describing how a participant feels about an issue. Noticing, describing, reporting about, or feeling a certain way about an issue are listed as important parts of the reflective process (Bain, 1999; Gibbs, as cited in Williams, 2008; Hatton & Smith, 1995; Jay & Johnson, 2002; Moon, 1999) but by themselves will not be considered as evidence of reflection. Within thoughtful discourse, the participant provides no justification or explanation regarding why the participant thinks or feels a certain way. They make no "attempt to reexamine or test the validity of prior knowledge" (Kember et al., 1999, p.21) and only make "use of existing knowledge, without attempting to appraise that knowledge" (p.21). At a very basic level, thoughtful discourse was operationalized for this study as discourse that participants write in order to explain what they saw, what they did, what they do in certain situations, or how they felt about an issue without providing any reasons why.

Thoughtful discourse, while not reflective, can be important and is often seen in eMSS online discourse as a precursor to reflective discourse for mentees as well as mentors. Moon (1999) would likely interpret thoughtful messages in eMSS discussion areas as the best possible representation of learning for the making meaning stage of learning. Kember et al. (1999) explains that as a participant's teaching practice becomes more repetitive and routine, the teacher may miss important opportunities to think about what he or she is are doing. Writing quality thoughtful discourse can play the initiating role in a process deemed important by eMSS program designers. Elaborating on

thoughtful discourse, helps bring to the "surface and criticize the tacit understandings that have grown up around repetitive experiences of a specialized practice and can make sense of the situations of uncertainty or uniqueness which (a person) may allow himself to experience" (Kember et al., 1999, p.21) as he thinks reflectively.

Most messages contained thoughtful discourse unless the message was solely procedural. The next step of the rubric had the coder determine if the participant provided any type of justification or explanation pertaining to their description, opinion, or feelings about the issue(s). If the thoughtful discourse was followed by a justification or explanation, the coder continued and determined whether or not the explanation contained characteristics of quasi-, content, content/process, or premise reflection.

Frequently in eMSS discourse quasi-reflective discourse followed thoughtful discourse in a given message. In quasi-reflective discourse participants did not refer to the underlying mechanism (Chin, 1999) associated with the issue. However, unlike in the preparation of thoughtful discourse, participants provided justification(s) for claims they made. These justifications were usually short and pragmatic in nature (Zeichner & Liston, 1985). They were simple and did not focus on purpose, strategy, or relationships between the current lesson and other things they had discussed in eMSS. They did not involve relating ideas to previous knowledge or experiences, looking for patterns and underlying principles, checking evidence and relating it to conclusions, or making explicit the underlying assumptions guiding thoughts, or feelings.

In this study, quasi- reflective discourse was seen as an area of overlap between non reflective and reflective discourse. At the most basic level, quasi-reflective discourse

was operationalized for this study as discourse that participants write in order to superficially or pragmatically explain why something occurred, why they did something in a certain situation, why they felt a certain way, or why they would do something in the future. Quasi-reflective discourse must have an explanation or justification associated with it. If the discourse was just a couple of sentences stating something the participant has learned or gleaned from working with an issue but contains no justification, the discourse was likely to be rated as thoughtful discourse.

If, after reading dialogue about an issue, a coder found herself asking or thinking the following thoughts about a participant's justification the coder was likely to have labeled this discourse as using quasi-reflective discourse. There is not solid evidence to draw that conclusion. The participant seems to be taking a surface approach to learning. The evidence cited by the participant to support his or her claim seems lacking and/or superficial. The participant seemed to be in a hurry to justify the claim.

Mezirow (1991) defined several types of reflection and Irvin (2005) explains that within any of these "focuses for reflection, reflective learning involves validity testing" (p.3). "Mezirow stresses the importance of the "validation of knowledge" for learners, and he believes reflection plays a crucial role in this validation process" (Irvin, 2005, p.3). When the online discourse showed evidence of validity testing through thorough explanations of justifications, the discourse was coded as some type of reflective discourse.

Reflective discourse found in eMSS was labeled as discourse showing evidence of content, content/process, or premise reflection. Kember et al. (1999) and others

(Kreber, & Cranton, 2000; Wallman, Lindblad, Hall, Lundmark, & Ring, 2008) who have used their rubric with slight modifications have used the categories of content, process, and premise reflection as a way to label different types of reflection. A pilot study made clear that online discourse showing evidence of content and / or process reflection as opposed to premise reflection was usually not complicated to distinguish between. Determining the differences between dialogue showing evidence of content versus process reflection was more challenging. It is assumed, as the authors did not explain, this was why Kember et al. (1999) used both content and process reflection as categories in their study, but also ended up making a category labeled content/process reflection.

Mezirow (1991) defines content reflection as reflection on what we perceive, think, feel, or act upon and process reflection as an examination of how we perform these functions of perceiving, thinking, feeling, or acting and an assessment of efficacy in performing them. There has been little agreement in the literature in operationalizing these terms. Some studies (Judicial Studies Board, 2006; Kreber et al., 2000; Wallman et al., 2008), in operationalizing content and process reflection, simply define the two by stating content reflection is reflection on the "what" and process reflection is reflection on the "how" of a situation. These simplified ways to operationalize content and process reflection are seen in Table 19 in the approaches used by the Judicial Studies Board (2006), Kreber et al. (2000), and Wallman et al. (2008). This table shows different definitions or examples of questions that, according to the authors, when answered involve the use of either content, process, or premise reflection. It has been this

researcher's experience that these simplified definitions do indeed make it difficult to differentiate between content and process reflection.

It is this researcher's view that, as you move down Table 19 the definitions/examples of content, process, and premise reflection become more representative of Mezirow's (1991) original explanation of these types of reflection. All examples in Table 19 show that as a participant's writing shows evidence of moving from content to process to premise reflection the role of self-reflection, which can be seen as a process of examining and explaining one's role in an issue and possibly examining how one's thoughts and actions influenced or could influence teaching and learning in future contexts, is greater.

Table 19. Various ways content, process, and premise reflection have been defined or operationalized.

	Content	Process	Premise
Judicial Studies Board (2006)	What information given to participants is at the right level?	How was the training interactive?	No example
Wallman et al. (2008)	What can I do when I meet an angry customer in order to elicit a positive reaction from them?	How can my own feelings upon seeing an angry customer influence how I react to them?	What are the real causes of my and the customers frustrations and what can I do with this knowledge to better the situation?
Kreber et al. (2000)	What should I do to best facilitate learning?	How did I do? Am I successful in facilitating student learning?	Why does it matter if I consider how students learn?
Curtis (2006)	Reflection on what one believes, experiences, or acts upon. This includes all postings where	Reflection on how one comes to their beliefs, experiences, or actions. This includes all postings in which	Reflection on why one has specific beliefs, experiences, or action. This includes all postings

Table 19 - Continued

	students reflect on what they know or believe.	students reflect on the source of their beliefs.	in which students question the validity of a belief.
Cranton (1996)	What indicators are there that students were motivated and how are these associated with my teaching strategies?	Were the indicators I used to determine the level of student motivation adequate? Were the indicators relevant and/or dependable?	Is student motivation my concern or responsibility? Can teachers motivate students at all?
Mezirow (1991)	What characteristics of this issue match up with what I see when this happens? What part of this problem corresponds to what I have seen before?	What features do I notice when I recognize this issue? What procedures am I enacting when I make this judgment? What procedures am I enacting when I perform this skill?	How am I framing the problem that I am trying to solve? What are the criteria by which I make this judgment?

Content reflection is indicative of a deep approach to learning. When participants showed the acquisition of new knowledge as a result of focusing on the content or the description of an issue by providing justifications consistent with their current beliefs, the discourse was labeled as showing evidence of content reflection. Many times, in the eMSS online discourse, messages containing content reflection focused on a description of what was happening in the classroom as students and teachers interacted during the course of a particular lesson, or focused on a description of a topic for discussion in an online discussion area. Such content reflections often focused on student actions and experiences and gave justifications for what students did, or predictions of what students would do if changes were made to the lesson or teaching approach. Habermas (1971) would likely view this as generating knowledge in the technical interest area.

Justifications for claims, in messages showing content reflection, were higher quality than was seen in quasi-reflective discourse. For example the participant will provide more evidence to support his or her claims or new knowledge. This evidence may be in the form of explaining why they have come to have new insights or altered opinions about a particular lesson, or teaching and learning in general, as a result of having reflected on the content of an issue. Unlike quasi-reflective discourse, discourse involving content reflection often displays an intention by the participant to make sense of new ideas found in the analysis of an issue (Moon, 1999).

If, after reading dialogue about an issue, a coder found himself or herself questioning a participant's justification the discourse was likely coded as quasi-reflective or thoughtful discourse. For example, the coder may have felt that the participant needed more evidence to support his or her claim, wondered how the participant could draw a given conclusion from the information in the post, or would have liked to know more about what the students did during a lesson to cause the participant to make this claim.

However if, after reading discourse about an issue, a coder found himself or herself thinking the following thoughts about a participant's discourse the discourse was likely labeled as showing evidence of content reflection. These justifications were explained well and support the claim. These were good explanations about why something happened. I can see why a participant would want to change the lesson in this way. I am satisfied the participant is taking a deep approach to learning. The participant is not just doing the bare minimum to meet program requirements. The participant made

an effort to check evidence against the conclusions they formed.

In a deep approach to learning, participants could reflect on the content or the description of a problem, as described previously. However, when a deep approach to learning included focusing of one's specific role in the process of working with an issue, as opposed to or along with just focusing on what and why students did something during a lesson, the discourse is likely showing evidence of content/process reflection.

This study did not use process reflection as a second type of reflection. However this study did use the content/process category of reflection from Kember et al. (1999) as a second type of reflection in the rubric. Discourse showing evidence of content/process reflection is indicative of a deep approach to learning. In the process of rubric modification for this study, process reflection was seen to be very frequently linked to content reflection. It was difficult to find evidence of process reflection without it being intertwined with content reflection in the same message. Content reflection, in and of itself, could be identified by coders. Content/process reflection could be identified by coders. Process reflection, by itself, was difficult to identify.

In order to operationalize content/process reflection for this study it was useful to look at explanations of process reflection. Mezirow (1991) defines process reflection as reflecting on the effectiveness or appropriateness of strategies used to work with issues or solve problems. Some researchers have used Mezirow's (1991) definition of process reflection to mean if a person writes, "I changed the lab group size from two to three and the lab went more smoothly," the person is showing evidence of process reflection. However, it is this researcher's belief that the literature supports the premise that

Mezirow intends process reflection to be different and of a higher quality than this example.

Mezirow (1991) and Cranton's (1996) examples of process reflection characterize it to be associated with self reflection. Mezirow (1991) gives the following example of process reflection: After reflecting on the content of a problem a person may claim that John is bad. If the person then asks himself or herself whether or not they could have misinterpreted some incident used as evidence for making this claim, the person is using process reflection. Cranton (1996) explains a person may conclude by looking at the content of an issue, that student motivation is a problem. If the person then asks himself or herself questions such as whether or not their effort to find indicators of motivation was adequate, if the same problem came up in another class, or would the same procedure solve the problem, then the person is using process reflection.

The way in which process reflection is operationalized by Cranton (1996) and Mezirow (1991) in Table 19 supports the assertion that process reflection and metacognitive experiences as described by Flavell (1979) are similar. Flavell explains a metacognitive experience can occur any time before, during, or after an intellectual experience. These intellectual experiences are "especially likely to occur in situations that stimulate a lot of careful, highly conscious thinking: in a job or school task that expressly demands that kind of thinking; in novel roles or situations, where every major step you take requires planning beforehand and evaluation afterwards" (p.908). The metacognitive experience is the conscious consideration of the intellectual experience that accompanies any success or failure in learning and is associated with thinking about what sort of

progress one is making or is likely to make.

As a result of a comprehensive synthesis of the literature, the author has concluded that an identifiable difference between content and content/process reflection occurs when a participant has moved from focusing solely on the content or description of an issue to focusing on their role in the issue in such a way as to possibly inform further actions in different contexts (Cranton, 1996). This was seen in online discourse when participants made their thought processes more visible and tangible compared to quasi- and content reflection. Mezirow (1991) explained this is important because knowledge for the learner does not exist in books or in the experience of a mentor or fellow teacher. It exists only in the learner's ability to interpret and reinterpret the meaning of an experience in his or her own terms. eMSS provides a platform for this interpretation.

The aforementioned visibility and tangibility was seen when there were justifications, evidence of the acquisition of new knowledge, or the modification of beliefs that came about as a result of reflecting on the effectiveness or appropriateness of strategies used to work with issues or solve problems while focusing on a participant's thoughts about their role in working with an issue or solving a problem. It is this type of reflecting that is useful in multiple contexts, what a participant gleans from reflecting in this type of message will have implications for other settings.

The key differences coders looked for to distinguish between content and content/process reflection was the quality of the aforementioned visibility and tangibility of a participant's thought process supporting their claims and whether or not the

discourse was focused more on the participant's role in an issue or was just an analysis of what and why students did something during a lesson. Additionally, if a participant's explicit thought processes could be seen to inform not only the lesson at hand but also future lessons, this study operationalized this type of discourse as content/process reflection.

When justifications or the acquisition of new knowledge came about as a result of reflecting on, or making explicit, the assumptions, beliefs, or values underlying the issues of interest, the discourse was labeled as showing evidence of premise reflection. If questioning of a belief system occurred, premise reflection was likely involved. If a participant pondered "why does it matter that I attend to this problem-does it matter that I chose this problem-is there an alternative?" (Kreber, 2005, p. 36) then there is evidence of premise reflection.

Mezirow (1991) explains that premise reflection involves becoming aware of why we perceive, think, feel, or act as we do. Evidence of premise reflection may be seen when participants become critical or examine "epistemic, social, or psychological presuppositions" (p.108). Critical reflection is often defined this way in the literature. However, because the term critical reflection has also been frequently used in the literature to mean different things, the author used the term premise reflection for this study. It has been this researcher's experience that premise reflection is rare but the easiest of the five types of reflection to identify in eMSS online discourse.

Further Action-Element 4. Dewey (1933) posits that reflective thinking "must tend to a conclusion" (p.5). Others propose that reflection is a process which includes

developing an action plan (Gibbs, 1988) or planning for future action (Kolb, 1984). When using the Boyer et al. (2006) rubric, coders looked for evidence of participants writing about further action they might or did take as a result of experiencing, writing, and / or reflecting about an issue.

In the context of the eMSS program this element of reflection is important because a major goal of the program is to modify participants' teaching practice in such a way as to improve student achievement. It is imperative that participants take what they have learned through participating in the online discourse and apply it to their teaching situation. When participants write about further action they are likely showing this connection. In this study coders indicated whether not participants had written about action they took, or planned to take, as a result of reflecting on an issue.

Rubric Refinement. Following the development of the initial rubric, it was piloted by this researcher and a co-rater. The original rubric for discourse analysis was developed by this researcher. After several meetings with co-rater the original rubric was modified to its current form and is found in Appendix E. Our discussions during these meetings, which led to the development of the modified rubric, focused on interpreting the rubric in the context of reaching agreement on coding messages.

Before our first meeting I gave my co-rater a Reflect section of an Inquiry discussion area to read in order to help her begin to understand the structure of eMSS discussion areas. In our first meeting, I described the design and purposes of the eMSS program. I spent time explaining the format of the discussion areas and the asynchronous system under which the program works. Next, I taught her how to use the rubric as

originally developed. After this explanation we practiced using the rubric by coding 18 messages together. This activity lead to interesting discussions and the beginning of the rubric modification process. I gave my co-rater 30 more messages from a Reflect section of an Inquiry discussion area to code prior to our next meeting.

After we both coded the same 30 messages we met again, for the second time, to check our agreement as well as to discuss modifications that needed to be made to the rubric. While discussing reasons for coding a message in a certain way, we both agreed that a deep approach, the highest approach, to learning was fairly easy to identify. The difference between a surface and a surface to deep approach, the lowest and middle approaches, was more difficult to distinguish. It was originally thought that determining a participant's approach to learning would help in determining the highest level of non reflective or reflective discourse used in a message. However, we agreed that the opposite was actually true. The highest level of discourse in a message actually became a good indicator of participants' approach to learning. This may have had to do with the many interpretations or examples of the different approaches to learning. Some of these interpretations, written earlier in this paper were difficult to operationalize. Since far more effort had been put into operationalizing types of non reflective and reflective discourse, we decided, when using the rubric, to first indicate the highest level of discourse in a message. Then, we would determine how the discourse aligned with the explanations of the different approaches and indicate the participants' approach to learning in a given message on the rubric.

For the vast majority of messages we found those coded as Thoughtful and Quasi-reflective discourse aligned well with a surface approach to learning. Messages having discourse coded as Content/Process or Premise aligned well with a deep approach to learning. Messages coded as Content-short and Content usually aligned with a surface to deep approach to learning. Although a fair amount of Content-short messages were coded as a surface approach to learning and some messages coded as Content were coded as a deep approach to learning. Messages coded as Content and Content-short best represented an area of overlap between a surface and deep approach to learning. This overlap has been seen in the reflection literature when researchers are looking for evidence or the lack of evidence of reflection in students' work (Moon, 1999; Peltier, Hay, Drago, 2005).

Additionally, in this second meeting I found that I needed to better describe Content/Process reflection to my co-rater. It is not that a lack of agreement for this coding existed between us so much as a lack of understanding on her part as to what was meant by Content/Process reflection. Originally, my co-rater had rated messages as containing evidence of Content/Process reflection when the participant made statements similar to "I need to make sure each student has their own set of dissecting tools next time" or "I will allow more time for this lab next time I do it." I explained to her that Content/Process reflection is a type of reflection indicative of a deep approach to learning, probably not commonly found in eMSS discourse, which focuses on the role of the individual participant in a way that can be useful outside the context of a singular lesson or eMSS Inquiry topic. Table 20 shows an example of Content/Process reflection. What this

mentor has learned by participating in an Inquiry about diversity is something that can be applied to many other lessons and it is focused on what the participant can do, as opposed to her students, to facilitate improvement in this area.

Table 20. An example of Content/Process Reflection, coded as a 6, written by a mentor and submitted to the Reflect section of an Inquiry discussion area.

Hi everyone, it has been so valuable to me to be matched up with my mentee, (name), these last two years as her population at (her school) is so different from her own. Her signing up for this inquiry gave me the reminder that even within racial groups, there is still diversity. *It's very easy for me to get bubble vision teaching in such a well-to-do area (area listed), and it's a disservice to my kiddos. So often I differentiate for academic levels but differentiating for socio economics, for example, does not always to occur to me; for example, although MANY of my students have computer experience, this pat Sept., when I took the kiddos into the lab to do a scavenger hunt on my website, I had to show two kids (7th graders) how to use a mouse. I have a diversity of science experience in my classroom. This is not just what their experience was in elementary school (for example, there is a World Education program across the street that feeds us many students who have experienced science in a global ed sense, but no lab experience) but also their experience at home (I have numerous students whose parents work in labs, one student even had already run gels before with his dad who works at Salk). Juxtapose this to the student who comes to me from an elementary that virtually eliminated science to increase time for test prep for NCLB…. these experiences figure into learning and accessibility in my classroom, and I need to remember that. I'm trying out an exit survey this year to measure their science experience as they leave…. next year, I'll use it as a pre and post.* *The structure of this inquiry, first examining your classroom and then applying a test in that context, was a terrific way to measure how those differences figure into your instruction and student learning. I enjoyed reading the insights presented here.*

Furthermore, discussions during this second meeting helped us realize the necessity of developing a flow chart to better focus both of our approaches when analyzing messages. Designing a singular rubric to rate something such as eMSS online discourse which followed no specific presentation format was the single most difficult

challenge of this research. The flow chart streamlined our coding efforts by having us look for a claim(s) and justification(s) associated with the claim(s) at the beginning of the analysis for each message. The flow chart had us reading the message in its entirety and then hunting for claim(s) and justifications(s) if they existed. The flow chart was not the rubric but a guide for using the rubric more efficiently. The flow chart can be found in Appendix F.

For our third meeting my co-rater and I checked agreement on another set of 27 identical messages which we had coded independently prior to the meeting. Two main issues concerning the design of the rubric were articulated in this meeting. First, we were lacking agreement in our designations of messages as Thoughtful or Quasi-reflective. If a message had any type of justification I was rating it as Quasi-reflective whereas my co-rater would label it as Thoughtful unless the justification 'showed greater thought' in which case she labeled it as Quasi-reflective. We vacillated with this issue. After coding more messages together we came to the conclusion that it can be a fine distinction between Thoughtful and Quasi-reflective dialogue. But because it was frequently difficult to define and operationalize what is meant by 'showed greater thought' we agreed that if a message had any type of justification it would be classified at a minimum as containing Quasi-reflective discourse. In the end the most important thing for this study's data analysis is that both message types are still considered low level discourse.

The second main issue we focused on in this third meeting was the fact that we were seeing two types of Content reflection in the eMSS online discourse. When participants reflected on the content of a lesson it was often because they were

specifically asked to do so. Many participants' messages to this end seemed to contain the minimum amount of words to satisfy this eMSS program requirement. However, occasionally a participant would submit a message which went far beyond the scope of just meeting the discussion area requirement and showed a high level of reflection by the participant while focusing on the content of a lesson. My co-rater and I struggled with giving these messages the same rating as one type of message seemed to represent a deeper approach to learning and a higher level of reflection by the participant. We therefore decided to include two types of Content reflection codings in the rubric. Various notes from one of our meetings are found in Appendix G.

Messages were coded as Content-short when participants' messages were interpreted as merely being written to meet the minimum requirement of a discussion area curriculum while focusing on the success or failure of the lesson and ways to modify and improve the lesson. These messages were coded as a four. The majority of participants, when asked to reflect about a lesson, did not write in detail about the reasons why or justifications for why something went the way it did or why they would change something about the lesson next time. When a participant went into greater detail with their explanation and justifications for their claims when writing about the content of a specific lesson, the message was labeled as Content Reflection and coded as a five. A rating of a five would be seen as the "rich dialogue" (eMSS Guidelines for Online Learning and Facilitation) the eMSS program hopes to encourage. Table 21 shows a message coded as a Content-short and one coded as a Content reflection. Both focused on the content of the lesson.

Table 21. Examples of messages coded as Content-short and Content reflection.

Message coded as Content-short, written by a mentee, and submitted to the Reflect section of an Inquiry discussion area.
I think the lab had great qualities. Again, I would like to suggest having real frogs or toads for external examination might reveal inquiry questions from students themselves. They would up their level of understanding by looking at the whole before the parts. Also, scaffolding back to our own systems in review might help set up the students for understanding endotherms vs. ectotherms and the differences between 3 and 4 chambered hearts. Frogs organs are so clean and such in great order, they really help kids understand the order of mammals also. Maybe also, looking at the flow of the year with human systems being closer to amphibian systems so the link up is in more recent memory.

Message coded as Content Reflection, written by a mentee, and submitted to the Reflect section of an Inquiry discussion area.
Today I started my next project, which is my Solar System Book. My plan is that while these students are working on this project over the next week, I will be able to call each group up to go over their writing piece on the Rock Cycle, as well as verbally quiz each person in the group, on one step in the rock cycle, for example, describe to me how a rock changes from igneous to sedimentary rock.

I found for the most part the writing was quite good and I was really impressed with what they wrote. A few groups forgot one or two things, but not much. There was a group of one or tow on my team, who just didn't write anything, and handed in what their game pieces did when they played, but never expanded or described what it all meant. This was disappointing, as I cannot help students learn to write, if they won't write. (Quite honestly, it's been a frustration all year for me, students just flat out not doing any work at all.)

As far as the verbal assessment went, boy did it take longer than I intended and I found I had to really limit what I asked each student so that I could get it all in. I also found that limiting what I asked them worked really well too, because they either had to know it or not, and they didn't know which part of the rock cycle I was going to ask them about. The verbal assessment was well worth it!! It really gave me a quick idea of whether the students learned and understood the Rock Cycle. Most students had a really grasp of the rock cycle. Some just had a hard time getting it out in words, which probably explains their difficulty in writing a little bit too. Even some of my best students, when called to the carpet to explain something, had a little bit of a hard time.

Interestingly enough. I found that many of students who actually didn't do the physical writing, knew less than the students who actually did the physical writing. I think that next year, I may ask for each to write their own game piece's path, or at least make it done in pairs within a group, instead of one writing per 4 people. I'll really have to reflect on this further to decide what I should do next year. Hard to say at this point, because I loved how this whole project went. Very successful I thought.

After this third meeting we both felt the rubric was in a form that was acceptable for coding messages. Table 22 shows the final explanations of the seven discourse coding categories used in this study. Using the rubric found in Appendix E, my co-rater and I individually coded 16 identical messages which represented one entire discussion thread from a Reflect section of an Inquiry discussion area. The Spearman's rho correlation coefficient was used for testing inter-rater reliability (Adam & Cornelius, 2006). The Spearman's rho correlation for these 16 messages was .63 (p=.01). This score indicates a marginally acceptable agreement between two coders (Gravetter & Wallnau, 2004). After scrutinizing these results I deemed it necessary to have another discussion with my co-rater about how to identify Content/ Process reflection. Following this discussion we each individually coded 30 messages which represented one entire discussion thread from a Reflect section of an Inquiry discussion area. The Spearman's rho correlation for these 30 messages was .81, indicating an acceptable degree of consistency between my co-rater and myself (Gravetter & Wallnau, 2004). This agreement as well as an increasing level of agreement between myself and my co-rater points to reliability in the coding process.

Table 22. Explanations of the types of discourse identified in this study.

Level	Type of Discourse	Explanation of Discourse
1	Procedural Discourse	Non Reflective: Discourse focused on aspects of the eMSS program such as assignment explanations or technical issues. Discourse expressing encouragement or gratitude, explaining science content, and miscellaneous discourse. This type of discourse was identified in the Discourse Format section of the rubric.
2	Thoughtful Discourse	Non Reflective: Discourse associated with a surface approach to learning. Discourse in which participants describe what they saw, what they did, what they do in certain situations, or how they felt about an issue without providing any explanation why.
3	Quasi-Reflective Discourse	Quasi-Reflective: Discourse associated with a surface approach to learning. Discourse in which participants write to superficially or pragmatically explain why something occurred, why they did or do something in a certain situation, why they felt a certain way, or why they would do something in the future.
4	Content-short	Low-level Reflective: Discourse associated with a surface approach to learning. Discourse in which participants' messages were interpreted as being written to meet the minimum requirement of a discussion area curriculum while focusing on the success or failure of the lesson and ways to modify and improve the lesson. Messages do not contain detailed justifications for why something went the way it did or why participants would change something about the lesson next time. (When a participant went into greater detail with their explanation and justifications for their claims when writing about the content of a specific lesson, the message was labeled as Content Reflection.)
5	Content Reflection	Reflective: Discourse associated with a deep approach to learning. Discourse in which participants focused on the content of an issue by providing justifications consistent with their current beliefs. Frequently, a message containing content reflection focused on a description of what was happening in the classroom as students and teachers interacted during the course of a particular lesson. They focused on student actions and experiences and gave justifications for what students did or predictions of what they would do if changes were made to the

Table 22 - Continued

		lesson or teaching approach. (Unlike quasi-reflective discourse, discourse involving content reflection often displays an intention by the participant to make sense of new ideas found in the analysis of an issue (Moon, 1999).)
6	Content/Process Reflection	Reflective: Discourse associated with a deep approach to learning. Discourse in which participants made their thought processes more visible and tangible compared to quasi- and content reflection. This was seen when justifications or evidence of the acquisition of new knowledge came about as a result of reflecting on the effectiveness or appropriateness of strategies used to work with issues or solve problems while focusing on a participant's thoughts about their role in working with an issue or solving a problem. What a participant gleans from Content/Process reflection will have implications for other settings. (The key differences coders looked for to distinguish between content and content/process reflection was the quality of the aforementioned visibility and tangibility of a participant's thought process supporting their claims and whether or not the discourse was focused more on the participant's role in an issue or was just an analysis of what and why students did something during a lesson.)
7	Premise Reflection	Reflective: Discourse associated with a deep approach to learning. Discourse in which participants' justifications or the acquisition of new knowledge came about as a result of reflecting on, or making explicit, the assumptions, beliefs, or values underlying the issue. Mezirow (1991) explains that premise reflection involves becoming aware of why we perceive, think, feel, or act as we do.

Statistical Analysis. Once the online discourse was coded, using the rubric described above and found in Appendix E, results were explained using frequency descriptions. Then a series of statistical tests were used to better answer the research questions. Independent t-tests and a One Way Analysis of Variance (ANOVA) were used to examine the data from this study. Independent t-tests were used to examine whether there was difference in mean discourse levels in messages between novice and

experienced science teachers. The ANOVA was used to examine whether significant differences existed in the mean levels of discourse across different discussion areas. An independent t-test was also used to examine whether there was difference in mean discourse levels in messages between messages submitted to a Dilemma discussion area and a Topic of the Month discussion area. These tests are described in greater detail in Chapter 4.

Reliability in this study is addressed earlier in this chapter when the process of establishing inter-rater reliability among coders was discussed. Although a reasonable level of inter-rater reliability was attained with the revised rubric, because of complex nature of data it was sometimes difficult to reach agreement when assigning discourse to a category.

All samples are nonprobability samples so external validity (Gliner & Morgan, 2000) will be affected. The results are not necessarily generalizable to discourse in all professional development programs emphasizing reflection. Because the eMSS participants whose discourse was examined were part of an induction program in which participation is voluntary, the teachers may not be representative of those in professional development programs with different recruitment procedures, and therefore their discourse may not be representative.

CHAPTER FOUR

RESULTS OF THIS STUDY

Introduction

This chapter includes the results of the analysis of data collected in this study. The first section of this chapter describes the process involved as my co-rater and I worked to modify and reach agreement with the discourse analysis rubric. The second section of this chapter presents qualitative and quantitative results of the online discourse analysis associated with the first research question focused on the different types of non reflective and reflective discourse used by mentors and mentees. The third section of this chapter presents qualitative and quantitative results of the online discourse analysis of the four different discussion areas analyzed for this study and uses these results to compare the non reflective and reflective discourse found in various discussion areas of the eMSS program. The fourth section of this chapter describes the qualitative and quantitative results associated with writing about further action within a message. The final section of this chapter presents the results of the discourse analysis associated with the non reflective and reflective discourse seen in conjunction with different issues discussed by participants. The concepts of deep and surface approaches to learning are interwoven into the discussions and analysis found in sections two through five. These four sections of chapter four found are written in order to help answer the three questions comprising this research, listed here for reference.

1. Which elements of non reflective and reflective discourse are found in the types of discourse that experienced science teachers, participating in a professional development program, write? Which elements of non reflective and reflective
discourse are found in the types of discourse that novice science teachers, participating in a professional development program, write? How can any observed differences be interpreted?

2. Which elements of non reflective and reflective discourse, written by participants in an online professional development program, are seen in discussion areas varying in content and format? How can any observed differences be interpreted?

3. To what extent are issues prominent in the National Science Education Standards present in the teachers' discourse, and is there a relationship between the presence of particular standards-based issues and the level or type of reflection?

Discourse used by Experienced and Novice Science Teachers

This section presents the results of the online discourse analysis as it relates to the types of non reflective and reflective discourse used by experienced and novice science teachers in different online discussion areas of eMSS. For this study mentors, facilitators, and university content specialists were classified as experienced science teachers. Mentees were classified as the novice teachers.

The discourse analysis used for this study coded only the highest level of discourse found in any selected message. All messages in any given selected discussion thread were analyzed for their non reflective and reflective content. Discourse was rated on a scale of 1-7. A rating of one or two indicated non reflective discourse as the highest level of discourse found in a message. A rating of three indicated Quasi-reflective discourse as the highest level of discourse. A rating four signified Content-short reflective discourse as the highest level of discourse. A rating of five, six, or seven

indicated a type of in-depth reflective discourse as the highest level of discourse in a message. Table 23 provides explanations of the seven discourse coding categories.

Table 23. Explanations of the types of discourse identified in this study.

Level	Type of Discourse	Explanation of Discourse
1	Procedural Discourse	Non Reflective: Discourse focused on aspects of the eMSS program such as assignment explanations or technical issues. Discourse expressing encouragement or gratitude, explaining science content, and miscellaneous discourse. This type of discourse was identified in the Discourse Format section of the rubric.
2	Thoughtful Discourse	Non Reflective: Discourse associated with a surface approach to learning. Discourse in which participants describe what they saw, what they did, what they do in certain situations, or how they felt about an issue without providing any explanation why.
3	Quasi-Reflective Discourse	Quasi-Reflective: Discourse associated with a surface approach to learning. Discourse in which participants write to superficially or pragmatically explain why something occurred, why they did or do something in a certain situation, why they felt a certain way, or why they would do something in the future.
4	Content-short	Low-level Reflective: Discourse associated with a surface approach to learning. Discourse in which participants' messages were interpreted as being written to meet the minimum requirement of a discussion area curriculum while focusing on the success or failure of the lesson and ways to modify and improve the lesson. Messages do not contain detailed justifications for why something went the way it did or why participants would change something about the lesson next time. (When a participant went into greater detail with their explanation and justifications for their claims when writing about the content of a specific lesson, the message was labeled as Content Reflection.)
5	Content Reflection	Reflective: Discourse associated with a deep approach to learning. Discourse in which participants focused on the content of an issue by providing justifications consistent with their current beliefs. Frequently, a message containing content reflection focused

Table 23 - Continued

		on a description of what was happening in the classroom as students and teachers interacted during the course of a particular lesson. They focused on student actions and experiences and gave justifications for what students did or predictions of what they would do if changes were made to the lesson or teaching approach. (Unlike quasi-reflective discourse, discourse involving content reflection often displays an intention by the participant to make sense of new ideas found in the analysis of an issue (Moon, 1999).)
6	Content/Process Reflection	Reflective: Discourse associated with a deep approach to learning. Discourse in which participants made their thought processes more visible and tangible compared to quasi- and content reflection. This was seen when justifications or evidence of the acquisition of new knowledge came about as a result of reflecting on the effectiveness or appropriateness of strategies used to work with issues or solve problems while focusing on a participant's thoughts about their role in working with an issue or solving a problem. What a participant gleans from Content/Process reflection will have implications for other settings. (The key differences coders looked for to distinguish between content and content/process reflection was the quality of the aforementioned visibility and tangibility of a participant's thought process supporting their claims and whether or not the discourse was focused more on the participant's role in an issue or was just an analysis of what and why students did something during a lesson.)
7	Premise Reflection	Reflective: Discourse associated with a deep approach to learning. Discourse in which participants' justifications or the acquisition of new knowledge came about as a result of reflecting on, or making explicit, the assumptions, beliefs, or values underlying the issue. Mezirow (1991) explains that premise reflection involves becoming aware of why we perceive, think, feel, or act as we do.

A total of 911 messages from six different Reflect sections of Inquiry discussion areas, four different Content discussion areas, and four different Specific Topics discussion areas, which include Topic of the Month and Dilemma discussion areas, were analyzed for this study. These 911 messages were used for the following analysis. The

109 messages from the Self-Reflection and Self-Assessment assignments in the Inquiry discussion areas were also analyzed for this study. However, these 109 messages are not included in the following analysis and discussion. (They were not part of an actual discussion so much as they were the written responses to four assigned questions. Novice science teachers submitted these to a specific assignment turn in area that was not public to any other novice science teacher. Facilitators usually responded to each of these a assignments with a 'good job' type response and that was the end of the dialogue exchange. These messages are discussed beginning on page 43.) All messages were coded using the discourse analysis rubric found in Appendix E.

Experienced Science Teachers

Table 24 compares the percent of each type of discourse found in messages submitted by experienced science teachers and submitted to the Content, Special Topics, and the Reflect sections of Inquiry discussion areas.

Table 24. Types of discourse found in messages submitted by experienced science teachers.

Rating	Type of Discourse	# of messages	% of messages
1	Procedural Discourse	469	74.92%
2	Thoughtful Discourse	38	6.10%
3	Quasi-reflective Discourse	76	12.14%
4	Content-Short	37	5.91%
5	Content	1	.16%
6	Content-Process	4	.64%
7	Premise	1	.16%

A vast majority of these messages showed non reflective discourse, Procedural or Thoughtful, as the highest level of discourse put forth by a participant in their message. Experienced science teachers submitted a high percent of messages coded as Procedural. Messages coded as Procedural discourse were rated as a one is indicative of discourse that gives instructions based on eMSS curriculum, ask questions for all to answer, provide technical assistance, provide encouragement, provide teaching advice, provide teaching resources, or provide content knowledge.

Messages rated as Thoughtful discourse were also considered to be non reflective with respect to their content. When experienced science teachers went beyond the scope of those instances coded as Procedural and provided Thoughtful discourse lacking in explanation or justification, the discourse was rated as a two. Messages rated as a three were considered to be Quasi-reflective. A message rated as three would contain some type of underdeveloped or simplistic justification as to why the experienced science teacher believes their claim. A claim may be a feeling they have about an issue, a description of a teaching methodology they use, or an examination of a curriculum sequence they follow, for example. Of the messages submitted by experienced science teachers, 93.16% were rated as a three or less. These messages would likely not be considered “rich dialogue” as described in the eMSS Guidelines for Online Learning and Facilitation or as moving teachers “along a professional continuum from survival to focused problem solving to critical reflection on teaching practice.” Table 25 gives an example of discourse written by three different experienced science teachers that was coded as one, two, and three.

Table 25. Discourse coded as a one, two, and three written by three different experienced science teachers.

Procedural Discourse: Coded as a 1. *Dear Mentees, You have done a terrific job in this inquiry. You are very inspiring to everyone in the inquiry. Keep up the good work. Be proud of yourself that students are learning and enjoying science through your efforts.* Thoughtful Discourse: Coded as a 2. *I feel my participation in this inquiry helped to open the eyes of other educators to alternative methods of instruction. These new methods will facilitate our students transition in the modern technological world. I also learned from others methods and opportunities that I can use and spread through my building.* *The major insight into technology I have found is that is not the ultimate answer to all educational problems. It is a tool that must be used properly to be effective. It is another WEAPON our arsenal to develop a differentiated classroom.* *I have (applied) and been accepted into the 21st century program and will undergo extensive technology and (pedagogical) instruction this summer.* Quasi-Reflective Discourse: Coded as a 3. *It sounds like your lab went very well. I think I may try it next year with my kids. I like the idea if doing the lab as a whole class so you can help them through each section and debrief as you go along. I did that with my competition lab, and even with 30 students it went well this way. Giving the quiz as a take home might still be a good idea because it could let them show their knowledge in a different way.*

Only 5.91% of experienced science teachers' messages were coded as Content-short. The Content-short coding existed in the rubric primarily because novice science teachers were asked to do this type of writing quite frequently in certain eMSS discussion areas as explained earlier in this chapter. Experienced science teachers were not required to partake in such an activity as often as novice science teachers. When experienced science teachers summarized the content of a discussion thread this message was coded as Content-short. The content reflected on in this case was not the content of a classroom lesson but the content of a discussion thread.

Messages rated as a five, six, or seven would be considered to be displaying higher levels of reflection compared to messages with a rating of one through four. These messages likely correspond to the "rich dialogue" as described in the eMSS Guidelines for Online Learning and Facilitation or as a type of discourse that would move teachers "along a professional continuum from survival to focused problem solving to critical reflection on teaching practice." Only .96% of messages submitted by experienced science teachers were rated with a five, six, or seven. Table 20 in Chapter 3 shows an example of Content/Process Reflection, coded as a six, written by a mentor and submitted to the Reflect section of an Inquiry discussion area. Table 26 shows an example of discourse written by experienced science teacher that was coded as premise reflection and was also submitted to the Reflect section of an Inquiry discussion area. Actually, in this message the experienced science teacher is explaining a process, which qualifies as premise reflection, she has undergone in the past. In the first paragraph she makes explicit her beliefs about why she behaved the way she did (Mezirow, 1991). She treated all students equally because she thought it would be enough. She has contemplated whether or not it matters that she chose this, minority student involvement in science and advanced science classes, as an issue to consider (Kreber, 2005) by giving several justifications as to why this problem was important to think about. For example, she explains that by recognizing students for their differences she was able to make progress. She also knows that by considering this issue she has had a positive impact on her students post secondary school choices.

Table 26. An example of Premise Reflection, coded as a 7, written by an experienced science teacher and submitted to the Reflect section of an Inquiry discussion area.

… I was also very interested in your observation that you need to become more proactive in your approach to tackling the problem of minority involvement in science and advanced science classes. I have also had to learn this lesson over time. I used to think that if I just treated everyone equally, it would be enough. But I have certainly learned over the years, that I need to "proactively' incorporate all the many cultures at my school into my classroom, through building relationships as well as through my design of curriculum and choice of learning activities. When I recognize my students for their very diversity, instead of trying to erase its presence, then I am able to make progress. When my minority students see that I understand some of their obstacles and will help them take on the challenges of science, they respond with energy and engagement. And when I can engage all students in the learning process, they all benefit! *…I know I have made a difference when I hear that my former minority students are majoring in science-or even better yet, are planning on becoming science teachers! And this has happened many times over the years.* *I really appreciated your first step, which was to go and interview a minority teacher at your school. My greatest source of knowledge, understanding, help, and wisdom has come from my minority colleagues-some of whom have become life-long friends through this personal growth with the common interest of helping all students learn.* *My own life has been enriched so much by the process of working with all my students. But learning to know my minority students better has brought me so much pleasure over the years. The caring, extra energy, and efforts to engage and involve them in science have really brought me great joy.*

Procedural discourse is important for conveying instructions and clarifications, keeping a discussion moving along, and providing different types of support to participants. One should not be disappointed that procedural discourse is not reflective. It serves a purpose in the discussion area and that purpose has little if anything to do with being reflective. Therefore, it is of interest to analyze the data with procedural discourse removed from the data set. With procedural discourse removed, the percent of each type of discourse found in messages composed by experienced science teachers is modified

and is found in Table 27. With procedural discourse removed from the analysis, 72.61% of experienced science teachers' messages were coded as a two or three and were considered to be low level discourse with respect to reflection. As a reminder, when procedural discourse was included in this analysis, 93.16% of messages were coded as a three or less.

Table 27. Distribution of discourse within the non-procedural subsample of discourse found in messages submitted by experienced science teachers.

Rating	Type of Discourse	# of messages	% of messages
2	Thoughtful Discourse	38	24.20%
3	Quasi-reflective Discourse	76	48.41%
4	Content-Short	37	23.57%
5	Content	1	.64%
6	Content-Process	4	2.55%
7	Premise	1	.64%

One reason for a high percentage of discourse being rated quite low rests with the role of experienced science teachers in eMSS. They, more than novice science teachers, are required and / or inclined to give instructions based on eMSS curriculum, ask questions for all to answer, provide technical assistance, provide encouragement, provide teaching advice, provide teaching resources, or explain science content. Messages pertaining to these types of issues would not lend themselves necessarily to the use of reflective dialogue when preparing messages to submit. For example, in some discussion threads experienced science teachers made sure to encourage or thank every

novice science teacher who submitted a message. While nice, this message would not be identified as reflective. Experienced science teachers, more frequently than novice science teachers, provided teaching advice or resources. Again, while possibly helpful, this message would not be identified as reflective. If experienced science teachers had provided an in depth justification or rationale for their instructional advice, the message could have been rated higher as a five, six, or seven. But this type of explanation was rarely given by experienced science teachers. Additionally, experienced science teachers, more frequently than novice science teachers, submitted messages that asked questions to be answered by anyone, as they arose in a thread. While important to keep the discussion moving, these messages were not rated as reflective in this study.

Novice Science Teachers

Table 28 shows the percent of each type of discourse found in messages composed by novice science teachers and submitted to the Content, Special Topics, and the Reflect sections of Inquiry discussion areas.

Table 28. Types of discourse found in messages submitted by novice science teachers.

Rating	Type of Discourse	# of messages	% of messages
1	Procedural Discourse	97	34.04%
2	Thoughtful Discourse	27	9.47%
3	Quasi-reflective Discourse	83	29.12%
4	Content-Short	48	16.84%
5	Content	17	5.96%
6	Content-Process	13	4.56%
7	Premise	0	0.00%

A majority of these messages showed no or low levels of reflection. Of the 285 messages submitted by novice science teachers to the six different Reflect sections of Inquiry discussion areas, four Different Content discussion areas, and four different Specific Topics discussion areas, which include Topic of the Month and Dilemma discussion areas, 72.63% were rated as a three or less. Again, these messages would not likely be considered "rich dialogue" as described in the eMSS Guidelines for Online Learning and Facilitation. Table 29 gives an example of discourse written by novice science teachers that was rated as one, two, and three.

Table 29. Discourse rated as a one, two, or three submitted by three different novice science teachers.

Procedural Discourse: Coded as a 1. *I do have some trays left over from previous experiments and will try using those next year. Thanks for the great idea!*
Thoughtful Discourse: Coded as a 2. *I finally completed my Sedimentary Rock Lab where students used 3 different recipes to create sedimentary rock. They then devised methods to test and measure how strong their rocks were. They came up with a variety of ways. The majority of them decided that it was best to test the rocks by dropping them from increasing heights. One group timed how long it would take them to dissolve in a cup of water. Several other groups added text books on top of the rocks until they reached the breaking point. It was fun to see what they did when they ran out of text books and had to have someone sit on the text books. They would start with the smallest person first!* *After the rock making and testing they did some reading to understand how sedimentary rocks are made: clastic, chemical, and organic. When we reviewed their lab write-ups we compared how we made rocks to how clastic rocks are made. They were better able to understand the compaction and cementation much better once they had done it themselves.*
Quasi-Reflective Discourse: Coded as a 3. *I think one of the keys to getting students to perform is to develop an actual relationship with them.*

Table 29 - Continued

So often, students have had a string of teachers who are "stuck" teaching low level classes and hate every minute of it. If the teachers don't like them, the students aren't willing to do very much. *Because of this, it doesn't take very much to initiate that relationship with the students. As soon as they see that you actually care about them and how they're doing, they will be more willing to work for you. I found this to be true even when I was a student teaching in CPS. The students had so many teachers who didn't care what they did even though I was inexperienced, they responded more positively to me because I would actually listen and talk to them.*

Messages containing Content-short reflection, rated as a four, as the highest form of discourse comprised 16.84% of messages submitted by novice science teachers. Only 10.52% of messages submitted by novice science teachers were rated with a five, six, or seven. Table 24 shows examples of discourse written by a novice science teacher, coded as a four, Content-short, and a five, Content Reflection. Table 30 shows an example of discourse written by a novice science teacher that was coded as a six, Content/Process Reflection. This message shows the participant working with meaning (Moon, 1999) as they reflect on the content of an Inquiry in which they are participating, Diversity in Science Education, while also reflecting on their role in the problem-solving process and their effectiveness thus far in working with diversity issues.

Table 30. Discourse coded as a six written by a novice science teacher and submitted to the Reflection section of an Inquiry Discussion area.

For my inquiry, I decided to interview an experienced African-American history teacher in our school. This lady also been a parent of 2 students at our high school, so I figured that she would have a good perspective on the diversity issues our school is facing. I wanted to try and understand more about why our X and AP program has relatively few minority kids compared to the general school population.

Table 30 - Continued

To reflect, I think that I found out I need to be more proactive in my approach to diversity. It is not that anybody would come over and say that the minority kids are unwelcome in these classes, but there are certain elements in our school and our society that make it more difficult (for) these kids to be successful. Some of these are less preparation from their middle schools, factors resulting from lower socio-economic status such as having to work after school and not having parents push them as hard academically, and lack of minority role models who (have) been successful in sciences.

I order to counteract these things, I thought of several things I could do:

1. *Actively celebrate the contributions made to science by minority scientists. I have purchased several posters for my room for next year that document the achievement of black scientists. Also, we will celebrate Black history Month with a focus on several black chemists.*

2. *We are going to join the National organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOPABCCE). I would love for us to take a team to the national science bowl competition in St. Louis, Missouri, April 2009. This will be my goal next year. I am writing a grant already.*

3. *I have noticed that I need to alter my teaching style to appeal to more diverse population of students to get them engaged in chemistry. Our new book (active chemistry) works very well with this. We have just completed a unit on soap, which I noticed that my minority girls were really excited about! They could see real connections between what they were interested in (cosmetics) and chemistry. Their chapter challenge was to make their own soap. They came in after school to work on their soap, something they haven't done all year. They brought in various rich scented oils and lotions to make it smell good and feel soft against their skin. In short, they came alive!*

This was really a way for them to bring in elements from their culture into our chemistry classroom. We learned all about hydrocarbons, fatty acids, and saponification reaction. We talked about the effect of saturation and unsaturation on the type of soap. We talked about hydrocarbon chain length and how this affects soaps properties. Hard water vs soft water, surfactants, miscelles and emulsions- we did it all!

Table 30 - Continued

In fact, they loved it so much, I am planning on writing another grant to get us some real soap making supplies. We have a fabulous African-American boutique by our school that sells many essential oils from Africa. I would like to purchase some of these for my students to use so we can make even more fantastic soaps next year. I am amazed at how much they can learn when they want to.

With procedural discourse, rated as a one, removed from the analysis, the percent of each type of discourse found in messages composed by novice science teachers is modified and is found in Table 31. With procedural discourse removed from the analysis, 58.51% of experienced teachers' discourse were rated as a two or three and would be considered to be low level discourse with respect to reflection.

Table 31. Distribution of discourse within the non-procedural subsample found in messages composed by novice science teachers.

Rating	Type of Discourse	# of messages	% of messages
2	Thoughtful discourse	27	14.36%
3	Quasi-reflective discourse	83	44.15%
4	Content-short	48	25.53%
5	Content	17	9.04%
6	Content-Process	13	6.91%
7	Premise	0	0.00%

A little over a third of messages submitted by novice science teachers were coded as Procedural discourse. In these messages, novice science teachers are seen asking for and thanking fellow participants for teaching advice or resources. Occasionally novice science teachers felt confident enough to offer teaching advice to fellow participants.

While these types of messages were not coded as reflective, they can be important and may be indicative of other characteristics novice science teachers are developing as they move through the program, such as confidence in their teaching ability.

Frequently, messages submitted by novice science teachers seemed to be written with the express purpose of meeting the minimum requirement of a particular eMSS discussion area. For example, in the Reflect sections of Inquiry discussion areas novice science teachers are asked to reflect on the lesson associated with the Inquiry topic. Most did this by using a few sentences to express how they felt about the lesson, what went well, and what they might change. Whether you look at the data in Table 30 or Table 31 novice science teachers seem to do an adequate job of moving beyond thoughtful discourse, which usually were just descriptions of situations without any attempt at an explanation of the situation, to writing messages that were Quasi-reflective or Content-short. Hatton and Smith (1995) may remind us at this point that lower levels of reflection, similar to Quasi-reflective and Content-short, may be appropriate and desirable for the situation. They contend that all participants should be able to reflect at all levels depending on the context of the reflection or assignment.

Within the current structure of the eMSS program, novice science teachers have shown they are capable of reflecting at a higher level. An example is in Table 30. What motivates a participant to take a deep approach to learning and reflect at a higher level? Is it a question of motivation? Research supports that participants are more likely to be reflective if they are interested in a topic (Peltier, Hay, & Drago, 2005) and/or their view of knowledge (Whitmire, 2004). Other research maintains that the ability of a

person to be reflective is associated with their developmental state (Cranton, 1996; Hatton and Smith, 1995). If this is true, one may expect to see more reflective dialogue from experienced teachers compared to novice science teachers. This was not seen in the previous data. With messages coded as procedural excluded form the data, experienced science teachers only had 3.82% of their messages coded as a five or higher whereas 15.96% novice science teachers' messages were coded as a five or higher. This data may support the premise that reflection is more strongly related to the framework (Moon, 1999) or curriculum structure guiding it as opposed to the developmental state of those reflecting, at least in the eMSS program. This issue is important because eMSS discussion area facilitators may find it useful to know where to concentrate their time and energy. Should facilitators, before asking participants to reflect, have participants take part in activities designed to assist them in their cognitive development as it relates to reflective thinking? Or, should facilitators ignore a participant's developmental state and spend time fine tuning the curriculum guiding the dialogue between participants?

Comparison of Non Reflective and Reflective Content of Experienced and Novice Science Teachers' Messages

Experienced science teachers and novice teachers engage in online discourse with each other in the eMSS program with the overarching goal of improving the practice of teachers and their students' achievement. When analyzing the non reflective and reflective content of participants' discourse, 74.92% of experienced science teachers' discourse was procedural and therefore non reflective. This high percentage of messages labeled as procedural supports the assertion that experienced science teachers see one of

their primary roles in eMSS as that of providing discussion area guidelines, instructional advice, teaching resources, and encouragement. A lesser amount, 34.04%, of novice science teachers' discourse was rated as procedural. These messages typically had novice science teachers expressing gratitude, sharing teaching advice, and supplying teaching resources but not nearly to the degree found in experienced science teachers' messages. A comparison of these two percentages supports the claim that experienced science teachers play a different role, compared to novice science teachers, in the eMSS discussion areas and this role lends itself to the submission of a high percentage of messages containing non reflective discourse.

Both novice and experienced science teachers are submitting a high percentage of Quasi-reflective discourse. They are making a claim and supporting this claim with a justification or explanation which is indicative of a surface approach to learning and would be considered low level in the context of reflection. Only infrequently are experienced or novice science teachers submitting messages indicative of a deep approach to learning and containing evidence of a high level of reflection to these discussion areas. This has partly to do with the aforementioned roles experienced and novice science teachers see themselves playing in the eMSS program. This lack of high level reflection is also likely associated with but not limited to other factors such as discussion area design, facilitator instructions, and the aforementioned curriculum issues.

Three independent t-tests were conducted to determine if there was a difference in mean discourse level found in messages, across discussion areas, between novice and

experienced science teachers. All messages, except those from the Self-Reflection discussion area and any coded as Procedural, were used at some point in this analysis. Messages from the Self-Reflections completed at the end of an Inquiry were not used in this analysis because only novice science teachers submitted messages to this discussion area.

The three independent t-tests differed from each other in the levels of discourse used in each analysis. The first independent t-test used all messages written by novice and experienced science teachers that had a discourse coding of two (Thoughtful discourse) or higher. The second independent t-test used all messages coded as a three (Quasi-reflective discourse) or higher and the final independent t-test used only messages coded as four (Content-short) or higher. Using a significance level of .05, two of the three independent t-tests comparing the mean level of discourse, written by experienced and novice science teachers, found in messages written across discussion areas resulted in differences large enough to be considered significant as shown in Table 32. The results show novice science teachers have a statistically significant higher mean level of discourse in their messages when discourse coded as a two (Thoughtful discourse) and as a three (Quasi-reflective discourse) was used in the analysis. When messages coded only as a four or higher were used for the analysis, the difference in mean level of discourse between novice and experienced science teachers was not significant.

Table 32. Results of statistical tests for mean of levels of discourse written by experienced and novice science teachers.

Message Sample	N (messgaes) Exp.	Nov.	Mean/Standard Deviation Exp.	Nov.	*t*	*p*
2-7	157	188	3.11/.91	3.50/1.07	-3.63	.000
3-7	119	161	3.46/.76	3.75/.94	-2.76	.006
4-7	43	78	4.28/.73	4.55/.77	-1.90	.060

Non Reflective and Reflective Discourse Found in Various Discussion Areas of the eMSS Program

Online dialogue from four different discussion areas was analyzed for this study. These areas were from the Reflect sections of Inquiry discussion areas, Content, Special Topics (including Topics of the Month and Dilemmas), and the Self-Reflect or Self-Assessment assignment completed at the end of an Inquiry. Table 33 is a combination of Tables 6-9 found in Chapter 3 and shows the number of Topics and Messages analyzed from each of the four discussion areas.

Table 33. Number of topics and messages analyzed from each of the four discussion areas.

Discussion Area	Year(s)	# of Topics	# of Messages
Content Area			
Physics	2007 & 2008	12	56
Life Science	2007 & 2008	9	90
Chemistry	2007	9	59
Earth Science	2008	5	82
Total			**287**
Special Topics			
Topics of the Month	2008 & 2009	5	52
Dilemmas	2009	12	106
Total			**158**
Reflect Section of Inquiries	2008	6	**466**
Self-Reflection and Self-Assessment Sections of Inquiry Discussion Areas	2008 & 2009	5	**109**
Total Messages			**1020**

Content Discussion Area

The Content discussion area contains facilitated discussions designed to engage participants in dialogue focused on science education including science content and

pedagogical issues. Participants can post questions, comments, or concerns as they interact with established research scientists. Providing participants with science resources to use in the classroom is also a purpose of the Content discussion area. A total of 287 messages from four different Content discussion areas were coded using the discourse analysis rubric designed for this study. The majority of messages in the Content discussion area (87.46%) were submitted by experienced science teachers, either a facilitator, mentor, or a university content specialist. Novice science teachers, mentees, submitted the remaining 12.54% of the messages. Table 34 shows the types and percents of discourse found in messages submitted by participants to the Content discussion areas.

Table 34. Types of discourse found in messages submitted by participants to the Content discussion areas.

Rating	Type of Discourse	# of messages	% of messages
1	Procedural Discourse	249	86.76%
2	Thoughtful Discourse	1	.35%
3	Quasi-reflective Discourse	16	5.57%
4	Content-Short	20	6.97%
5	Content	1	.35%
6	Content-Process	0	0%
7	Premise	0	0%

Messages providing teaching advice, teaching resources, and science content knowledge were coded as procedural discourse. It should be of no surprise that this type of non reflective discourse dominated the Content discussion areas. Of the 287 messages submitted by participants to the content discussion areas, 249 were coded as Procedural discourse. Table 35 shows a breakdown of the different types of procedural discourse

found in the Content discussion area. Some messages contained more than one type of procedural discourse.

Table 35. Types of procedural discourse found in the content discussion areas.

Type of Procedural Discourse	Experienced Science Teacher's Messages	Novice Science Teacher's Messages	%
Providing Instructions	2	0	.75
Asking Questions to be answered by participants	70	15	32.08
Providing encouragement or thank-you	33	6	14.72
Providing teaching advice	66	7	27.44
Providing teaching resources	33	4	13.96
Providing technical assistance	3	0	1.13
Explaining science content	23	0	8.68
Other	2	1	1.13

The data in Table 35 supports the premise that participants did what the eMSS program had in mind for the Content discussion areas. Procedural discourse comprised 82.16% of the discourse in the Content areas. Participants asked questions (32.08% of procedural discourse) asking for teaching advice or teaching resources or an explanation of science content. Other messages had participants replying by providing teaching advice (27.44% of procedural discourse), teaching resources (13.96% of procedural

discourse), and explanations of science content (8.68% of procedural discourse). Table 36 shows an exchange from the Life Science content area in which a question is asked, teaching advice is offered, and content knowledge is explained by a content expert. While the message exchange is informative and likely helpful to experienced science teachers (the original question was submitted by a mentor) and novice science teachers, none of the messages were coded as being reflective. This message exchange highlights the idea that while reflective messages are desirable they are not always essential for messages to be useful and appropriate.

Table 36. Exchange of messages found in the life science content discussion area.

Message coded as procedural discourse, more specifically as asking a question, written by a mentor. *I'm working on a unit for 6th grade teachers around the human body. Many of these teachers are elementary teachers by training and not overly comfortable with science. In an ecosystems unit, they have already worked with microscopes to look at plant cells, so we are hoping to have students do a (lab) with animal cells. While many people do the cheek cell lab (we still can not agree as a department on whether or not it should be done due to medical waste issues), another option would be for students to look at skin cells. Have any of you done this before? Do you have a lab write up that works?* *Any suggestions are greatly appreciated!*
Message coded as procedural discourse, more specifically as providing teaching advice, written by a university content specialist. *If you are staining the cells before you observe them, the stain can be considered a disinfectant. (Then) you trade a biohazard issue for a chemical hazard issue. In any case, the most important thing would to be sure that they wash their hands after the procedure.*
Message coded as procedural discourse, more specifically as providing teaching advice, written by a life science facilitator. *My most effective way of looking at animal cells is to buy the premade slides from Carolina Biological or someplace like that. They are expensive, but they can be shared by students, and if you buy more each year, eventually you will have a decent collection.*

Table 36 - Continued

Our collection must be close to 30 years old. Lots of cracks in the slide coverslips. But the students can still see the cells.

Message coded as procedural discourse, more specifically as providing science content knowledge, written by a university content specialist.

The easiest way to observe cells in the microscope is to look at single-celled microorganisms. Looking at single cells taken from the TISSUES of multicellular organisms is fraught with technical difficulties in nearly all cases. Hence the popularity of the few specimens that can be seen (Elodea, cheek cells, blood cells, onion root tips). This is why there has been since the mid-19th Century an industry devoted to producing prepared tissue slides for demonstration purposes as (previous message's author) points out.

Message coded as procedural discourse, more specifically as providing science content knowledge, written by a university content specialist.
An interesting adaptation of Elodea/Egeria is that the leaves have no guard cells or stomata. The leaves are underwater, so they exchange gases directly with the water. That's why they are only 2 cell layers thick and make such excellent specimens for microscopy.

Messages coded as containing teaching advice for fellow participants made up 27.44% of procedural discourse. The majority of these messages were submitted by experienced science teachers. Again, while these messages were coded as containing non reflective discourse they could be informative and helpful. Many of these messages took the form of "here is what I do." Table 37 shows an example of one such message.

Table 37. Message coded as Procedural discourse, more specifically as providing teaching advice, written by a mentor.

That activity reminded me of an activity I used with the periodic table. It was called Element of the Year. Each student picked a number from a hat. The student with #1 picked first, #2 second,… They could choose any element that had not already been chosen and put together a powerpoint presentation that showcased their element. I gave them a list of things to include in their presentation (information-wise), but the idea was that their presentation persuade others of WHY their element deserved to be Element of the Year. The kids usually enjoyed it.

These examples of exchanges between participants help to illustrate that the dialogue in the Content discussion area is aligned with the goals the eMSS program has for this discussion area. The majority of messages were submitted by experienced science teachers and many times contained content that could be immediately useful in a teacher's classroom situation. However, most of these messages were not classified as reflective when using the discourse analysis rubric designed for this study.

In fact, only one message from the sample of Content Discussion area messages used for this study was coded as having a high level of reflection. This is not to say we approached coding the Content discussion area with the intention of coding no messages as containing high levels reflection. A message from a Physics Content discussion area and found in Table 38 would have been coded as containing a higher level of reflection had it been in the sample for this study. The discussion thread topic, The State of Science in America, lent itself to reflective thought and would have also been a good Special Topics discussion topic. This message and several other messages in the discussion thread in which it was found may be a good example of the importance of the issue when it comes to encouraging the use of reflective thought in participants. This idea is discussed later in the paper.

Table 38. Message containing Content reflection found in the Content discussion area but not part of the sample for this study.

There has been a noticeable trend, at least from what I can see in NC away from intellectual value and toward entitlement. *What I mean by that is that more students are coming to me expecting to learn physics just as quickly and easily as they did say with biology or civics, but when push comes to shove and they are faced with learning how to learn with regards to physics, many students take the easy way out and switch to an easier class like physical science. I'm seeing the numbers of students taking physics drop each year and knowing that this isnt' just a trend at my school, I have to look at the larger picture.* *It seems, to me at least, that in this age where technology allows anyone to have a nearly instantaneous answer or response that our students, and society, don't know what to do when they are faced with a challenge that can't be solved in under a minute.* *We have taken one of the most valuable tools out of the schools and that is that is the tool of teaching students how to fail. Planned failure can be a great teaching tool of used properly but that is another aspect of our society and educational system that is contributing, at least in my humble opinion, to the lack of emphasis in science and physics in particular especially since no one wants to fail.* *To support this we just have to look at how our students are 'promoted' from one grade to another. Very few students fail classes anymore and those who do are students who literally do no work or don't show up. In fact, in order for a student to fail a course many schools in NC, the teacher has to document several contacts with the parent, as well as document how they provided the opportunities for that student to 'pass' the course. While in itself these measures aren't anything I wouldn't do anyway, the issue of student responsibility is absent. In effect, students no longer fail because they don't understand the material, but because of the other, possibly social issues.*

Reflect Section of Inquiry Discussion Area

The Inquiry discussion area contains facilitated discussions designed to enhance participants' teaching practice and boost their effectiveness with students. Facilitators, mentors, and mentees engage in online discussions aligned with short assignments and conversation guides designed to help mentees, with the assistance of a mentor and

facilitator participants, to deepen their teaching practice. Mentees choose from a selection of Inquiries that are best matched to their teaching situation. Each inquiry lasts from six to eight weeks. The Inquiry discussion area is divided into three sections: Plan, Practice, and Reflect. Only messages from the Reflect section were analyzed for this study. In the Reflect section, participants were specifically asked to express their reflection, in the form of written online discourse, on a lesson they taught as a result of participating in a particular eMSS Inquiry.

A total of 466 messages from the Reflect sections of Inquiry discussion areas were analyzed for this study. Topics of Inquiries analyzed for this study were Diversity in Science Education, Teaching with Scientific Articles, Using Technology to Improve Student Learning, and Effective Labs. Experienced science teachers, either a facilitator or mentor, submitted 60.5% of the messages. Novice science teachers, mentees, submitted the remaining 39.5% of the messages. Table 39 presents the percent of each type of discourse found in messages submitted by participants to the Reflect sections of Inquiry discussion areas.

Table 39. Types of discourse found in messages submitted by participants to the reflect sections of the inquiry discussion areas.

Rating	Type of Discourse	# of messages	% of messages
1	Procedural Discourse	257	55.15%
2	Thoughtful Discourse	29	6.22%
3	Quasi-reflective Discourse	89	19.10%
4	Content-Short	57	12.23%
5	Content	17	3.65%
6	Content-Process	16	3.43%
7	Premise	1	.21%

A high percentage (55.15%) of messages were coded as being procedural. Many of these messages provided encouragement to novice science teachers from experienced science teachers as they responded to the good and bad aspects of a novice science teacher's lesson about which the novice science teacher reflected. Occasionally a participant would share a teaching resource or offer teaching advice in response to what was written in a message. As mentioned before these types of messages can be informative and helpful but were not coded as reflective in this study.

With procedural discourse removed from the analysis, the percent of each type of discourse found in messages in the Reflect sections of Inquiry discussion areas is modified and is found in Table 40. Data from this table will be used for the analysis that follows.

Table 40. Distribution of discourse within the non procedural subsample found in messages submitted by participants to the reflect sections of inquiry discussion areas.

Rating	Type of Discourse	# of messages	% of messages
2	Thoughtful Discourse	29	13.88%
3	Quasi-reflective Discourse	89	42.58%
4	Content-Short	57	27.27%
5	Content	17	8.13%
6	Content-Process	16	7.66%
7	Premise	1	.48%

In the Reflect section of the Inquiry discussion areas, participants are prompted either in a structured or unstructured manner to reflect on a lesson associated with the Inquiry topic in which they are participating. Table 41 shows an example of what was

considered structured and unstructured prompting by two different facilitators.

Table 41. Structured and unstructured prompting from two different facilitators in two different reflect sections of two different inquiry discussion areas.

Structured Prompting: *Mentees: Please take a few minutes to conclude this Inquiry by reflecting back on your work. Post to your group what worked for you and any challenges you faced in working in this Inquiry. Include possible next steps. Also were there any significant AH-HA moments?* *Unstructured Prompting:* *Hello, Welcome to the Reflect phase of our inquiry. Mentees: Please be sure that you post your thoughts about your plan and about your practice before posting a reflection. Mentors: Please post your thoughts about your mentee's plan and practice as well as your thoughts about other folk's postings in these areas before you post your reflection. Thanks for all of your insights. Cheers.*

The results of both types of facilitator prompting produced a fairly large amount of follow up messages coded as having either Quasi-reflective discourse or containing Content-short discourse as the highest form of discourse in the message. Quasi-reflective discourse and Content-short discourse comprised 69.85% of all messages coded in the Reflect sections of Inquiry discussion areas. When looking at the structured prompt it should be of no surprise that participants submitted messages that were coded as Content-short. The prompt is asking participants to reflect on a specific lesson. Many participants' messages in response to this prompt were interpreted as being written to meet the minimum requirement of this prompt without using a deep approach to learning. For this Reflect assignment, most participants listed one or two things that did and did not work and one or two things they would do differently. This type of response had participants learning in the instrumental domain (Habermas, 1971). Only 16.27% of the messages in

the Reflect sections of Inquiry discussion areas had participants reflecting in depth on the content of the lesson while engaging in a deep approach to learning.

Table 42 shows three messages in response to the same structured prompt found in Table 41. The first message shows a Quasi-reflective response to the prompt. The second message shows a Content-short reflection and the third message was coded as containing Content reflection.

Table 42. Responses to the same structured prompt in the reflect section of an inquiry discussion area.

Message coded as Quasi-reflective, written by a mentee, and submitted to the Reflect section of an Inquiry discussion area. *The energetic reactions lab went well for me and my students. Our classes were incredibly well behaved and engaged-all students completed the task(s) at hand, and applied seemingly discreet facts to the reactions in front of them. In addition, this lab produced the highest completion rate of any lab todate-80% of which were proficient responses, some of which were incredibly well-developed (for a group of Title 1 students with no prior science exposure, its not too shabby). Unfortunately, some of the basic process skills such as graphing and measurement were lacking. With a little more up front instruction on variables next time, we should be good.*
Message coded as Content-short, written by a mentee, and submitted to the Reflect section of an Inquiry discussion area. *I placed this lab at the end of a unit on dominant/recessive and using Punnet Squares to predict traits. I think the timing was right, for the students had a basic vocabulary related to genetics. Students understood the concept of inherited traits.*
I was glad to have thought about logistics in advance related to organizing the material and flow of students in the room. Having water jugs and "slop buckets" on the tables helped circumvent some problems. Assigning jobs also helped. Most students were able to follow the lab procedure with little prompting—once I modeled the first "transfusion." However, my lowest achieving class still needed help every step of the way. It is amazing the difficulty that some students have with following a procedure. One strategy I used to address this was to have the struggling groups select a writer to highlight parts of the lab that they did not understand and make annotations in the margins about their thinking (questions, comments). Overall, students did a fine job analyzing the lab in the lab questions. I also got a lot of positive feedback: "that was cool!"…"I love hands-on stuff."

Table 42 - Continued

The lab served as a good way to model blood transfusions, and I am now using it as a jumping off point for a discussion about codominance. Hopefully, an introduction to codominance will assist these students later on in their science studies.

Message coded as Content reflection, written by a mentee, and submitted to the Reflect section of an Inquiry discussion area.
I agree with (name) that a jigsaw-style lab is a great idea. Because of time limitations, I decided to do the same thing. In addition to saving time, it forced the students to be really cautious about their part of the lab. If they messed up, the rest of the class wouldn't have decent data to work with.

My lab investigated the effect of temperature, pH, substrate concentration on enzyme activity, specifically on catalses's ability to break down hydrogen peroxide. I did have to make last-minute changes to the catalase lab. For the temperature station I was planning on using different temperatures of the substrate (H2O2) and dropping the catalse-dipped discs in them. The problem was the catalase wasn't affected in time to show the results we were looking for. I had the students that were in charge of that station change their procedure, and keep the catalase solution at different temperatures and the substrate at room temperature. That worked much better, but I think ideally both substrate and enzyme should be at the same temperature. I'm going to change the procedure for next semester.

Even with the students gathering their materials and rinsing their glassware, the labset-up was pretty intensive. I kept index cards with an exact materials list and the concentrations of substrate and enzyme at each station to remind both me and the students of what was necessary at each station. The debriefing session was vital to this activity. Students reported out on their part of the experiment, and all the students drew graphs showing the effect of all four variables (substrate concentration, enzyme concentration, pH and temperature) on enzyme activity, so each student came away will all the information necessary.

Next time I think I'll have them jigsaw first, and then debrief as a class, so they have an opportunity to discuss in various small groups first. I'll also rewrite a couple of the analysis questions, as I discovered they weren't as appropriate for the students who investigated substrate and enzyme concentrations.

Another idea I had for next time would be to use my seating charts with sheet protectors to record a grade for lab skills, including safety. (I record absences and homework completion on these.) Hopefully this will encourage students who have a tendency to goof off during labs to focus and participate.

All three messages in Table 42 were found in the same facilitated discussion area and were written in response to the same structured prompt provided by the facilitator. Yet, the messages show three different levels of discourse. Why do some participants take a deep approach to learning, as in the third message, when writing their discourse while others take a surface approach, as in the first message?

Some participants may take a surface approach to preparing their online discourse when they find the content of the discussion area as not applicable or uninteresting or they see writing this particular message simply as an imposition to reaching the goal of completing an inquiry (Peltier, Hay, & Drago, 2005). Or, their approach may be associated with the type of prompting or instructions given by a facilitator. Table 43 shows actual instructions, from a facilitator, for completing an Inquiry reflection assignment. The facilitator asks participants to take a few minutes to reflect on their work and shows an example of what is expected from participants. For all intents and purposes, the facilitator is asking participants to take a surface approach to learning. In following the facilitator instructions and taking “just a few minutes” and referencing the example as a guideline, participants would likely submit messages with Quasi-reflective discourse or Content-short discourse, as the highest form of dialogue, in order to meet the requirements of the discussion area. The data does shows 69.85% of the messages in the Reflect sections of Inquiry discussion areas were coded as one of these two types of discourse.

Table 43. Instructions for participants in the reflect section of an inquiry discussion area.

Please take a few minutes to conclude this Inquiry by reflecting back on your work. Post to your group what worked for you and any challenges you faced in working in this Inquiry. Include possible next steps. On the Menu bar, click on Discussion and Private Messages and click on your Discussion Group. *Example: I ended up letting the small groups pick different topics about viruses and vaccines that I gave them. That way, each group presented a different subject to the class. It worked really well and the kids liked it. But it did take a lot of time. I had to devote two more class periods to the project than I had planned. Nevertheless, I think it was worth it.*

The third message in Table 42, coded as Content reflection, clearly shows evidence of the participant taking a deeper approach to learning as they used a summary of facts, in the context of improving a lab, while working towards an end which in this case was the clarification of thoughts on a lab activity which could be labeled as the issue (Moon, 1999). This message shows the participant learning in the instrumental and communicative domains (Habermas, 1971). Instrumental learning is seen as the participant writes about technical aspects of the lab. Communicative learning is seen when the participant writes discourse about the jigsaw approach partly in an effort to gain validity for their use of the method. Additionally, in the same message they are also providing validity for the jigsaw approach used by a fellow participant. This validation process relies on a consensus of those who participants consider to be informed, rational, and objective as opposed to relying on tradition, authority, or force (Mezirow, 1991). The participant has a particular aim, effective use of the jigsaw approach, and "communicates with another person in order to arrive at an understanding about the meaning of a common experience" (Mezirow, 1991, p.65).This type of

exchange between participants, validating each other's thoughts and beliefs in the online discussion areas, is one of the goals of the eMSS program partly because this type of exchange can be conducive to reflective thinking.

Why did the author of this third message take a deep approach to learning when writing his online discourse? Whitmire (2004) claims the tendency of a person to write reflective discourse is linked to that individual's view of knowledge. He explains that only when learners see knowledge as contextual are they able to think reflectively. These types of learners will write discourse that is evaluatory while providing justifications. This is seen in the third message in Table 42. The reflective discourse will assess the adequacy of problem solving processes with the aim of improvement. This is seen primarily at the end of the second paragraph. While focusing on the content of the lesson, the participant explains the substrate/enzyme problem in detail, explains what she did to fix the problem, and then evaluates her problem solving effort by stating that while what she did worked, she has an idea as to how to improve something for the next time they do the lab. In effect, she is saying I was OK with how I solved the problem but I can and will do better next time when working with this same problem. Most messages in the Reflect sections of Inquiry discussion areas that were not coded as Procedural discourse moved beyond Thoughtful discourse and showed some type of reflection.

A One Way Analysis of Variance (ANOVA) test was conducted to compare the mean level of discourse found in different discussion areas. The independent variable for the ANOVA consisted of four different discussion areas: Fall 2007 Life Science Content discussion area, 2009 Special Topics discussion area (Expectations for Low-Level

Students and Spring Weariness Dilemmas), 2008 Effective Labs Inquiry discussion area, and all six end of Inquiry Self-Reflection discussion areas. The four different discussion areas used in this ANOVA were chosen because they each had a similar amount of coded messages. The dependent variable was the mean level of discourse seen in the four different discussion areas. All messages, including those coded as Procedural, were used in this analysis.

The ANOVA for this analysis was significant $F(3,402)=51.71$, $p=.000$, indicating different discussion areas had overall higher mean levels of discourse. Means and standard deviations from this comparison are reported in Table 44. The Tukey HSD post hoc test procedure was conducted for pair-wise comparisons among the four group means in each discussion area. The results of these tests are shown in Table 44. Significant differences were found in all comparisons except the 2009 Special Topics discussion area and the 2008 Effective Labs Inquiry discussion area.

Table 44. Comparison of dialogue quality among participants in four different eMSS discussion areas.

Discussion Area	N (Messages)	Mean	Standard Deviation	1	2	3	4
1-Inquiry Reflection Section-2008 Effective Labs	103 *Exp.-56* *Nov.-47*	2.03	1.37		*	NS	*
2-Content-Fall 2007 Life Science	91 *Exp.-76* *Nov.-15*	1.23	.73	*		*	*

Table 44 - Continued

Discussion Area	N (Messages)	Mean	Standard Deviation	1	2	3	4
3-Special Topics-Expectations for Low-Level Students and Spring Weariness Dilemmas	104 *Exp.-60* *Nov.-44*	2.20	.96	NS	*		*
4-Inquiry Self Reflections	108 *Exp-N/A* *Nov.-108*	3.17	1.21	*	*	*	

Note. NS = nonsignificant differences between pairs, an asterisk (*) = significance using the Tukey HSD procedure, $p = .000$.

The reason(s) as to why this significant difference exists is unclear. Novice science teachers are asked to reflect and given a template to guide this process in the Inquiry Self Reflection. Facilitators are not specifically asking participants to reflect in the Special Topics or Content discussion areas. Because messages explaining science content was coded as Procedural, many messages in the Content discussion were coded as a one for Procedural. The Content and Special Topics discussion areas each have different goals and therefore different methods by which the facilitators and curriculum writers organize/facilitate the discussion.

Usually a content specialist but occasionally an experienced or novice science teacher would put forth a question that would begin a discussion about some science content in the Content discussion area. Table 45 shows four examples of the first message in four different Content discussion area threads. Some questions, similar to the first two

questions in Table 45, are asking for specific answers that most likely would not require reflection in order to sufficiently answer. Some questions, like the second two questions in Table 45, may require some reflection, likely on content, but they also have the potential for generating higher levels of reflection when writing a response as they could persuade participants to examine some of their deeply held ethical belief systems.

Table 45. First messages in four different Content discussion area threads.

Message #1 written by a mentee and submitted to the Content discussion area. *Hi all, Does anyone have a good description of the polymerization reaction between white glue and liquid starch? I have done it at home and I got a nice putty, I would like to have the best explanation possible for them. Thanks in advance for any help, Name*
Message #2 written by a mentee and submitted to the Content discussion area. *One of my students wondered if animals have different blood types like humans do. She asked 3 vets so far and no one knows the answer. Can anyone help us? Thanks in advance.*
Message #3 written by a mentee and submitted to the Content discussion area. *…There are so many misconceptions about science that are circulated by the media. One is the idea of chemicals as "bad", or all toxic. Another is the misuse of the term "organic". As we learn about things in chemistry that student have these preexisting misconceptions about, I try to bring them up or find ads and articles that contain this misinformation. It usually creates great discussions in class and students want to know how they can help….Does anyone else discuss this issue? Have you found any good sources? Do you have any suggestions for students on ways to help (clear up misconceptions)?*
Message #4 written by a facilitator and submitted to the Content discussion area. *In this week's Parade (a magazine in our Sunday paper), Marilyn vos Savant (in her column AskMarilyn) was asked, "Are there any beneficial viruses?" She said no, because "they are parasites that disrupt normal cell functioning, the very essence of disease". Do you agree?*

The Special Topics discussion areas usually function under a more specific agenda, compared to the Content discussion area, as envisioned by curriculum writers and facilitators. Table 46 shows a prompting progression over a time span of several weeks in the Expectations for Low-Level Students Dilemma discussion. Each prompt is written by the same facilitator. Compared to the prompts for the Content discussions areas, seen in Table 45, the prompts in Table 46 seem more likely to elicit response messages that contain some degree of explanation. Although the prompts do not directly instruct participants to justify why they do what they do when it comes to dealing with this issue, it is likely that the expectation of the facilitator is participants will provide some type of explanation or justification for their beliefs or actions when working with low-level students. The high percentage of Quasi-reflective dialogue found in the Special Topics discussion areas shows that participants are attempting to justify their beliefs, feelings, or actions.

The prompting progression in a Special Topics discussion area, in Table 46, shows the facilitator, in guiding the discussion, is himself reflecting on the content of the discussion threads in order to develop the next questions/prompts in order to keep the flow of the discussion moving in a way that participants seem to be taking it and at the same time adhering to the purpose of the discussion area. The discussion progression designed by this facilitator aligns with how Dewey (1933) views reflective thought, “The successive portions of a reflective thought grow out of one another and support one another…There are in any reflective thought definite units linked together so that there is a sustained movement to a common end” (p.4-5).

Table 46. Prompting progression over a time span of several weeks in the expectations for low-level students dilemma discussion area.

Prompt #1: *Sherri's classes are homogeneously mixed, and most students are at a low academic level. Many lack motivation. She has discovered that quite a number of teachers are willing to make life easier for these students by allowing them to use notes on every quiz and test. Because Sherri wants to challenge her students and hold them accountable, she does not permit them to use notes during assessments. In other aspects of her teaching-such as homework assignments-Sherri also tries to hold all her students to high expectations. As a result, Sherri is feeling pressure from her students, as well as other teachers in her department, that her classes are to hard.* *Dilemma response: Is it appropriate for Sherri to expect low-level students to follow the same learning process as other classes, whether it is dealing with the use of notes during tests, homework policy, "free days," or other components of classroom instruction?* Prompt #2: *Hi everyone, So far many of us have stated that it's important to keep the bar high and to expect great things from our students no matter what level they are working at. This is often times hard after the students have experienced years of lowered expectations. How do we effectively deal with the learned helplessness and lack of drive that can arise from this situation?* Prompt #3: *Hello Everyone, During week 1 of our discussion the topic of student motivation and drive, or lack there of, came up over and over. For week 2 I thought we would focus on that aspect of expectations for low-level students.* *I think that we all agree that motivating students is one of the most challenging aspects of our job as teachers and that unmotivated students comprise a large proportion of our low-level students. What specific techniques do members of our group use to help motivate students? What has worked for members of our discussion group? Thanks.* Prompt #4: *Hi Everybody, So far we've discussed how to keep the bar high for low-level students and how to increase the motivation and drive of the students we teach. One key piece in this equation is our student's parents. What ways are best to communicate with the parents of our students to hopefully inspire them to help motivate the success of their child? This is a difficult thing to consider as many of our students who lack motivation have parents who do as well. What has worked for members of our discussion group? Thanks.*

Table 47 shows several response messages to the prompts in Table 46. The response messages in Table 47 are not in order to correspond with the prompt order in Table 46. For example the first message in Table 47 was written in response to the last prompt in Table 46. The messages in Table 47 are presented in order from Thoughtful to Content/Process reflection and are all a response to one of the prompts in Table 46. A question that emerged during this study's data analysis and was alluded to in the previous section of this paper focuses on what inclines one participant to write a Thoughtful response to a prompt while another participant submits a message coded as Content/Process reflection while, in this case, responding to the same prompting structure? Does life experience play a role? In the examples in Table 47 one participant, the author of message number four, had a particular personal life experience germane to this discussion on which to reflect as they composed their response message. The author of message number one merely described in her Thoughtful discourse what her school does in regard to this issue.

Table 47. Response messages to the various prompts in Table 46.

Message #1: Thoughtful message written by a mentee and submitted to the dilemma discussion area. *In our school, parents and their children are given the chance to interact to each other during math night which culminate end of each quarter. They are given activities wherein both solve given problems. Another way to communicate with parents is the students lead conference. Students compiled all work done in school and presented to their parents at the end of each quarter. Parents have the chance to understand what are the different standards that their children suppose to learn. Students have the sense of responsibility and elevate their self-confidence. Parents work hard for their childrens' success and their children understand so that they also do their parts to study harder. Good thing if parents constantly following up their children about their school work by calling up their teachers.*

Table 47 - Continued

Message #2: Quasi-reflective message written by a mentee and submitted to the dilemma discussion area.
Students will perform up to, and rarely beyond, the expectations given to them by their teachers, parents, and mentors. I believe she needs to stick with her gut instinct, provide high expectations while accommodating true learning disabilities. Intrinsic motivation must be increased through hands-on activities and inquiry based lab experiences. While approaching the situation by simply "making things easier", may seem to be the appropriate thing to do, we must step up to the plate and realize that these students will rarely move beyond our expectations.

Message #3: Message coded as having content-short reflection, written by a mentee, and submitted to the dilemma discussion area.
I teach regular biology and within my 5 classes are many students who lack motivation and perform much lower than their ability level would suggest. It's difficult because I also have students who are very motivated to get good grades and do their work and study for their exams. However, it seems that instead of the work ethic of those students spreading it is the lack of work ethic of the former groups spreading. A couple things I see is many of my students is they don't have a reason to believe they can succeed. They haven't seen their parents or brothers or sisters succeed and they aren't succeeding in school (often one failing grade will send a message to a student that they can't do something). They also don't see the point in studying biology (going back to the idea they can't imagine themselves being doctors, researchers or working in biotech or environmental industries, or even being teachers). When it comes to skills in order to complete the work and understand the concepts basic things are lacking. Most of my students are at different levels of learning English and read at very low levels. Their math skills generally are low as well. They've got a lot going against them that isn't their fault. Being a kid in that situation is tough and it's often easier to give up. As teacher we have to believe in them and support their learning. Ideally learning should occur before an exam and after depending on the mastery of that content. Also, I think low level should be held to the same standards as other students (barring any special ed issues) but the path to success may look different.

Message #4: Message coded as having content/process reflection, written by a mentee, and submitted to the dilemma discussion area.
I try to speak to the parents as if we are on the same side-that I'm just a normal parent like them. During my first year of teaching, when I spoke to parents on the phone, I made it clear that I was a professional and I have authority in my classroom and that I have certain expectations for the child. I started realizing that when I did this, the parents felt I thought I was someone above them or condescending. I guess when I sent my own son to kindergarten, I got better perspective of what it feels like to be on the other end of the phone or school note. Making a parent feel like they are somehow not meeting the needs of their child (even if they clearly aren't) puts them on the defensive and they become

Table 47 - Continued

aggressive or shut you down. Some of them have had no contact with teachers since they themselves were in school, so they already see us as bad guys. If I get on the line with them and start telling them their child is not cutting it in class, they will take this very personally. So, instead, I try to start the conversation by sharing a bit about myself, or letting them Know I am a parent, or by telling them a positive story about something I've seen their child doing my classroom. Even if it's got nothing to do with the reason I was calling, it helps to level the playing field, so to speak, and parents don't feel it's me against them or me against their child. *I used to also love emails. But emails sometimes do not express and tone that you want to have with the parent. Something you write could mean so much with a look or tone of voice. Sometimes emails are left to the interpretation of the readier- they have to figure out the meaning of your words-and they don't always take it as you meant it. I like phone calls better, even though they are a bit more time consuming.*

Within the scope of this research it is unknown whether this significant difference in levels of discourse in the context of reflection holds for all Content discussion areas compared to all Special Topics discussion areas.

Special Topics Discussion Areas:
Dilemmas and Topics of the Month

The Special Topics discussion areas include the Dilemma and Topic of the Month discussion areas. Dilemmas are open-ended scenarios that pose a question about a specific teaching issue. Participants discuss possible solutions and exchange thoughts about the scenario. Topic of the Month is a discussion area where participants discuss a wide variety of topics germane to science teaching. Participation in either of these facilitated discussion areas is optional.

A total of 157 messages from the Special Topics discussion areas were analyzed for this study. Experienced science teachers, either a facilitator or mentor, submitted

61.78% of the messages. Novice science teachers, mentees, submitted the remaining 38.22% of the messages. These message submission rates are similar to what was seen in the Content discussion area in that experienced science teachers were submitting the majority of messages. In the Content discussion area experienced science teachers submitted 87.46% and novice science teachers the remaining 12.54% of messages. Table 48 compares the percent of each type of discourse found in messages submitted by participants to the Special Topics discussion areas.

Table 48. Types of discourse found in messages submitted by participants to the special topics discussion areas.

Rating	Type of Discourse	# of messages	% of messages
1	Procedural Discourse	59	37.58%
2	Thoughtful Discourse	35	22.29%
3	Quasi-reflective Discourse	54	34.39%
4	Content-Short	8	5.10%
5	Content	0	0%
6	Content-Process	1	.64%
7	Premise	0	0%

Similar to the Content discussion area, high level discourse in the context of reflection is almost nonexistent in the Special Topics discussion area. It is interesting to note that the Special Topics discussion area had a far lower percentage of messages coded as Procedural compared to the Content discussion area.

An independent t-test was conducted to compare the mean discourse level found in messages written by participants and submitted to the 2009 Questioning and Math Skills Topics of the Month discussion area to messages written by participants in the

2009 Expectations for Low Level Learners Dilemma discussion area. The results show messages submitted to the 2009 Expectations for Low Level Learners Dilemma discussion area have a statistically significant higher mean level of discourse compared to messages submitted to the 2009 Questioning and Math Skills Topics of the Month Special Topic discussion area $t(119)=3.30$, $p=.001$. Means and standard deviations from this comparison are reported in Table 49.

Table 49. Means and standard deviations for discourse in the Special Topics discussion area.

Discussion Area	N (Messages)	Mean	Standard Deviation
Topics of the Month- 2009 Questioning 2008 Math Skills	52 *Exp.-36* *Nov.-16*	1.83	.98
Dilemma- 2009 Expectations for Low-Level Students	69 *Exp.-34* *Nov.-35*	2.42	.98

Reasons for this significant difference are not clear. Table 46 shows the type of prompting structures used in the Expectations for Low-Level Students Dilemma discussion area. Table 50 shows the initial prompts found in the 2009 Questioning and 2008 Math Skills Topics of the Month discussion areas.

Table 50. Prompts found in the 2009 Questioning and 2008 Math Skills Topics of the Month discussion areas.

Questioning Topic of the Month Prompt: *In February we'll be reflecting on "Questioning." Please read the background information below. We'll begin our discussion in the next topic area labeled, "Questioning, week 1."* *… Studies of questioning in typical science classrooms confirm that most questions make minimal demands on student thinking. Low-level questions include yes/no inquiries, guessing, simple recall of fat, formula, or procedure, leading or rhetorical questions, and those answered immediately by the teachers. Answers are often immediately judged right or wrong by the teacher, and discussion moves to the next question. Increasing the wait time between posing a question and expecting and answer increases the number of responses, student confidence, responses by less able student, and reflective responses. (Source is cited). What roles does teacher questioning play in learning science?* Math Skills Topic of the Month Prompt: *….Wisdom and research supports teaching content and skills on a "need-to-know" basis as (Name) suggests. What assignments or additional assignments do you or could you use to add the needed algebra skills to your classroom and with which topics should they be presented in conjunction? Your suggestions would be greatly appreciated complete with "handouts" attachments if you have them.*

The Topics of the Month prompts (Questioning and Math Skills) in Table 50 and the Dilemma prompts found in Table 46 are each asked by the respective discussion area facilitator and seem similar in structure. Each of these facilitators responded and summarized participants' messages throughout the discussion duration. Yet, the analysis shows that the messages in the Dilemma discussion area had significantly higher levels of dialogue in the context of reflection. One theory focuses on interest in the discussion topic. Is the topic of Expectations for Low-Level Students a more interesting topic than Questioning? And therefore are participants taking a deeper approach to writing and therefore produce more reflective messages in the Expectations for Low-level Students discussion area?

Currently the eMSS program seeks recommendations from mentors and mentees for Dilemma topics. Topics of the Month are brainstormed by various eMSS staff. If topic interest is the reason why participants write more reflectively on a certain topic, the eMSS program may want to survey participants, particularly novice science teachers, prior to the start of the program in order to determine what topics their current participants are most interested in or passionate about. Discussing these chosen topics in the various discussion areas as the program year proceeds may lead to the creation and submission of higher level reflective dialogue by participants.

Other questions emerged in the process of analyzing the eMSS online dialogue for this study. Do these response messages, in Table 47 for example and in particular messages one and four, indicate that one participant knows how to reflect whereas the other does not? Or, are these response messages examples of a topic being of more interest to one participant so they are more likely to take a deeper approach to learning when composing their response message? Or, do both participants know how to reflect and are equally interested in the topic but have different ways to express their thoughts because one has had a personal experience and the other has only a school experience to pull from when writing their response messages? Should the eMSS program place higher value on response message number four because it was coded as reflective compared to response message number one which was coded as non reflective? Can other participants in the discussion area reading these two messages learn something valuable from both response messages even though one message was not coded as being reflective? If the answer is yes, then this lends support to the assertion that messages do not necessarily

need to be reflective in order to be worthwhile to someone in the discussion group. Response message number one is probably more beneficial to someone who reads it as opposed to the writer of the message who just had to describe a program while preparing her message. Is having messages written by one participant that are helpful to another participant a desirable goal of the eMSS program even if the message is non reflective?

Self-Reflections and Self-Assessments of the Inquiry Discussion Area

Self-Reflections are a required assignment for novice science teachers participating in an Inquiry. They are completed and handed in at the end of each Inquiry. Participants are asked to specifically to reflect on a lesson they taught that was associated with the Inquiry in which they just participated. Starting in the spring of 2009 the Self-Reflections were renamed and are now called Self-Assessments. For this section of the paper the term Self-Reflection will be used to mean both Self-Reflection and Self-Assessment.

The Self-Reflections have participants answering four questions. The four questions are identical regardless of the Inquiry discussion area and are listed in Table 51. A total of 109 Self-Reflections from the following Inquiries were analyzed for this study: Teaching with Scientific Articles, Diversity in Science Education, Managing Student Behaviors, and two different Effective Labs Inquiries. Each Self-Reflection was considered a singular message. Thus, each Self-Reflection was a single unit of analysis. Only Self-Reflections from novice science teachers were analyzed because experienced science teachers did not complete this assignment.

Table 51. Four questions to be answered for the end of inquiry Self-Reflection.

1. What worked for you in this Inquiry? *2. Did you have any challenges?* *3. Based on your work in this Inquiry, what are your next steps?* *4. What did you like about this Inquiry, and do you have any suggestions for improving it?*

Table 52 lists the percent of each type of discourse submitted by novice science teachers for the Self-Reflection assignment due at the end of each Inquiry. Due to the nature of this assignment, no discourse found in the Self-Reflections was coded as procedural discourse. After novice science teachers submitted their Self-Reflections, their facilitator, if they did respond, usually responded in a way that would have been coded as procedural. However, only the Self-Reflections were coded for this part of the study, not the responses to the Self-Reflection assignment.

Table 52. Types and percentages of discourse found in messages submitted by participants to the Self-Reflection assignment of the inquiry discussion areas.

Rating	Type of Discourse	# of messages	% of messages
2	Thoughtful Discourse	37	33.94%
3	Quasi-reflective Discourse	39	35.78%
4	Content-Short	21	19.23%
5	Content	4	3.67%
6	Content-Process	6	5.50%
7	Premise	2	1.83%

These messages may be where eMSS program designers would expect to see the highest levels of reflection in participants' messages due to the nature of the title of the

assignment, Self-Reflection. Table 53 lists the instructions for completing the Self-reflection assignment. These instructions, like some facilitators' instructions for the Reflect sections of Inquiry discussion areas contain the phrase "few minutes" as it pertains to the amount of time participants should plan on taking as they complete the Self-Reflection or the assignment found in the Reflect section at the end of an Inquiry. By suggesting that participants take only a "few minutes" to complete a Self-Reflection assignment and by providing what should be four fairly straight forward questions to be answered in this "few minutes", one should not be surprised that only 11.0% of the messages submitted to the Reflect sections on Inquiry discussion areas showed a higher level of reflection (Content, Content/Process, or Premise).

Table 53. Instructions for completing the required Self-Reflection or Self-Assessment assignment at the end of each Inquiry.

Please complete this Inquiry Self-Reflection. It is a valuable tool for assessing your progress and is necessary for completing this Inquiry. Click on Self-Reflection on the left menu bar. Select either the Mentee or Mentor Self-Reflection and reply to the questions. It takes just a few minutes to fill this out. *To complete the Self-Reflection:* *1. Click on **Self-Reflection**-note you can see the due date.* *2. Click on the blue title.* *3. To work on the Self-Reflection, follow the instructions and type your responses in the text box. You can simply number the responses and do not need to retype the questions.* *4. If you'd like to see how your reflection will look, click Preview.* *5. If you want to save your reflection to complete later, click Save Draft at the bottom of the screen. When you want to reopen it, you'll find it listed in the assignment list with a status of "In progress".* *6. To submit the reflection when you have finished, click Submit at the bottom of the screen.*

As mentioned previously, the type of reflection that teachers, program designers, and facilitators should expect to see is likely aligned with the framework guiding the reflection (Moon, 1999). In order to operationalize this statement for the eMSS program I would submit that in order to expect high level reflection from participants, facilitators must ask the type of questions and expect the type of answers that are indicative of a deep approach to learning where participants are at the least, working with meaning and ideally occasionally involved in transformative learning which is a likely result of engaging in premise reflection.

By simply changing the first question in Table 51 to "What worked for you and why?" would facilitate a movement from Thoughtful to Quasi-reflective discourse when responding. By asking "What part or your thinking process in preparing for this lesson are you satisfied with and why?" and "What aspect your thinking process in preparing for this lesson was inadequate and how do you know" may start a participant down the road towards working with meaning and Content/Process Reflection. When asking participants about next steps facilitators could ask them to write about the next steps associated with the particular lesson but also to write how what they learned in the context of this lesson will affect other lessons in the future. This may encourage the participant to take a deeper approach to learning as they reflect on the content of the lesson.

Regardless of the goal for the content of participants' answers to the self-reflection questions, eMSS program designers may need to change the wording of the questions. Some interesting data emerged as the 109 Self-Reflections were being coded

for this study. This data showed that individual participants' interpretation of the word "inquiry" in the four questions varied. Some participants saw the word "inquiry" as referring to the actual lesson, lab, or unit which they completed as a result of participating in the Inquiry. Table 54 shows an example of a participant using this approach.

Table 54. One interpretation, focused on the inquiry lesson, of the word inquiry as participants completed their Self-Reflections.

1. What worked for you in this inquiry? Except for two glitches the Inquiry went very well. My students were so excited to work with the sow bugs. One of my goals for this lab was to get my students (to become) more aware about nature. My students don't spend a lot of time outside to appreciate the natural world around them. I always worry that if they don't develop this appreciation now they never will care. If they don't care about nature than as adults they are not going to care about pollution, destroyed ecosystems or endangered species. I shared these thoughts with my class and then I discussed how to handle the sow bugs. Even though they are very little, the sow bugs need to be treated with respect. My students loved the sow bugs and took great care of them. They also were also able to come up with a close estimate using the Peterson equation. *2. Did you have any challenges? I face two major challenges while implementing this inquiry. The first one occurred when trying to collect enough sow bugs. I wanted my students to collect their own sow bugs but proved to be harder that I thought. One day during the second week of September my seventh grades set off in search of sow bugs. I thought for sure we would get over a hundred. That was not the case. We only collect 30. I had to borrow my ecology professor's sow bug bin so everything worked out. The other challenge I faced happened when in class during the lab. I realized I wrote the incorrect equation on their worksheet. But I realized my mistake right away and I quickly fixed it.* *3. In your work in this Inquiry, what are your next steps? After completing this lab and wrapping up catch and release, my class went into population trends and the effect introduced species have on the native ecosystem. We talked about zebra mussels in particular because we are so close to Lake Michigan. The Inquiry itself was success and I definitely do it next year.* *4. What did you like about his Inquiry, and do you have suggestions for improving it? My students and I really enjoyed this Inquiry. My students successfully complete a capture and release for the sow bug bin. They also showed great respect for the sow bugs. Next year I will have the student practice putting nail polish on themselves before they mark the sow bugs. Students put a little to much nail polish on some of the sow bugs. I had to carefully separate some of the sow bugs before the nail polish dried.*

Some participants saw the word "inquiry" as referring to the actual lesson, lab, or unit for the first three questions and the actual eMSS Inquiry process for the fourth question. Table 55 shows an example of a participant using this approach.

Table 55. One interpretation, focused on the inquiry lesson and the inquiry process, of the word inquiry as participants completed their Self-Reflections.

1. What worked for you in this Inquiry? Students already knew the structures and function of each part of the eye, so seeing each of those structures was a big help to them. I think that some of the structures don't look quite how they pictured them, but it was really amazing to get the "real picture". Dissections always go pretty well in my class, as this is my second year of running them. Though this year, I actually typed out my own procedures. I feel like they got out of it what I wanted them to. *2. Did you have any challenges? Some students were really grossed out by the aqueous humor dripping out of they eye. I would prepare them for that ahead of time next time. My biggest challenge in any lab is going back and processing with the students, and it's the most important part! I usually feel like we've run out of time, so processing takes a back seat. I hate it, and it's one way that I need to get more organized in my class structure.* *3. Based on your work in this Inquiry, what are your next steps? I'd say addressing the processing issue and developing an actual calendar for my class. It's my biggest weakness as a teacher.* *4. What did you like about this Inquiry, and do you have any suggestions for improving it? I enjoyed it. It made me think about what I'm doing. It's so easy to get stuck going through the motions, not thinking about what's "effective". I liked the process and would do it again, though I need to get better with deadlines!*

Finally, it was obvious that some participants were not sure what was meant by the word "inquiry" found in the four questions. This is seen in the Self-Reflection in Table 56. This participant refers to the actual eMSS Inquiry process when answering the first question. Then she refers to the actual lab and the Inquiry process when answering

the second question. For the third question she refers to labs in general and for the fourth question she refers to the Inquiry process as she answers the question.

Table 56. One interpretation, unsure of focus, of the word inquiry as participants completed their Self-Reflections.

1. What worked for you in this Inquiry? I liked that I had a flexible time frame to complete each task. I also liked that there were deadlines for each step, this really helped me on task and help manage my time with the inquiry. Content wise I liked the question during the planning process about effective labs. Normally when you think of labs you think back to "in my day…" the planning questions helped to think about objectives first and then finding an activity to fit those objectives. This broadened possibilities for students and it also helps to freshen things up a bit for the teacher. *2. Did you have any challenges? I had some trouble getting the lab to actually work with the students in class, but I know the need for potassium iodine in iodine solution. In regards to the inquiry, I found this a very accommodating and successful venture.* *3. Based on your work in this Inquiry, what are your next steps? I (now) think about labs in terms of what are the kids going to remember when they are done? If it is something like "well that was cool, but I have no idea why we did it" then its time to start over and come up with a different idea. I've become more intone with having students try the lab and make mistakes and talk to me about why they made those mistakes. I'm learning to take advantage of the 'teachable moments" in labs that don't function and also to allow students that learning opportunity of not getting the right answer and then talking about why that happened.* *4. What did you like about this Inquiry, and do you have any suggestions for improving it? I'd like to read more articles about effective labs and suggestions in planning labs. I really liked the mentor feedback, it was so very helpful.*

In Table 57 a novice science teacher attempts to explain the confusion associated with how to interpret the word "inquiry" in the four questions used for the Self-Reflection Assignment. When uncertainty like this exists, reflection at any level could likely be hindered and assessing whether or not reflection exists becomes more difficult.

Table 57. Novice science teacher's explanation of the confusing use of the word inquiry in the four Self-Reflection questions.

The one suggestion that I would have would be seriously reconsider how these questions (in the self-assessment) are written. I have completed 4 inquirys this year (all of them very good), and each time I've struggled to understand what the purpose of the questions is. I asked for clarification the first time and did not get a meaningful response. After your note, I'm still not sure what is referred to by Inquiry in these questions. Does this question want comment on the process in general as opposed to the reflect where there is comment on the same questions (what worked, what didn't, what's next) refer to the specific plan, prepare I chose? If so, it seems like you are asking for feedback on a general process that I've gone through so many times it seems redundant to say "yes, plan, prepare, reflect is a good way to think about changing my teaching", If not, it seems redundant to rewrite the lengthy post that I wrote in the actual reflect section where I put a lot of effort into answering these same questions about what I did for an audience of people I've worked with along the way.

The eMSS program may consider separating questions about the Inquiry process in the context of the eMSS curriculum from questions concerning the actual classroom lesson completed and analyzed by the participant as a result of participating in the Inquiry. Questions in reference to the Inquiry process in the context of the eMSS curriculum seem to be serving an evaluatory function for the program and could be asked of participants one time at the end of May.

Or, the Self-Reflection/Self-Assessment could become an assignment specifically geared towards requiring a deep approach to learning and reflection not focused on a specific lesson but rather on justifying keeping or changing one's personal beliefs about an issue associated with what was learned and discussed in a particular inquiry. This assignment could ask participants to, after examining what they wrote in response to the Reflect prompt in the Inquiry, identify and examine the validity of underlying beliefs that attributed to their choosing or avoiding a certain teaching approach for the Inquiry,

choosing to participate in or avoid a specific Inquiry, or identifying a problem as something they needed to work on. This assignment could be a time when the eMSS program provides support that helps participants make the implicit become explicit, the embedded become overt. It would be in this part of the program where one would expect to see Content/Process and/or Premise reflection.

Non Reflective and Reflective Discourse Seem in Conjunction with Different Issues Discussed by Participants.

Dewey (1933) writes "The nature of the problem fixes the end of thought, and the end controls the process of thinking" (p.15). The problem in this research was labeled as an issue. The issue did not necessarily have to be a problem. It could have been a disorienting dilemma, or an area of concern, curiosity, or interest. In their study Boyer et al. (2006) used a rubric which included identifying whether or not the participant wrote about an issue of concern in their reflection assignment. Identification of the issue was a required step in the rubric they used to identify the level of reflection in their participants' writing (Boyer et al., 2006). For this current study not only was it of interest to determine if, when, and how participants were using reflective discourse but also to determine if issues about which they were writing and reflecting on were aligned with the National Science Teaching Standards (1996). This identification was necessary in order to answer the third research question of this study.

Any message that did not have Procedural discourse identified as its highest level of discourse was used in the following analysis. No issue was identified for messages

coded as containing Procedural discourse. For all other messages the process of identifying the issue provided coders with an initial focus as they began the task analyzing the contents of the message for elements of reflective or non reflective dialogue. Usually just one issue was identified for each message. Occasionally two issues and rarely three issues were identified in a single message.

The next section of the rubric used in this study shows the format used to code the issue of a message. Identification of the issue was done in the context of the Changes in Emphasis in Science Teaching (1996) by identifying which associated National Science Teaching Standard (1996) was the focus of the message. This approach was used to provide more specific options for issue identification in the form of the National Science Teaching Standards because the wording of the Changes in Emphasis in Science Teaching tended to be quite general.

Although their wording was general, the Changes in Emphasis were included in the issue identification section of the rubric in part because of an assertion made by Ball and Cohen (1999). If teachers are to do the type of teaching and facilitate the type of learning that the reform literature promotes, there must be a change in emphasis in science teaching that is simultaneously supported by professional development experiences designed to facilitate teachers in the process of augmenting or developing entirely new teaching strategies. These changes in emphasis, reforms, and standards are described in Chapter 2. If teachers/participants in a professional development program are discussing topics associated with these aforementioned changes in emphasis and the associated teaching standards then the program is likely on the right track for improving

teacher practice and ultimately student achievement in a manner aligned with the reform literature.

Table 58 shows the number of times various issues were identified as the focus of messages written by participants. The Changes in Emphasis in Science Teaching are in bold and the associated National Science Teaching Standards are found underneath the associated Change in Emphasis.

Table 58. Issues in the context of the Changes in Emphasis in Science Teaching and National Science Teaching Standards on which participants focused when writing messages.

Changes in Emphasis and National Science Teaching Standards	# of Messages (n=486)	% of Messages
Understanding and responding to individual student's interests, strengths, experiences, and needs		
___Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students-A	111	22.84
___Recognize and respond to student diversity and encourage all students to participate fully in science learning-B	23	4.73
Guiding students in active and extended scientific inquiry		
___Structure the time available so that students are able to engage in extended investigations-D	26	5.35
___Create a setting for student work that is flexible and supportive of science inquiry-D	61	12.55
___Make available science tools, materials, media, and technological resources accessible to students-D	48	9.88
___Identify and use resources outside the school-D	11	2.26
Working with other teachers to enhance the science program (in their school districts)		
___Work together as colleagues within and across disciplines and grade levels-A	6	1.23
___Use student data, observations of teaching, and interaction with colleagues to reflect on and improve teaching practice-C	0	0
___Plan and develop the school science program including	0	0

Table 58 - Continued

Changes in Emphasis and National Science Teaching Standards	# of Messages (n=486)	% of Messages
the allocation of time and planning and implementing professional development strategies for themselves and their colleagues-F		
Continuously assessing student understanding		
___Select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners-A	41	8.44
Focusing on student understanding and use of scientific knowledge, ideas, and inquiry processes		
___Focus and support inquiries while interacting with students-B	9	1.85
___Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science-B	3	.62
Providing opportunities for scientific discussion and debate among students		
___Orchestrate discourse among students about scientific ideas-B	14	2.88
Supporting a classroom community with cooperation, shared responsibility, and respect / Sharing responsibility for learning with students.		
___Challenge students to accept and share responsibility for their own learning-B	12	2.47
___Guide students in self-assessment-C	4	.82
___Display and demand respect for the diverse ideas, skills, and experiences of all students-E	3	.62
___Enable students to have a significant voice in decisions about the content and context of their work and require students to take responsibility for the learning of all members of the community-E	0	0
__Nurture collaboration among students-E	8	1.65
___ Other-If no other issues apply	106	21.81

Obviously the topics about which participants wrote were usually associated with the topic of the discussion area. Twenty seven of the 48 times “Make available science tools, materials, media, and technological resources accessible to students” was identified as an issue, the message was in the discussion area titled Using Technology to Improve Student Learning. In the Reflect section of the Inquiry discussion area titled Teaching with Scientific Articles, participants will write about using a scientific article in a teaching situation. However instead of identifying the issue of a message as “Teaching with Scientific Articles”, in this study the coders identified the issue in the context of which Change in Emphasis in Science Teaching and the associated National Science Teaching Standard with which content of the message best aligned.

The majority of issues found in participants’ messages were identified as falling into one of three main Changes in Emphasis in Science Teaching categories: Understanding and responding to individual student’s interests, strengths, experiences, and needs; guiding students in active and extended scientific inquiry; and continuously assessing student understanding. Table 59 shows the number and percent of messages whose issue was associated with the various Changes in Emphasis.

Table 59. Number and percent of messages identified as having various changes in emphasis as their issue.

Change in Emphasis	# of Messages	% of Messages
Understanding and responding to individual student's interests, strengths, experiences, and needs	134	27.57
Guiding students in active and extended scientific inquiry	146	30.04
Working with other teachers to enhance the science program (in their school districts)	6	1.23
Continuously assessing student understanding	41	8.44
Focusing on student understanding and use of scientific knowledge, ideas, and inquiry processes	12	2.47
Providing opportunities for scientific discussion and debate among students	14	2.88
Supporting a classroom community with cooperation, shared responsibility, and respect / Sharing responsibility for learning with students.	27	5.56
Other	106	21.81

Because the actual issues identified in messages, when using the discourse analysis rubric designed for this study, were National Science Teaching Standards, the remainder of this section of the analysis will focus on which National Science Teaching Standards were identified as issues in participants' messages.

Due to the design and goals of the eMSS program, the most frequently identified issues written about in participants' messages were identified as "Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities,

and experiences of students", "Create a setting for student work that is flexible and supportive of science inquiry, "Make available science tools, materials, media, and technological resources accessible to students" or "Select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners." These issues focus directly on the process of teaching, the focal point of the eMSS program.

In the coding process, if there was a more specific issue by which to label a message, it was selected. For example, Table 60 shows a message written by a participant and posted to the Reflect section of the Teaching with Scientific Articles Inquiry discussion area. The issue could have been labeled as "Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students" or even "Select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners". But because a more specific issue choice existed, it was selected: "Work together as colleagues within and across disciplines and grade levels." Only 1.23% of messages had "Work together as colleagues within and across disciplines and grade levels" identified as the issue.

Table 60. Message with an issue identified as “work together as colleagues within and across disciplines and grade levels.”

I used an article from Science News called Built for speed. My physics students had a great time with this article and the activity that went along with it. I have 15 students and they worked in 3 groups of 5 to develop a lesson to teach one 6th grade class in our district. The 6th graders had as much fun as my high school kids did and were looking forward to visiting us at the high school again in the future. They also invited us to their class to show us a project they have been working on. How cool is that? Kids teaching kids about science. I love it! My fellow science teachers were impressed with my idea of having the older kids teach the younger ones and are going to borrow it. Some of my students commented that they will never become classroom teachers because it is a lot of work. I told them this job is not for everyone. But we all learned a lot and had a great time doing so. My students are looking forward to doing some more challenging lessons for next semester. I will be right by their side to assist them and push them to the limit. This was a great experience and I look forward with trying it in some of my other classes.

The most frequently identified issue in participants’ messages, at 22.84%, was “Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students”. Curriculum is an obvious area of immediate concern for novice science teachers. When writing these messages, participants were usually focused on selecting and modifying activities for use with students in the classroom or on aspects of how their curriculum was aligning from day to day with their overall instructional goals. These types of messages mainly had participants generating knowledge in the technical area (Habermas, 1971) while writing dialogue coded as Quasi-reflective or Content-short. However, messages identified as focusing on this issue also occasionally showed evidence of a deeper approach to learning and a higher level of reflection. Table 61 shows examples of messages with “Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students” identified as the issue of the

message that were coded as having different levels of reflection: Quasi-reflective and Content/Process Reflection.

Table 61. Messages with an issue identified as "select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students."

Message coded as Quasi-reflective:
The Traits survey I did with my students went well. They really enjoyed their own (as well as other students') traits. They were beginning to put a visual picture with a very new vocabulary term (trait).

I would like to purchase a few more small mirrors or have the students use their own to see their traits. It is one thing if another student can tell you what you "have," but it makes even more sense when you can see it!

I used this more as a beginning lab, rather than a summative lab. They are still learning about the different pieces of genetics. In fact, I will refer back to this lab when we talk about genotype, phenotype, recessive, and dominant this week in class!

Message coded as Content/Process Reflection:
I chose a local newspaper story on evolution, the topic we were working on. I handed out a template with 3 clearly stated requirements for what and how the students were to write:
1. 30 points: Use and underline key terms: change, evolution, genetic, pollinators.
2. 30 points: Skip lines. Use proper paragraph form (Intro, Detail, Conclusion).
3. 40 points: Explain how evolution is relevant to this news story.

I had each of 4 classes read the story aloud before writing about it. As I gained experience by trying the experiment with each class I gradually increased my scaffolding in an effort to aim students' focus at key paragraphs deep in the 2nd page of the story that few students differentiated from the rest of the text on their own: -that evolution is an on-going process, not only an ancient one; -that human impacts (global warming) are causing dramatic ecosystem changes (over 50% of flowers common to Thoreau's Walden are now gone or approaching extinction); -How symbiotic mutualism between flowering plants and their pollinators is the mechanism in play here; (Long comment about contrast triggers).
And my own speculation…:
***I could easily devote more than the single class session I gave this activity, spending a*

Table 61 - Continued

2nd (or further) sessions on revisions based on my written comments (Which were extensive but remain unshared because I am required to hold 3 samples per marking period of each student's writing. ***Many students seem trapped by a need to 'tag base' (on the 4 key terms I asked them to use) at the expense of sense-making.* ***Many are still at an early phase in their concept of evolution and the term 'genetics' is completely unfamiliar to most of them (in the article it is used as a synonym for 'closely-related' as in 'flowering in response to the same trigger').* ***I gleaned from ways they used the term genetics and evolution that the students may have been confused about the story because, although the contrast triggers themselves were not identified-a problem that led me to offer the 2 possibilities, temperature vs. day length.* *In summary, I thought it was good that students grappled with the problem of extracting sense from a topical news story. I found it problematic that my pressures (need to possess student work samples and cover material) led me to move on without mining the material more deeply. On the other hand, these are conceptual processes (genetics, evolution, textual analysis) that students will encounter elsewhere in their academic progression. I am actively seeking additional articles to analyze, and evolutionary and genetic activities for them to investigate, as we continue our coursework, now working through the vehicle of regional biogeography, or biomes, for the next 6 weeks leading into mid-January's exam."*

The fact that two different participants wrote messages identified with the same issue but with different approaches to learning and different levels of reflective discourse, leads one to question whether or not the type of issue about which a participant writes has an impact on the level of reflection they may use in their online dialogue. The previous example would indicate that the issue may not influence what level of reflection found in a message. A participant could take a deep approach to learning and write reflectively regardless of which issue was identified in their message. The operative word in the previous sentence is "could." Why did one participant write Quasi-reflectively and

the other use Content/Process reflection when writing messages identified as having the same issue? The answer is multi-faceted.

Moon (1999) would remind us that a participant's pre-existing cognitive structure as it relates to an issue will play a role in their ability to use a deep or surface approach when writing about an issue (Moon, 1999). If they have never made sense of an issue prior to writing their message they are not likely to take a deep approach and work with meaning when writing their message focused this issue. Whitmire (2004) explained in chapter two that a participant's view of the nature of knowledge influences their ability to write reflectively. Perhaps most importantly, a participant may be more inclined to take a deeper approach to learning and write messages coded as having higher levels of reflection when an issue is an area of interest or uncertainty (Dewey, 1933) to them or is disorienting or difficult for them to define (Schon, 1983).

For example, Table 62 lists the six Reflect sections of Inquiry discussion areas analyzed for this study. Of the six discussion area topics, Diversity in Science Education sticks out as a topic that may be the most uncomfortable for a participant to write about and/or share their beliefs with others. It is interesting to note that compared to the other five Reflect sections of Inquiry discussion areas the Diversity in Science Education discussion area has a much higher percentage of messages coded as Content/Process and Premise Reflection, 6 and 7 respectively. All of the messages coded as containing these high levels of reflection in the Diversity in Science Education Reflect section had their issue identified as "Recognize and respond to student diversity and encourage all students to participate fully in science education."

This data would suggest that different issues may facilitate the generation of higher levels of reflection in participants' messages but, as explained earlier, the issue is not the sole determinant of whether or not a participant will write reflectively and at high levels. In fact five of the 12 messages in the Diversity in Science Education that had "Recognize and respond to student diversity and encourage all students to participate fully in science education" identified as the issue had only Thoughtful discourse, Quasi-reflection, or Content-short as the highest level of discourse in the message.

Table 62. Number and percent of messages coded as a 6 or 7 in the six Reflect sections of Inquiry discussion areas.

Reflect Section of Inquiry Discussion Area	Total messages analyzed	# of messages coded as 6 or 7	% of messages coded as 6 or 7
Effective Labs: Fall 2008	103	1	.97
Using Technology to Improve Student Learning	55	0	0
Teaching with Scientific Articles	90	3	3.33
Effective Labs: Spring 2008	133	4	3.01
Effective Labs: Spring 2008	41	1	2.44
Diversity in Science Education: Spring 2008	44	6	13.64

The second most common issue identified in participants' messages, across all discussion areas, was "Create a setting for student work that is flexible and supportive of science inquiry", at 12.55%. Messages were identified with this issue when participants

wrote specifically about modifications to the physical setting to improve a lab experience for their students or when they wrote about ways to better structure the overall facilitation of an inquiry based activity or lab. Many messages analyzed for this study, including three of the six Reflect sections of Inquiry discussion areas, were specifically focused on lab activities. Therefore, having a high percent of messages with "Create a setting for student work that is flexible and supportive of science inquiry" as the issue should not be a surprise. Tables 63 and 64 show examples of messages with "Create a setting for student that is flexible and supportive of science inquiry" identified as the issue. The "setting" in Table 63 is associated with the actual classroom space. The "setting" in Table 64 is the role of the teacher in the overall facilitation process.

Table 63. Message with an issue identified as "create a setting for student work that is flexible and supportive of science inquiry" with the classroom space as the setting.

It's exciting to read the reflections and the positive results. I was falling behind and sent a quick email to my mentor, (name), I told him I was panicking and he responded very quickly with words of wisdom that calmed me and I got on with my inquiry, thank goodness for our mentors.
I really enjoyed and learned from this inquiry. My initial thought on which inquiry to take on was, "I don't have much space for labs". We validated that with the assessment of our narrow hallway during our car experiments. Another concern was $ for equipment, well (Name) told me he didn't have a huge budget either and we could use easy to find "pieces and parts" to teach with, and we did. This drove home the Keep it Simple slogan. I'm excited to continue with these types of labs. I heard from the 5/6 room that they couldn't wait to come to Science next year. That in itself compels me to continue with labs.

Table 64. Message with an issue identified as "create a setting for student work that is flexible and supportive of science inquiry" with overall teacher facilitation as the setting.

I did a lab with my 8th grade students to study wave speed in Slinkys. I enjoyed this lab, as did my students. It was nice to see them having "fun" while exploring science concepts. This is something that my colleagues promote-instilling a sense of enjoyment & fun in the kids before they "turn off" because science is boring and full of memorization. *This was also a good learning experience for me. I learned that I need to create a lot of structure in my lab activities or experiments. I learned how to demonstrate technique and procedure and otherwise prep the kids to do the lab "on their own."* *The best part was that we all learned by doing-things we couldn't have learned in any other way. My students learned by using slinkys, stopwatches and meter sticks-way more memorable than reading from a textbook … I learned by instructing my students in this lab experiment was valuable. I look forward to doing more labs with the kids- and keeping myself open to lifelong learning.* *Thank you to everyone who shared. I really loved being able to read everyone's contributions and posing my own questions, etc.*

Another reason why "Create a setting for student work that is flexible and supportive of science inquiry" may have been identified so frequently as an issue has to do with its connection to classroom management issues. None of the Changes in Emphasis in Science Teaching and National Science Teaching Standards specifically include the phrases "pedagogical strategies" or "classroom management", participants' messages seem to be frequently encompassing what the NSTA Position Statement for Induction Programs for the Support and Development of Beginning Teachers of Science (NSTA, 2007) recommends for induction programs:

> The use of appropriate materials and strategies so that new teachers of science (referred to as "mentees") at each level—elementary, middle, and high-school—receive support for the science content they teach as well as reinforcement of appropriate pedagogical strategies and classroom management in the context of science classrooms. (p.2)

When conducting a lab in an inadequate or inefficiently used setting or when pedagogical strategies are inadequate in some way, classroom management concerns likely ensue. When asked by an eMSS program facilitator to reflect on a lab, it is natural for a participant to begin this process by first focusing on what the teacher visibly witnessed as the lab progressed. This setting, both physical or the one produced as a result of teacher facilitation, and how students functioned in it becomes an easy initial place onto which to focus one's attention, as opposed to focusing on one's deeply held beliefs about teaching and learning as it relates to the lab.

With this focus the participant, when writing their message, is likely concentrating on issues associated with classroom management or pedagogical strategies even if he does not explicitly use the phrases in his message. In having this issue identified frequently in participants' messages, it shows the eMSS program in alignment with the aforedescribed position statement. Participants were likely generating knowledge in the technical area (Habermas, 1971) when writing a message with this as the issue.

For most messages we were able to identify an issue aligned with one of the National Science Teaching Standards. The majority of the 21.81% of messages that have "Other" identified as the issue resulted from just four discussion threads located in four different discussion areas. The topics included having their students reflect in class, explaining Physics content, passing kids who fail, and problem students.

The majority of messages from the Physics Content discussion area, whose message issues were coded as other, were coded as Quasi-reflective and Content-short. This is unlike what was seen in other Content discussion areas analyzed for this study.

Most messages from other Content discussion areas were coded as Procedural and had plenty of teaching advice and resources provided in messages. This Physics topic area (threaded discussion) provides a good example of participants reflecting on content. It is an exemplary case of Mezirow's (1990) definition of communicative learning which he explains occurs when participants come to an understanding about an issue through rational discourse and by "relying on as broad a consensus possible of those who are most informed, rational, and objective" (Mezirow, 1991, p.76). When the discussion is viewed as a whole it can be seen that participants are working with meaning (Moon, 1999). Table 65 contains part of this Physics Content discussion area dialogue between participants.

Table 65. Physics Content discussion area dialogue between participants.

Mentee:
I was sitting in my communications class last night and the professor stated that when you see a rainbow, all of the electromagnetic spectrum from radio to gamma is there in that rainbow, we just can't see it. I always thought it was only light that was refracted to create a rainbow. Is it really the entire electromagnetic spectrum?

Physics Facilitator:
I think probably what the professor was saying is that we frequently think of light as being only that part of the electromagnetic spectrum we can see instead of a broad range of different wavelengths and frequencies that cannot be detected visually but can be using other diction devices. Given that, I would have to agree with him that within the rainbow it's very likely there are other wavelengths and frequencies of electromagnetic waves. If I am mistaken, please, correct me immediately.

Tech Facilitator and Mentor:
I would question the phrase "within in the spectrum". I picture an interspersing of light and for my middle school student I want them to see the radio-micro-IR-visible-UV-xray-gamma, in that order. What wavelengths ARE refracted by light? Certainly each wavelength is affected differently by different media. We just did GEMS "Living with a Star" to study the protection the magnetosphere, ozone layer, and atmosphere grant us through differing effects on radiation.

Table 65 - Continued

Original Mentee who submitted the initial question:
I suppose it would make sense that all waves are refracted by the water drops. I just never thought of it that way and it seemed somehow odd to think that there are microwaves in my rainbows. Thanks for the clarification.

Experienced Science Teacher:
Based on the fact that some of the electromagnetic spectrum is below the frequency of visible light and the rest of the electromagnetic spectrum is above the frequency of visible light, I would say that the refraction and reflection of each of these non-visible frequencies within the raindrops can be detected on each side of the rainbow instead of in the rainbow.

Physics Facilitator:
Excellent point (Experienced Science Teacher). Thanks.

Tech Facilitator and Mentor:
Please allow me to expose my ignorance… I am aware that the layers of the atmosphere affect some wavelengths and not others. Is it unreasonable to suppose that some wavelengths are refracted more than others by a water drop (or anything else) or is all light regardless of wavelength affected equally?

Physics Facilitator:
Hi, (Tech Facilitator and Mentor). If all light were affected equally, we wouldn't see the rainbow. It's because of difference in refraction due to wavelength that light is bent unequally. I would assume the same is true with non-visible light waves of the EM spectrum. But you know what they say about assuming anything.

Physics Specialist:
(To Physics Facilitator): Your assumption is correct.

Mentor and Facilitator:
Hi folks, Great discussion. Here are my thoughts: If the raindrops were exposed to all of the em spectrum, then the lower the freq radiation would refract less that the higher freq. However since the raindrop is within the earth's atmosphere, it isn't exposed to gamma rays (I hope). Furthermore, cosmic rays that it may be exposed to interact with molecules to form exotic and non-exotic particles- so if the comic rays were to be refracted there is an excellent chance that we would not observe them since by the time they would have reached us at the surface of the earth they would we something else.

Physics Specialist:
Thank you (Mentor and Facilitator) for your contribution in this discussion. You made a great statement! A question to all teachers: Why low frequency waves refract less? How would you explain to school students that low frequency waves refract less?

Non Reflective and Reflective Discourse Seen in Conjunction with Further Action.

In the eMSS program participants engage in online dialogue in an effort to meet the overall goal of the program, improving their teaching practice and ultimately their students' achievement. When participants think about what they have learned in the online discussion areas and consider ways they will apply this knowledge to their classroom experience in an attempt to improve practice, they are participating in what some describe as a final step of a reflective process. Dewey (1933) posits that reflective thinking "must tend to a conclusion" (p.5). Others propose that reflection is a process which includes developing an action plan (Gibbs, 1988) or planning for future action (Kolb, 1984).

In the context of eMSS, to have participants think reflectively without applying what is learned from this thinking to their classroom situation would be wasteful. Therefore, it is relevant to this study that an analysis of the online discourse for evidence of reflective thought included identifying when participants wrote about further action that they intend to or did take as a result of participating in the online discussions or activities associated with the online discussion areas. Table 66 compares messages from four different discussion areas and shows whether or not messages contained a statement by the participant in regards to what they were going to do or did as a result of participating in the online discussions or activities associated with the online discussion areas.

Table 66. Number and percentages of messages in the four discussion areas containing reference to further action.

Discussion Area	# of messages	Author	No further action stated		Further action stated	
Content	29	Experienced	28	96.55%	1	3.45%
	9	Novice	9	100%	0	0%
Special Topics	54	Experienced	53	98.15%	1	1.85%
	44	Novice	44	100%	0	0%
Reflect Section of Inquiry	74	Experienced	47	63.51%	27	36.49%
	135	Novice	48	35.56%	87	64.44%
Self-reflect. Self-assess. of Inquiry	N/A	Experienced	N/A		N/A	
	109	Novice	2	1.83%	107	98.17%

The data shows as participants submit messages to the Content and Special Topics discussion areas they rarely write about further action that they plan to take as a result of participating in the online discourse. These results should not be surprising. The facilitators of these areas do not ask participants to write about further action. It is not an explicit goal of these discussion areas. Participants may be learning new ways to work through certain situations in their classrooms and they may plan on using something that they have learned in these discussion areas in the future. Past research has shown that participants, in particular novice science teachers, appreciate and learn from the Content discussion area especially. However, they are not writing about their intent to use what they have learned, in these online discussion areas, in the classroom.

Participants submitting messages to the Reflect sections of Inquiry discussion areas and to the Self-Reflection/Self-Assessment assignment area in the Inquiry discussion areas are writing about further actions they plan on taking at a far higher rate than what was seen in the other discussion areas. Facilitators of these discussion areas usually specifically ask participants to write about how what they have learned during an Inquiry will influence what they will do in future situations. By asking participants to write about actions they will take in the future as a result of participating in an online discussion, the eMSS program has taken an approach that aligns with what Dewey(1933) and others think about reflective thought processes in the context of further action(s).

Table 67 shows prompts from two different facilitators of Reflect sections of Inquiry discussion areas. Although written by different facilitators each prompt is asking, in some way, for participants to write about further action they plan to take as a result of participating in the Inquiry. Both facilitators ask participants to include possible next steps in their message. The third prompt in Table 68 is the standard prompt for the Self-Reflection assignment required of novice science teachers at the end of each Inquiry in which they participate. The prompt has participants answering four questions. The third question calls for participants to think about further action by asking them to write about their next steps.

Table 67. Different prompts all containing reference to a further action aspect.

Prompt from a facilitator of a Reflect section of an Inquiry discussion areas: *Mentees: Please take a few minutes to conclude this Inquiry by reflecting back on your work. Post to your group what worked for you and any challenges you faced in working in this Inquiry. Include possible next steps. Also were there any significant AH-HA moments?*
Prompt from a facilitator of a Reflect section of an Inquiry discussion areas: *Mentees: Now that you have implemented your plan and considered strengths and challenges of your lesson design, what insights have you gained about the role of technology in learning within your classroom? How would you go the next step(s) in bringing more technology into your instruction (where do you plan to go from here?)? How has your involvement in the inquiry helped you in this effort?*
Standard prompt for the Self-Reflection assignment required of novice science teachers at the end of each Inquiry in which they participate *Please take a few minutes to conclude this Inquiry by reflecting back on your work. Post to your group what worked for you and any challenges you faced in working in this Inquiry. Include possible next steps. On the Menu bar, click on Discussion and Private Messages and click on your Discussion Group.* *1. What worked for you in this Inquiry?* *2. Did you have any challenges?* *3. Based on your work in this Inquiry, what are your next steps?* *4. What did you like about this Inquiry, and do you have any suggestions for improving it?*

Responses, found in both the Reflect sections of Inquiry discussion areas and the Self-Reflection assignments done at the end of an Inquiry, to the further action aspect of a prompt fell into three main categories. Many response messages were seen by coders as merely an effort by a participant to meet the minimum requirement of the discussion area curriculum as opposed to a time for deep reflection on practice. Examples of this type of message are seen in Table 68. Moon (1999) would support the assertion that these responses are characteristic of a surface approach to learning because participants are not making sense of new ideas and/ or not connecting their thoughts to deeper or broader

meanings. The messages are indicative of a participant who finds writing the dialogue merely a means to an end as opposed to an opportunity to think reflectively.

Table 68. Examples of responses, to the further action aspect of a prompt, in which the participant merely responds in an attempt to meet the minimum requirement of the discussion area.

Message written by a mentee, and submitted as the Self-Reflection assignment at the end of an Inquiry: *As we do labs, I am going to have my students continue to implement the Scientific Method.*
Message written by a mentor and submitted to the Reflect section of an Inquiry discussion area: *I will have my students spread their wings even further into the realm of technology.*
Message written by a mentee and submitted to the Reflect section of an Inquiry discussion area: *I will definitely be repeating this lab in the coming years, and I think I had more fun than the kids!*

A second category of responses to the further action aspect of a prompt or assignment has the participant writing about specific things that can be done to improve a specific classroom experience. Examples are found in Table 69.While thinking and then writing about the content of a singular lesson or a singular Inquiry topic participants are most likely functioning in the making meaning or working with meaning stages of learning (Moon, 1999) while learning in the instrumental domain (Habermas, 1971).

When participants were preparing online discourse found in Table 69, they were engaged in a process of analyzing aspects of a classroom lesson or Inquiry topic in an attempt to make better meaning, explore options, and / or organize new learning with what they already know with the explicit purpose of improving their teaching practice. Moon (1999) would claim they are working with meaning. However, she would also

posit that, if only a relatively minor accommodation of the cognitive structure occurs while working with the material of learning, then these messages are likely more representative of the making meaning stage of learning. Nevertheless, reflection can still play a role at this level of learning (Habermas, 1971). These representations of learning characterize a deeper approach to learning compared to those in Table 68.

Table 69. Examples of responses, to the further action aspect of a prompt, in which the participant writes about specific things they will do to improve a specific classroom experience.

Message written by a mentee and submitted as the Self-Reflection assignment at the end of an Inquiry: *My next steps are to reflect on things that I can improve on for both labs such as adding more detailed pictures with the pig lab so that the students spend less time asking me what something is and more time finding it out on there own. And I would add a few more questions based on the questions that came up during the lab. I will also get the cards for the digestive system game laminated. Reflect and improve.*
Message written by a mentee and submitted as the Self-Reflection assignment at the end of an Inquiry: *I would keep this lab next year and think about more labs where I will have many groups working to assemble a large set of data for a full group discussion. I will make changes to the lab: 1) I will have students collect data individually for a single point and pull together data at the end of the first day and 2) I will have the "write the procedure" part of the lab be a pre-lab homework assignment that must be complete before students can make measurements.*
Message written by a mentee and submitted to the Reflect section of an Inquiry discussion area: *Next steps: 1-Using real microscopes 2-review material to assess comprehension 3-whole unit on cells and their structures as well as levels of organization within a human (Cells, tissues, organs…) 4-I will use brain-pop as well since this usually grasps their attention and the quick quizzes are not only fun for the kids but very telling of what they got. (Formative assessment) 5-Now that I have used this technology, I plan to use the lap top lab as often as I can get it signed out. With the material on the web, this form of technology can enhance just about any topic. 6-I have now researched sites for my net unit and I will either use this lap top lab or show them information from the web using a projection system. Just think they will be able to see blood flowing through veins, lungs filling, etc.. These are things I would not be able to show them these types of things normally.*

A third category of messages written in response to the further action aspect of a prompt or assignment had participants writing how they might modify a lesson or their teaching but compared to messages found in Table 69, these modifications were overwhelming or not as specific, perhaps a characteristic of a strategic learner (Whitmire, 2004). Which participants, those who wrote the messages in Table 69 or Table 70, are more likely to carry out the proposed modifications? Which messages, those in Table 69 or Table 70, are examples of a deeper approach to learning? Are participants whose messages required a deeper approach to learning more likely to carry out the modifications? It is important to note that while participants may write that they will do something in the future as a result of participation in the Inquiry, there is no guarantee that writing discourse, reflective or not, will result in some type of actual further action. One may infer however, participants who take the time and energy to write in a focused manner about specific types of further action they may take, may be more likely to partake in such action down the line.

Table 70. Examples of responses to the further action aspect of a prompt.

Message written by a mentee and submitted to the Reflect section of an Inquiry discussion area: *This inquiry has given me sort of a springboard to a new way of teaching and thinking about education. All of which is a little too long to go into here and I'm pretty sure you might be saying 'phew' anyway! One of the things I am going to create over the summer is a 'digital science classroom' and digital curriculum. By this I mean that I am going to write a curriculum that is based in a virtual classroom and includes access to content. The end products of any investigation, on-line or not, will be a video, podcast or webpage. Please feel free to email me if you'd like more info of just questions.*

Table 70 - Continued

Message written by a mentor and submitted to the Reflect section of an Inquiry discussion area: *My next steps are to find more articles that I can use for upcoming units. Based on what I have picked up during this inquiry I feel that articles can and will become a valuable part of my repertoire. Now that I know the steps to follow I feel confident that I can get my students use and understand a variety of scientific articles. They also enjoy reading things from the real world.* Message written by a mentee and submitted as the Self-Reflection assignment at the end of an Inquiry: *My next step is to make inquiries like this and let the students explore on their own so they would have a feeling of accountability of their learning. I am going to use more project-based lessons to help my students develop critical-thinking, independence, work-oriented, research oriented dependability, etc. Skills they need in order to survive college and university life in the future.*

The data supports the premise if the program goal is to have participants write online discourse that contains dialogue about further action then the facilitator needs to ask for such dialogue. Discussion areas where participants were frequently asked to write about further action saw 69.50% of participants doing so. Only 1.47% of participants wrote of further action in discussion areas in which facilitators did not specifically ask for participants to write about further action.

When asking participants to reflect on and write about further action, the eMSS program has primarily seen responses focused on generating knowledge in the technical area (Habermas, 1971). eMSS program designers may need to determine their goal for the role of reflective thought when having participants write about further action. For example, do they want further action based on technical aspects of a lesson or further action based on the participants' underlying beliefs guiding their decisions in the

classroom? Do they want participants focusing on big picture ideas or technical aspects of individual lessons? Which approach is most beneficial to participants and their students?

Summary

This study analyzed online discourse between experienced and novice science teachers for elements of reflective and non reflective discourse using a research based discourse analysis rubric designed specifically for the study. Data was collected to determine what elements of reflective and non reflective discourse participants were using and where this discourse was found. Several comparisons of the use of reflective and non reflective dialogue were discussed in this study. The evidence supports what has been seen in other studies of the eMSS program (Bice, 2007). Experienced science teachers submitted more messages to the discussion areas compared to novice science teachers. Many of the messages were written to provide teaching advice, encouragement, assignment explanations, and other procedural information. These types of messages were coded as a type of non reflective discourse-Procedural discourse. Novice science teachers submitted an overall lower volume of messages but a higher percentage of these messages were coded as reflective.

The data showed that different discussion areas had different percentages of messages identified as containing reflective discourse. This discrepancy may be attributed in part to the different goals and methods of facilitation of the different discussion areas. The messages submitted to the Reflect sections of Inquiry discussion areas, and the messages submitted to the Self-Reflection assignment section in particular,

had greater percentage of messages displaying higher levels of reflective thought compared to the Content and Special Topics discussion areas. An analysis of various discussion area prompts and the responses they elicited has shown the need for modifications of the prompts embedded in the online curriculum or created by individual facilitators in certain discussion areas if a higher percentage of messages is sought.

The analysis also showed when discussion area facilitators asked participants to write about or reflect on future action they may take as a result of participating in an online discussion or completing a discussion area curriculum, participants generally complied. In their responses to this prompting they typically used a surface approach to learning while focusing on technical aspects of a lesson or by writing about general things to try in the future. If facilitators did not ask participants to reflect on and write about future action, it was usually not seen in participants' messages.

The issues about which participants wrote in any message, other than those coded as Procedural, were identified as focusing on several different National Science Teaching Standards (1996). The most commonly identified issue found in participants' messages in the context of the National Science Teaching Standards were "Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students." Considering the authors of the messages, novice science teachers interested in improving their practice and experienced science teachers trying to assist them in this endeavor, the prevalence of these issues in participants' messages was not surprising.

CHAPTER FIVE

CONCLUSIONS

Introduction

The eMSS program was created in response to the need to retain and to provide ongoing learning opportunities for mathematics and science teachers. The program provides support to science teachers using a variety of approaches designed to improve their teaching practice and subsequently student achievement. It matches novice science teachers with an experienced science teacher who, along with university scientists and called content specialists, and discussion area facilitators, guides them through the online eMSS curriculum and discussion areas. This unique combination of support personnel was selected in part to assist teachers in the development of their content and pedagogical content knowledge, an important focus of the eMSS program.

Additionally, and consistent with many other professional development programs for novice science teachers, the eMSS program provides a support structure designed to help improve the general pedagogical knowledge as well as the survival skills of novice science teachers. And, like other professional development programs, eMSS relies heavily on participants' writings as a primary means by which participants represent what they learn and reflect on while involved in the program. Much of the learning in this program takes place as participants prepare messages for and in response to other participants' messages in various online discussion areas.

By encouraging participants to write and submit messages to the online discussion areas, the eMSS program intends to, among other things, promote reflection by its participants. One of the eleven eMSS Design Principles states that the on-line learning experiences will be explicitly designed to foster reflection on classroom practice or mentoring practice by providing participants with frameworks or models of good practice, along with opportunities to do reflection. McAleer (2008) describes the discussion areas as a place that offers "professional learning experiences for all of the eMSS participants and are intended to foster collaboration and reflection in order to enhance professional growth, particularly in content and pedagogical knowledge" (p. 219). This study does acknowledge that participants may be reflecting on their practice or belief system and not showing evidence of this in the discussion areas. Read-only behavior is widespread amongst mentees (Rugemer, 2009) and it will be impossible to ever know the degree to which these silent participants take a deep approach to learning and reflect on their practice.

Clearly the eMSS program views reflection in the context of online dialogue as integral to the professional growth of its participants. There is a plethora of support for this view in the literature. The purpose of this study was to analyze the eMSS online discussion areas in order to determine if there was evidence of elements of reflection in participants' dialogue. Although plenty of literature exists that espouses reflection as a tool to facilitate adult learning, this same body of research frequently admits that the term reflection has been ill-defined making it difficult to operationalize in studies. Therefore, this study also attempted to add to the paucity of literature describing criteria and

research tools, such as rubrics, used to identify reflective and non reflective discourse. Specifically, this study, using content analysis of online discourse, sought to answer the following research questions:

1. Which elements of non reflective and reflective discourse are found in the types of discourse that experienced science teachers, participating in a professional development program, write? Which elements of non reflective and reflective discourse are found in the types of discourse that novice science teachers, participating in a professional development program, write? How can any observed differences be interpreted?

2. Which elements of non reflective and reflective discourse, written by participants in an online professional development program, are seen in discussion areas varying in content and format? How can any observed differences be interpreted?

3. To what extent are issues prominent in the National Science Education Standards present in the teachers' discourse, and is there a relationship between the presence of particular standards-based issues and the level or type of reflection?

Chapter Four presents the findings of this study and relates those findings to these research questions. In summary, the results indicated that many participant messages were coded as Procedural discourse when using the rubric designed for this study. Although these messages did not contain evidence of reflection, a fair number of these messages were an informative part of the online discussion. Detailed descriptive statistics can be found in Chapter 4. Depending on the type of discussion area, the content of these types of messages was many times appropriate in that they aligned with the eMSS goals for that discussion area.

The results did indicate that participants are, at times, writing messages that contain some elements of reflection. The majority of these messages showed evidence of Quasi-reflection as the highest level of discourse. In these messages participants usually took a surface approach to learning and wrote underdeveloped justifications as to why they felt, believed, or acted the way they did. A fair number of messages that were coded as

containing reflection had participants reflecting on the content of a specific lesson or a specific pedagogical topic. These messages were coded as Content-short unless the explanation was indicative of a deep approach to learning, in this case the message was coded as containing a higher level of reflective discourse. Both Quasi-reflective and Content-short messages were usually indicative of a surface approach to learning. Statistical tests showed that different discussion areas had overall higher levels of discourse when compared to other areas. This difference could be attributed to several factors including the goal, curriculum design, facilitation, and topic of the specific discussion area. Additionally, tests showed that novice science teachers had an overall higher level of discourse across discussion areas compared to experienced science teachers. This difference could be attributed to the different roles these participants play in the eMSS program.

In discussion areas where facilitators asked participants to write about further action they may take, as a result of participating in the discussion area, there was a high degree of participant compliance to meet this discussion area expectation. Most of the explanations of intended further action were only one or two sentences long and aligned with a surface approach to learning. The majority of further action statements were focused on the technical aspect of a lesson or discussion topic and showed evidence of participants learning in the instrumental domain (Habermas, 1971). As long as this is the goal of the discussion area and/or beneficial to teachers, then these type of responses should be viewed as appropriate and relevant.

Most messages had issues identified as focusing on three main Changes in Emphasis in Science Teaching (National Research Council, 1996): Understanding and responding to individual student's interests, strengths, experiences, and needs; guiding

students in active and extended scientific inquiry; and continuously assessing student understanding.

Implications for Educators

The findings from this study show that elements of reflection can be found in the written online dialogue submitted to various discussion areas by program participants. The literature supports this finding as valuable to enhancing the professional development process (Mezirow, 1994; Schon, 1983). In light of this, professional development programs may consider creating, as part of their curriculum, a learning environment conducive to encouraging reflective thought processes by their participants. In order to create an environment supportive of reflection several areas of existing research as well as the results of this study should be examined and applied.

First, it is germane to these implications for educators that the online discussion areas be recognized as places where reflection can be found. Next, the rubric as a tool for measuring levels of reflection is analyzed. Then the importance of specifically operationalizing reflection for a professional development program including how, when, and where, it should be seen, is discussed. This is followed by a discussion about paying special attention to the curriculum writing and facilitation processes in order to best encourage reflective responses from participants. Lastly, the assertion that if a professional development program is to be effective in terms of improving student achievement, then making connections between what is learned in the program and the participants' classrooms is essential and will be discussed. Recommendations from the literature and findings from this study will be used to make recommendations for programs which espouse reflection as integral to its participants' professional growth.

Online Discussion Areas as a Place for Reflection

This study has shown that online asynchronous discussion areas are an appropriate medium in which to ask and look for evidence of reflection by participants in a professional development program. Varying levels including high levels of reflective thought processes can be seen in online discussion areas. Developing and writing messages found in online discussion areas can be both the process and the purpose of a participant reflecting on an issue (Moon, 1999).

Reflection Rubrics

The section of the rubric in which the highest level of discourse in a message was identified was heavily influenced by the work of Kember et al. (1999). They explained the following about their rubric:

> (Our) category definitions are unambiguous and usable in practice for determining the levels of reflective thinking from journal writing. We feel the scheme can be recommended as a tool in assessing students enrolled in courses which have the aim of developing reflective practice and thinking…The scheme should also be applicable to any professional development course which requires students to write reflective journals.

This study showed that the Kember et al. rubric can be used to identify different levels and categories of reflective writing in a professional development context in addition to reflective writing found in the undergraduate health science classes examined in their study. The results of this study support the assertion by Kember et al. (1999) that their rubric is a viable tool that can be used by educators as they analyze student work for evidence of different levels of reflective writing.

Operationalizing Reflection for a
Professional Development Program

The literature on reflection frequently describes reflection as a complex construct to define and operationalize (Moon, 1999). Yet, professional development programs commonly include the importance of reflection in its program goals and attempt to embed its use within the program design. What is frequently left out of the program explanation with regard to reflection is an elucidation of how reflection will be operationalized, including how and when it should be physically manifested, and what it should look like.

The eMSS program, like many others, espouses the role of reflection in its program description yet does not operationalize the concept. When a program lists reflection as a component of its design or framework it should explain its view of the concept in detail. Not only will this likely assist in the subsequent development of effective curricular materials, including the development of writing or discussion prompts, but also help in the program evaluation process when necessary.

Within the description of a professional development program, designers could provide the definition of reflection it deems appropriate and aligned with the goals of the program and then provide bulleted statements in an attempt to operationalize and explain the how, when, and what as it relates to reflection in the program. For example, the eMSS program could begin the process of better operationalizing reflection for their program by listing the following bulleted statements under the associated eMSS Design Principle.

-Reflection is defined for this program as a mental process, with a purpose or outcome (such as knowledge generation), associated with learning at a deep level and often involves justifying what one knows, feels, believes, or acts upon. It is especially applied when examining issues, situations, or experiences that produce a sense of uncertainty or doubt, or are complicated with no obvious solution for a given participant.

- Reflection is seen as one of several components of the rich dialogue envisioned for the eMSS program. In the eMSS program evidence of participants' reflection on issues will be found in the written online dialogue and depending on the content of the messages, these messages can be seen as evidence of participants' reflection on an issue.

-While messages containing elements of reflection can be found in all discussion areas throughout the semester, evidence of reflection is specifically expected to be seen in messages submitted to the Reflect section of Inquiry discussion areas and in participants' Self-Assessments completed at the end of an Inquiry.

-Different approaches to discussion area curriculums will be utilized to meet the reflection goals of the eMSS program. Primarily in the Inquiry discussion areas but also in the Special Topics and Content discussion areas, facilitators will guide participants in discussions geared towards generating knowledge that is immediately useful in their classroom setting. The Self-Assessment assignment will be intentionally designed to advance participants' to a point where they are reflecting on and writing about the efficiency of their problem solving strategies and the effect of aspects of their underlying belief system guiding their decision making process as it relates to classroom situations.

Additionally, professional development programs may find it beneficial to provide participants with actual examples of the different types of reflection that the program hopes to foster. More than one example may need to be provided if different aspects of the program include reflection in their description. For example, one part of the program may have participants reflecting on the content of their lesson and how it may be improved. Another part may have participants reflecting on strongly held beliefs about education which guide their daily decision making processes about curriculum.

Program Curriculum Writing and Facilitating Reflection in a Professional Development Program

Discussion Area Initial Prompts. The literature on reflection and adult learning supports the notion that reflection, and especially reflection associated with a deep (Moon, 1999) and intentional (Habermas, 1971) approach to learning, is not necessarily

an automatic process for participants in a professional development program (Moon, 1999). Curriculum writing and the facilitating of this curriculum, therefore, can be seen as essential to the reflective process. In view of this, special attention should be made to the manner in which these processes are carried out.

The results of this study showed that the wording of online discussion prompts need to be intentional if certain types of reflective thought are to be invoked in the development of participants' representations of learning. When phrasing a discussion prompt, with the goal of encouraging response messages that required the use of reflective thought processes in its preparation, curriculum writers should have in mind a specific overall focal point for participant reflection. For example, is the curriculum designed to promote participant reflection on the content, including possible modifications, of a recently taught lesson, the thought process behind the preparation of the lesson, or the belief system participants used to guide the problem solving process associated with conducting the lesson? Messages written about each of these different issues could produce messages identified as containing different types of reflection. If curriculum writers are specific in their phrasing of the discussion prompt, they may see responses better in line with their program's description of reflection.

Facilitators may find they do not want to limit participant responses to a particular focus as seen in the examples described in the previous paragraph. They may wish to "leave the door wide open" and phrase their prompt using a more general format. Findings from this study suggest that, when using a general format for prompting, facilitators should provide an example response message to help express what is expected

in terms of reflective content, time, and effort from participant response messages.

Discourse analysis from this study showed that general prompting can lead to large discrepancies in participant response messages with most participants taking a surface approach to learning in the preparation of their messages. Additionally, by modeling good and expected work facilitators may encourage participants who are already taking a deep approach to learning, and spending quality time in the preparation of their messages, to continue to do so. When all response messages are "accepted" by facilitators regardless of the large discrepancies in the quality of the message, participants who had been taking a deep approach to learning may see others getting "credit" for spending a fraction of the time and effort on their response messages. As a result they may decide to only take a surface approach in their next response messages or writing assignment. This, of course, would be a step backward in regard to program goals associated with the development and use of reflection as a tool to improve teacher practice. Additionally, examples of good work will help participants to know if they are working up to program expectations or if they need to change their approach and effort when writing messages.

Wording of discussion area prompts or of the model response message is critical. Findings from this study show you typically get what you ask for. For example, the following prompt is found in the eMSS Inquiry discussion area: "Mentees: Please take a few minutes to conclude this Inquiry by reflecting back on your work. Post to your group what worked for you and any challenges you faced in working in this Inquiry. Include possible next steps. Also were there any significant AH-HA moments?" Many responses

to this prompt were indeed indicative of having taken only a few minutes to prepare as recommended in the prompt and were usually coded as representing a surface approach to learning.

Furthering Conversation through Ongoing Facilitation. Validating discourse (Mezirow, 2000), a key component to reflection and learning in the communicative domain (Habermas, 1971) is more likely to occur during an exchange of discourse as opposed to just reading what others have written. Therefore it is imperative that facilitation continues throughout the discussion area after the initial discussion prompts are given and responded to. Rather than viewing messages submitted in response to an initial discussion prompt as endpoints of a discussion area these messages could be seen as prompts, with the proper facilitation, for different conversations requiring further participant reflection. These discussions could also advance the online dialogue in such a way as to encourage an upgrading of learning (Moon, 1999).

Results of this study would indicate that after providing participants with an initial discussion prompt, facilitators still need to provide guidance in promoting validating discourse. Attempts at this type of guidance were occasionally seen when looking at entire threads of discussion. This facilitation process could be carried out in such a way as to encourage participants who were only at the making sense stage of learning (Moon, 1999), when they submitted a message to a discussion area, to engage in deeper approaches to learning and to begin making meaning, as they partake in discourse pertaining to their original message. Or, this type of ongoing facilitation may encourage novice science teachers to reevaluate what they have written in a previous message.

During the time when a new teacher is just entering the profession their knowledge can seem most certain to them. This can provide them with a false sense of confidence and perhaps impatience with those who differ in opinion from them. Facilitated discourse can play a role in working through this type of scenario.

Facilitators could encourage participants to respond in a meaningful way to a message from another participant. For example, participants could be guided to respond with an opinion and explanation that either agrees or disagrees with another participant, formulate a question to be answered by another participant, or provide advice to another participant with a detailed explanation as to why the participant believes in the content of this advice. This research does acknowledge the difficulty in asking participants to constructively explain why they disagree with a fellow participant's view on an issue. These types of dialogue can appear much more intense in an online environment.

In the eMSS program a facilitator in a Dilemma discussion area could ask participants to express how they have integrated others' point of view into their belief system about the Dilemma topic. Or, after reading the online dialogue in a discussion area a facilitator could phrase a question to several participants similar to "I see that you and Participant B both like to handle this situation in a similar fashion. Is there anything that other participants do in this situation that you may incorporate into your strategy for dealing with this situation in the future?" or "Explain why what another participant does in their classroom situation would not work in your situation."

If this type of questioning becomes too burdensome or confusing, profession development programs may need to "find provocative ways to stimulate dialogue from different perspectives, controversial statements, readings from contradictory points of view, or structured group activities that lead people to see alternatives" (Cranton, 2006,

p.125). This type of questioning or prompting would also generate higher quality disorienting dilemmas (Schon, 1983) or complicated and unstructured ideas in learning for which there is no obvious solution (Moon, 1999) which the literature associates with reflection.

Facilitating online discourse in a way that promotes validating discourse is complicated. In order to promote this type of discourse a professional development program will need to determine the delicate balance between wanting to guide conversations in a way that leads to deep levels of learning and reflective thought and respecting both novice and experienced teachers' time demands.

Questions Designed for Deep Approaches to Learning. As with prompts for discussion areas, questions making up other parts of a professional development program, including face-to-face versions of professional programs, should be designed with the end in mind when it comes to preparing questions to promote reflection. In other words, if having participants reflect as they create their representations of learning is a goal of the question, writers of questions should be cognizant of the reflection goal.

If the goal of a question is to elicit an answer that shows high levels of reflection, for many participants the question needs to be phrased in a manner designed to elicit this type of response. Typically if a question is phrased in such a way to promote a deep approach to learning chances of seeing evidence of higher levels of reflection in the responses is enhanced (Moon, 1999). An example of a way to modify a question commonly found in the eMSS program in order to elicit a more reflective response follows.

Instead of asking participants to respond to “What challenges did you have with this classroom activity?”, the question can be rephrased in a way that encourages participants to examine and then explain why something did not work. For example the question could read “Reflect on the challenge(s) you encountered in preparation for and during this classroom activity. Describe the challenge(s), explain why you think you had these challenges by not only focusing on the student and classroom environment but your specific role in planning for and facilitating the activity. Explain what you did to work through these challenges and/or suggest how you might change the activity. Include why you chose these modifications.”

Another way to better elicit a deep approach with a less verbose question would be to ask the question “What challenges did you have with this classroom activity?” and then give an example of what the response message should look like. The example should be indicative of a deep approach to learning that took more than five minutes to think and write about. It could contain sentences that are responses to the various related questions in the previous paragraph.

Making Focused Connections between What is Learned in Professional Development Programs and Participants’ Classrooms

The literature on reflection supports the notion that reflection should lead to a conclusion (Dewey, 1933), include the development of an action plan (Gibbs, 1988), or a plan for future action (Kolb, 1984). When professional development programs assist participants in making focused connections between what they are learning in the program and their classroom, a plan for future action in the classroom is likely to ensue.

This research supports the idea that one way to encourage participants to make the connection between a professional development program and classroom practice is to ask them to reflect on and write about what they may do in the future as a result of having learned something from participating in a particular discussion area. The data from this study showed when asked to write about future action, participants complied with a high response rate. In discussion areas where participants were not asked to write about future action only 1.47% of messages contained reference to what the participant may do in the future as a result of what they had learned in the discussion area.

The discourse analysis in this study showed that participant responses may be enhanced and different types of reflection elicited if, rather than merely asking "what's next," curriculum writers phrase questions in such a way that requires more reflective responses even when participants are just trying to meet the minimum requirement for answering the question. Additionally, prior to phrasing this type of question, curriculum writers should determine if their goal for participants is to have them reflect in such a way, when writing about future action, to generate knowledge in the technical area (Habermas, 1971). Or, curriculum writers may determine that responses focused on participants' underlying beliefs guiding their decisions in future classroom situations as more valuable. Responses to these different focuses of future action should require different types of reflection. Facilitators may also wish to determine if participants will benefit most by focusing on big picture ideas or technical aspects of individual lessons. Perhaps a combination of both is most beneficial to participants and their students.

Recommendations for Further Research

Analyzing Participants' Reflective Characteristics

Several unanswered questions and recommendations for further research resulted from this study. Data collection for this study was limited to the analysis of messages in online discourse. Although this study attempted to identify messages that did or did not show elements of reflection by participants, Moon (1999) reminds us that "the difficulty of distinguishing the processes of learning from the representation of that learning is common to many studies of reflection and learning" (p.7).

There are different variables affecting participants' abilities to express or represent thought processes, reflective or not, that influenced their learning. For example, a participant may be able to think reflectively but be unable to express these thoughts due to poor writing skills or lack of confidence in sharing their thoughts (Bice, 2007). Others may think reflectively about a discussion topic and have the ability to express these thought processes but choose not to due to time constraints and/or their decision to just meet discussion area minimum requirements.

Further research incorporating a type of Reflection Inventory could build on the findings of this study. This would involve using a more objective measure of participants' reflective tendencies and comparing these results to what is actually seen in their online discourse, perhaps at the beginning and end of the program year. This could provide the eMSS program with information to help determine if the program is indeed encouraging, developing, hindering, or having no effect on participants abilities to reflect on their practice as the program year proceeds.

Different Ways to Look for Evidence of Reflection

The rubric used for the discourse analysis in this study focused on identifying elements of reflection in participants' messages by relying heavily on Moon's (1999) and Mezirow's (2000) views of reflection. There are other methods, including indirect means, to examine online discourse for evidence of reflection. For example, determining whether or not a participant is showing evidence of generating knowledge at the working with meaning (Moon, 1999) and transformative learning stages of learning, or looking for evidence of participants taking a technical, humanistic, or social action approach to preparing their messages (Cranton, 1996). Identifying messages in either of these two contexts, both of which have reflection associated with their explanations, would add to the overall understanding of the use of reflection by professional development participants as they prepare online discourse.

Deep Approach to Learning

Results of this study showed when participants took a deep approach to learning they were more likely to write messages showing evidence of higher levels of reflection. Determining what motivates some participants to engage in a deep approach to learning as they prepare their messages may be key to promoting high levels of participant reflection on discussion area topics. Some areas to consider could include the wording of some discussion area prompts, which was discussed earlier in this chapter, providing examples of messages indicative of a deep approach to learning and letting participants know that this type of writing is expected of them in certain instances, or providing participants training in writing reflectively. Making changes similar to these followed up with another analysis of the online discourse for evidence of reflection could be useful to

professional development designers and facilitators as they continue to modify the structure of the program in ways to best promote, among other things, quality dialogue.

Identifying Issues in Different Contexts

In this study issues on which participants' messages focused were identified primarily in the context of the National Science Teaching Standards (1996). Identifying issues that participants typically discuss or write about in a given professional development program, and the elements of non reflective and reflective discourse associated with these issues, may lead to a better understanding of what types of issues engage participants in a deep approach to learning. For example, issues could be identified as they align with different types of knowledge important to teachers such as knowledge about content, pedagogy, different types of learners, what learning looks like, curricular issues, and the system in which they work (Strom, 1991).

Proper Balance between Reflective Discourse and Other Conversation Types

Many of the messages coded for this study were found to contain no or low levels of reflection but could still be considered helpful and important messages. Messages found in the Content, Dilemma, and Topic of the Month discussion areas provided participants with immediately useful information. Collecting data concerning which discussion areas were the most helpful to participants, and cross referencing the results with what is known about the reflective content of messages found in those discussion areas, may be influential in determining the importance and roles of reflective discourse and other conversation types as they are associated with learning in professional development programs.

Proper Balance between Providing Beginning Teachers with Resources to Meet their Short Term Goals and Attending to Discussion Area Requirements

Further research into factors that influence quality participation in the online discussion areas is still needed. Frequently this is the primary means by which participants are learning in online professional development programs. Studies are needed to better define a balance between what will make novice science teachers feel the discussion areas are immediately relevant and provide assistance in the short term, and thus keep them logging on and participating, with helping them to develop the habit of thinking reflectively that will serve them and their students in the long run.

Summary

This study provided an examination of online discourse for evidence of reflective and non reflective discourse between participants in a professional development program. Using a rubric designed for analysis of individual participant messages, the results indicate that many participants' messages showed no or little evidence of reflection. Specific descriptive statistics to support this statement are found in Chapter 4. A higher percentage of experienced science teachers' messages were coded as Procedural, a type of non reflective discourse. This higher percentage is partly attributed to the different role experienced science teachers have in eMSS. These messages were often a necessary and an informative part of the online discussion and, depending on the type of discussion area, the content of these messages was appropriate in that they aligned with the eMSS goal for that discussion area.

Most messages had issues identified as focusing on three main Changes in Emphasis (National Research Council, 1996): Understanding and responding to individual students' interests, strengths, experiences, and needs; guiding students in active and extended scientific inquiry, and continuously assessing student understanding. These areas of emphasis are directly associated with issues novice science teachers would find useful and necessary to think about and discuss at this point in their career.

The results did indicate that participants are, at times, writing messages that contain some evidence of reflection. The majority of these messages showed evidence of Quasi-reflection as the highest level of dialogue. In these messages participants usually took a surface approach to learning and wrote underdeveloped justifications as to why they felt, believed, or acted the way they did. A fair number of messages that were coded as containing reflection had participants reflecting on the content of a specific lesson or a specific pedagogical topic. These messages were coded as Content-short unless the explanation was indicative of a deep approach to learning. In this case the message was coded as containing a higher level of reflective discourse.

A higher percentage of messages in the reflection specific areas of this professional development curriculum showed evidence of overall higher levels of reflective discourse compared to other areas. No one factor was singled out as being responsible for the production of the reflective content of a message. This study showed that, amongst other variables discussed earlier in this paper, the goal of the discussion area, discussion area curriculum, facilitation, and prompting structure, individual participants' innate ability to think and write reflectively, the role a participant plays in a program, participants' interest in the discussion topic, and the nature of discussion topics can likely be implicated as reasons why a participant may or may not write reflectively at

a certain point in a professional development program.

The study clearly showed that when facilitators ask for participants to specifically write about something in their messages, compliance is high. However, the quality of compliance in the context of reflective and non reflective online dialogue varied. Providing examples of quality reflective responses will give participants a better idea of what is expected of them as they prepare their own messages for submission to online discussion areas and may lead to the production of messages requiring higher levels of reflection in their preparation.

This study showed that messages within online discussion areas are places where participants' reflective thought processes can be represented. Participants' approaches to learning and the subsequent types of reflection found in their messages is associated with a variety of previously discussed factors. Designers of professional development programs can use the results of this study to assist their curriculum writing and program facilitating processes in order to better encourage reflective thought and the representation of this thought by their participants.

APPENDICES

APPENDIX A

GUIDELINES FOR ONLINE LEARNING AND FACILITATION

Guidelines for Online Learning and Facilitation

A central goal of eMSS is to promote reflection, conceptual growth and change, and improvements in professional practice through rich online dialogue. We believe that online learning environments, when carefully designed and moderated by trained facilitators, can be singularly effective places for meaningful dialogue leading to teacher growth, accompanied by changes in classroom practice and student learning gains.

Through systematic design and facilitation, eMSS online experiences will:

1. Promote rich dialogue building on the varied roles and strategies described in *Facilitating Online Learning*, and other relevant literature.

2. Focus this dialogue on the project's core themes, especially growth in knowledge of science and mathematics content, pedagogical content knowledge, and effective strategies for working with diverse learners.

3. Involve designated, trained facilitators, and the participants themselves, in fostering meaningful dialogue. In other words, engage the entire community – mentors, mentees, scientists mathematicians, lead teachers from the disciplines, and project staff – in sustaining and ensuring the quality of the online dialogue.

4. Create a culture of "contributing community members" who model effective participation by logging on frequently and contributing in ways that further other members' knowledge, resources, and professional practice.

5. Institute strategies to promote *conceptual growth and change* in an online environment, making use of relevant literature.

6. Purposefully pilot and monitor principles and strategies for promoting *change in classroom practice* through distance learning, an area in which eMSS can assume a pioneering role for the field.

7. Use dialogue intentionally to further beginning teachers' *progress along a professional continuum* from survival to focused problem solving to critical reflection on teaching practice, another area in which eMSS can play a pioneering role.

8. Foster participants' sense of belonging to an online learning community that adds value to their professional and personal lives, building on the approaches described in *Building Learning Communities in Cyberspace*, and other relevant literature.

9. Systematically elicit information about participants' varying goals, needs, local contexts and constraints, and adapt online offerings – including activities and resources – accordingly.

10. Regularly assess the quality and impact of the online experiences, involving participants and staff in ongoing self evaluation of their contributions.

11. Vary group size, providing opportunities for pair, small group and whole group dialogue.

12. Rotate role assignments. For example, provide mentees with opportunities to assume to role of "experienced expert," as well as chances for mentors, content experts and project staff to assume the role of a learner. Regularly engage participants in helping to facilitate the online dialogue.

13. Provide clear instructions about online expectations and time requirements. Build in feedback mechanisms allowing the project to make adjustments quickly when the demands become too high or inflexible.

14. Design facilitator roles and responsibilities to balance quality with scalability.

APPENDIX B

EMSS DESIGN PRINCIPLES

Each eMSS on-line or face-to-face learning experience will be explicitly designed to:

1. Meet one of the "Central Tasks of Learning to Teach" (Feiman-Nemser, 2001) for mentees (preservice or induction level), or mentors (continuing professional development level).1

2. Incorporate one or more essential outcomes selected by eMSS from the NSTA Standards for Teachers of Science (adapted from NCATE, INTASC and National Board Certification standards).2

3. Build upon relevant research as well as national guidelines or standards in these areas: (a) science and mathematics education; (b) teacher education, especially for early career teachers; and (c) supporting the learning of diverse student populations.

4. Strengthen beginning teachers and mentors' understanding of science and mathematics content and pedagogical content knowledge.

5. Build participants' sense of belonging and actively contributing to a professional learning community of science or mathematics teachers.3

6. Foster reflection on *classroom practice* or *mentoring practice* by providing participants with frameworks or models of good practice, along with opportunities to do reflection (individual, pair, small group).

7. Build participants' ability to act intentionally in their *classroom practice* or *mentoring practice*. Examples of strategies include regularly involving participants in examining and adapting their practice in light of research, standards, student work or data.

8. Provide and focus upon one or more shared experiences, for example, a reading, video, student work or data.

9. Promote individual or group growth through dialogue focused on the shared experiences.4

10. Elicit and respond to participants' current interests and concerns.

11. Respect participants' time constraints.

1 See eMSS Table 2 Central Tasks of Learning to Teach Science and Mathematics
2 See eMSS Standards for Teachers of Science Matrix as adapted for Year 1-3 teachers at the project's Chicago planning meeting, June, 2003.
3 See eMSS Table 3 Guidelines for A Professional Learning Community
4 See eMSS Table 4 Guidelines for Online Learning and Facilitation

APPENDIX C

EMSS CONVERSATION RUBRIC
HRI (2005)

To what extent is the dialogue likely to enhance the capacity of the participant to provide high quality mathematics/science instruction or to be an effective mentor and/or facilitator charged with helping move mentees forward in their practice?

OR

To what extent does the dialogue provide evidence of the above?

Not at all		To some extent		To a great extent
1	**2**	**3**	**4**	**5**

To help guide the overall rating, the following considerations were taken into account:

- The purpose of the conversation is clear and participants are addressing the specific question or discussion item.
- The content within the conversation is accurate or made accurate through the discussion.
- There is a positive culture within the conversation (participants willing to share; evidence of trust; collegial relationships; sensitive to the needs of participants).
- There is evidence of participants reflecting on their practice.
- The topics/issues are perceived as relevant by participants (e.g., mentees' questions are answered; common pitfalls are addressed).
- The topics/discussions are important for classroom practice.
- The topics/discussions are made relevant to classroom practice and explicitly discussed.
- There is sense making within the conversation (someone pulls the common ideas out – summarizes – fits these ideas within a larger context of teaching, etc.).
- The conversation is taken to a higher level (generalized to larger themes/why the practice is important in promoting student learning).

APPENDIX D

STUDY CONVERSATION RUBRIC (ADAPTED BY TAYLOR (2007) FROM HRI, 2005)

Study Conversation Rubric (Adapted by Taylor (2007) from HRI, 2005)

1. **Content of Dialogue**
   - The content (science, math, pedagogy) within the conversation is accurate or made accurate through the discussion.
   - The topics/issues are perceived as relevant by participants (e.g., mentees' questions are answered; common pitfalls are addressed).
   - The topics/discussions are important for practice in a science/math classroom.
   - The topics/discussions are made relevant to practice in a science/math classroom and explicitly discussed.

Not at all		To some extent		To a great extent
1	2	3	4	5

2. **On Task/Moving Forward**
   - The purpose of the conversation is clear and participants are addressing the specific question or discussion item.
   - There is sense making within the conversation (someone pulls the common ideas out – summarizes – fits these ideas within a larger context of teaching, etc.).
   - The conversation is taken to a higher level (generalized to larger themes/why the practice is important in promoting student learning).

Not at all		To some extent		To a great extent
1	2	3	4	5

3. **Community Building**
   - There is a positive culture within the conversation (participants willing to share; evidence of trust; collegial relationships; sensitive to the needs of participants).
   - The conversation invites inquiry, encourages others to think and respond, and creates an open, inviting framework.

Not at all		To some extent		To a great extent
1	2	3	4	5

4. **Reflection/reflective practice**
   - There is evidence of participants reflecting on their practice in one or more of the following ways:
     a. technical examination of one's immediate skills and competencies
     b. descriptive analysis of one's performance
     c. dialogic exploration of alternative ways to solve problems
     d. critical thinking about effects on others of one's actions considering social, political, and cultural forces

     *Taken from Hatton and Smith (1995)

Not at all		To some extent		To a great extent
1	2	3	4	5

APPENDIX E

EMSS DISCOURSE ANALYSIS RUBRIC

eMSS Discourse Analysis Rubric

I. Message Information

Message Information Program Semester: ___Fall 2007 ___Spring 2008 ___Fall 2008 ___Spring 2009 Message # _____	Message Author: ___Mentor ___Mentee ___Facilitator ___Other: _____ ___Can't Tell

II. Discourse Format

Response **__ To structured prompting or questioning** **__ To unstructured prompting or questioning** __To what was written by an individual participant in a given thread __Providing encouragement or a thank-you __Providing instructional advice __Providing teaching resources __To a question about procedural or technical help __ Other	**Question** __ That can be answered by anyone participating in the discussion area __ To be answered by a specific participant __ Asking for procedural or technical help (assignment requirements, technical help, etc...) __ Other
__ Instructions	

III. Discussion Area and Issue-Mark all that apply. The issue(s) in the message focuses on:

__ Inquiry Area Topic __ Specific Lesson _____ __ Other _____ __Self-Reflection Topic _____	__ Content Area Topic _____ __ Dilemma Area Topic _____ __ Topic of the Month _____

Changes in Emphasis in Science Teaching and corresponding National Science Teaching Standards (adapted from the National Council, 1999)

Understanding and responding to individual student's interests, strengths, experiences, and needs ___Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students-A ___Recognize and respond to student diversity and encourage all students to participate fully in science learning-B	**Focusing on student understanding and use of scientific knowledge, ideas, and inquiry processes** ___Focus and support inquiries while interacting with students-B ___Encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science-B
Guiding students in active and extended scientific inquiry ___Structure the time available so that students are able to engage in extended investigations-D ___Create a setting for student work that is flexible and supportive of scienc inquiry-D ___Make available science tools, materials, media, and technological resources accessible to students-D ___Identify and use resources outside the school-D **Working with other teachers to enhance the science program (in their school districts)** ___Work together as colleagues within and across disciplines and grade levels-A ___Use student data, observations of teaching, and interaction with colleagues to reflect on and improve teaching practice-C ___Plan and develop the school science program including the allocation of time and planning and implementing professional development strategies for themselves and their colleagues-F	**Providing opportunities for scientific discussion and debate among students** ___Orchestrate discourse among students about scientific ideas-B **Supporting a classroom community with cooperation, shared responsibility, and respect / Sharing responsibility for learning with students.** ___Challenge students to accept and share responsibility for their own learning-B ___Guide students in self-assessment-C ___Display and demand respect for the diverse ideas, skills, and experiences of all students-E ___Enable students to have a significant voice in decisions about the content and context of their work and require students to take responsibility for the learning of all members of the community-E __Nurture collaboration among students-E
Continuously assessing student understanding ___Select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners-A	___ Other-If no other issues apply

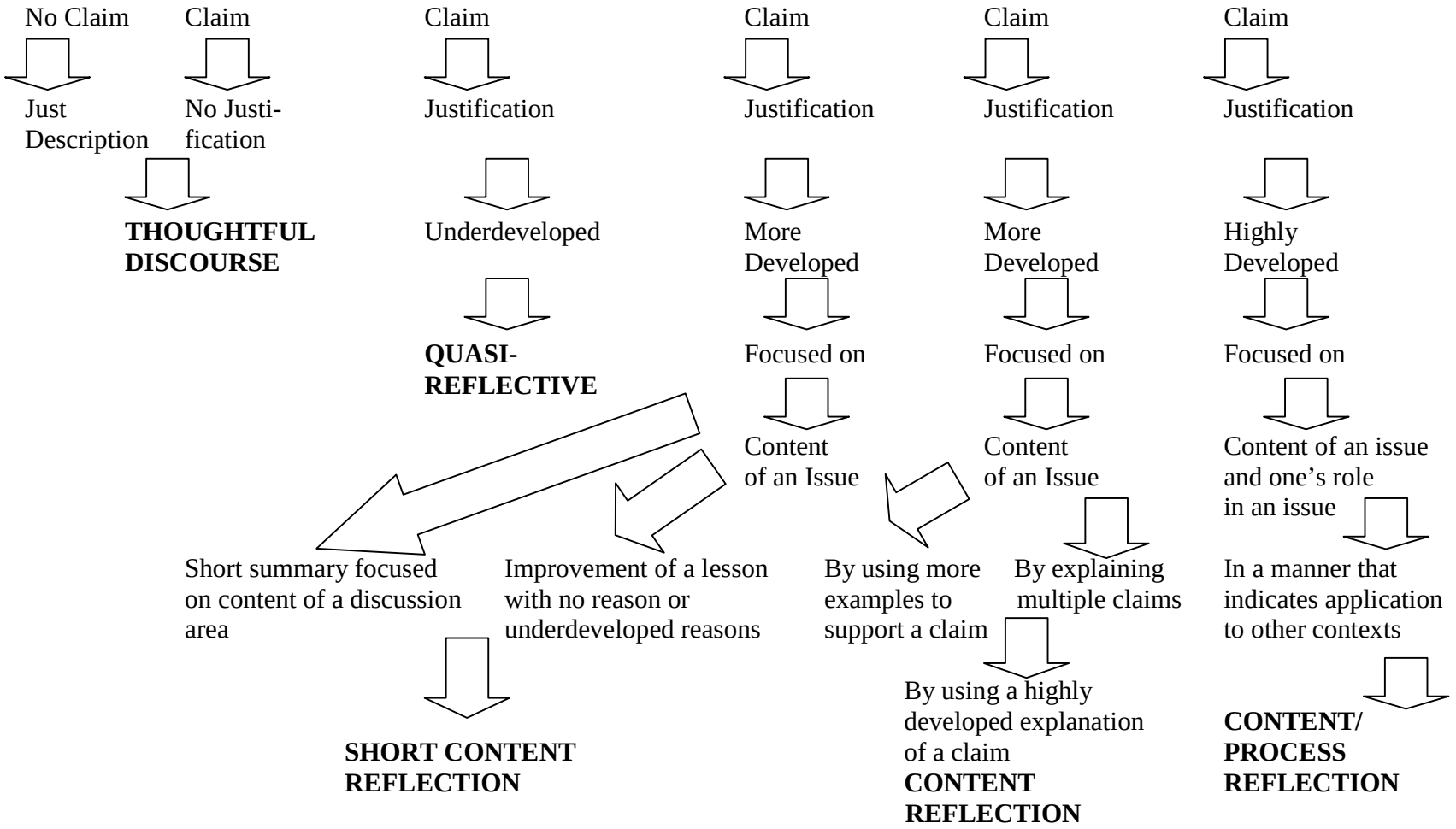
IV. Approach to Learning and Discourse Analysis

Approach to Learning. Which approach to learning does the response best represent? OR Which approach to learning does the question likely require for an answer?-Mark only the highest. __ Surface __ Surface to Deep __ Deep	**Description and/or Opinion of the Issue:** Do participants provide a justification in their message for their thoughts on an issue(s)? Mark only one-the highest. __ No Justification **(Thoughtful Discourse-Non-reflective discourse)** __ Justification
Justification: What type of justification is found in the message? Mark only one-the highest __ Pragmatic, simple, underdeveloped. **(Quasi-Reflection)** __ Brief explanation of how to improve, what wrong, and /or what went well with a lesson or a summary of what is written in the discussion area. **(Content-Short Reflection)** __ In depth explanation focused on the content of an issue. **(Content Reflection)** __ Focused on the content of an issue as well as one's role in the issue **(Content/Process Reflection)** __ Focus on articulating and examining the assumptions that guide one's thought processes in the other types of discourse. **(Premise Reflection)**	**Further Action:** Mark all that apply. __ Will try to do something as a result of this experience __ Tried something as a result of this experience __ Nothing stated ___Other: _____

APPENDIX F

DISCOURSE ANALYSIS RUBRIC FLOW CHART.
LOOK FOR CLAIMS ASSOCIATED WITH THE ISSUE

Discourse Analysis Rubric Flow Chart.
Look for Claims Associated with the Issue



APPENDIX G

VARIOUS MEETING NOTES

Thoughtful Discourse

MENTORS: How has your involvement in this inquiry helped you and others build more opportunities to bring technology into classrooms? The many great lessons shared by the many mentees have given me a wide range of ideas to integrate into my classroom. The google mapping lesso was great...I want to have my kids try it.

What insights have you gained about the role of tech in instruction? Technology used is critical in the classroom. We are preparing students to live a a world that is all high-tech!

Where do you plan to go from here in terms of incorporating technology into your instructional practice? I will have my students spread there wings even further into the realm of technology!!

No justification-reasons why she feels or believes this way are listed. Just a description of thoughts about the issue.

There is not and never has been a question in my mind about the role of technology in the classroom. Even as the students had less success than I anticipated, I remain convinced that they learned far more than if I had just stood and lectured, shown movies or had only hard copy lesson plans. I have also become stronger in thought that the activities must be made more engaging. Part of the reason for my lack of contribution here is that I have spent much time looking at, playing around in, and communicating with other educators about a virtual world called Second Life. This is a product of Linden Labs. I was introduced to it a couple of years ago, but did not have time to engage in it. It was also kind of new and not necessarily useful to me. There were about 10000 people when I joined then, now, there are more than two million worldwide (I believe). One thing I learned lately is that educators are beginning to use Second Life as classrooms. They are creating extraordinary environments from which to teach. Response from students is very good. I encourage you to check it out.

This inquiry has given me sort of a springboard to a new way of teaching and thinking about education. All of which is a little too long to go into here and I'm pretty sure you might be saying 'phew', anyway! One of the things I am going to create over the summer is a 'digital science classroom' and digital curriculum. By this I mean that I am going to write a curriculum that is based in a virtual classroom and includes access to content. The end products of any investigation, on-line or not, will be a video, podcast or webpage. Please feel free to email if you'd like more info or just questions.Thank you for your patience and if you have feedback or ideas, I would love to hear them! Happy reflecting.

Thoughtful Reflection: No justification or explanation as to why the participant believes the underlined segments. As a coder I find myself wanting to know why they so strongly believe these underlined statements. The message is just a listing of things she has done or will do. It is a long message that says little.

How has your involvement in this inquiry helped you and others build more opportunities to bring technology into classrooms?

By participating in this inquiry I hope I have provided sites and experience that others could grow on! I like reading the posts and "stealing" ideas from all the new people in the profession!

What insights have you gained about the role of tech in instruction?

I have made a resource sheet that i have passed out to my staff as well as at the science leadership meeting. I also gained a validation that technology can mak our lives so much easier.

Where do you plan to go from here in terms of incorporating technology into your instructional practice?

I want to help myself as well as my mentee see that technology will allow us to work smarter not harder- I plan to get some type of interaction planned for each 6th weeks that can be incorporated within my class.

No justification-reasons why she feels or believes this way are listed. Just a description of what she has done or will do with respect to the issue.

The more I teach, the more I see that it takes TONS of repetition. For those of us who teach the same lesson many times a day, maybe it feels like more repetition than it is! I might teach the parts of a cell one day online, then use a coloring sheet from the biology coloring book the next day, then do a project where they make a model of a cell. After doing this cell processes and other key content strands, I will review for a couple of days! Amazing what it takes for them to truly understand and retain information.

No justification-reasons why she feels or believes this way are listed. Just a description of thoughts about the issue.

All good points. I have used the book Amy refers to on formative assessments. Important for new teachers to know also that getting a picture of what the kids know can be a quick and easy and not necessarily a formal thing. I have used sticky notes along a continuum of understanding or to "agree/disagree" for example. More and more this type of activity is used in teacher workshops. What a great way (non threatening) to get the discussion going and uncovered misconceptions. I agree that time is always an issue and there never seems to be enough but giving teachers a handful of quick strategies to get a sense of what kids know way before the "test" is so important. The harder part is making them a part of our practice.

The underlined part could be considered a pragmatic justification but it is my thought that it is more of a cliché or filler statement and that is why I labeled this message as thoughtful and not quasi-reflecitve.

True or false? Chromosomes are found in the nucleus of cells. I would say the answer is false using the following reasoning. A nucleus as the entity in a cell is defined by having a nuclear membrane (envelope). When perceiving a cell during interphase, the DNA material though present is not tightly coiled around histones and therefore does not have chromosome structure. A gene is a sequence of paired DNA nucleuotides whether the DNA is wound or unwound. I have seen many books refer to chromosomes in the nucleus, but literally, I find fault when one analyses that statement. Am I nitpicking.? If one can"t be percise with "science" facts based on observation and experimentation then are we not teaching the nature of science. Comments welcome.

I used to tell my students to mean what they say and say what they mean.

Another wording that used to bug me that I often saw in print was along the lines of ...Plants change light into food. (I used to tell my students..... that if that is the case..... I'll turn on the oven and see if I can change heat energy into dinner !) It certainly made for interesting discussions.

No justification-there is no explanation for why she feels or believes that …"If one can't be precise with "science" facts based on observation and experimentation then are we not teaching the nature of science. **I find myself wanting to know why she believes this way. For this reason I coded this message as Thoughtful and not Quasi-reflective discourse.**

Quasi-Reflective Discourse
My students enjoyed doing the food nutrient lab, especially since it was a break from lecture and group work. It was a good thing that I assigned specific jobs or the lab would have continued onto another class period. Next time I do this lab, I'm going to add more questions that will link the lesson with the lab better. Also the part of the lab that requires the test tubes to be added to the hot water bath, I didn't write the directions as clear as I should of.
For my future labs when I have students miss out on the lab, I'm going to try different things depending on the lab. I will probably have the students come in before or after school to work on the lab with me. If there are several students who missed then I will make them their own lab group and they will met at a set time to perform the lab. If it is only one student than I will try to modify my labs; either a "dry lab" or a demo set up. It just depends on the lab.

I think this message is more than Thoughtful but not to the point of Content Reflection. I underlined what I considered to be a justification but I thought she could have explained better what she meant by this justification. If she had explained this better this message

may have been to the level of Content Reflection. But if we view the rubric as continuum then I would place this message between Thoughtful Discourse and Content Reflection.

I have been very negligent in keeping up with posts and plans. I apologize for not contributing more to the inquiry. As I learned early on, this academy works if you work it! I have missed a great deal and hope that I can catch up before all ends.

My inquiry has only begun to take hold with my students. There is so much hand-holding to be done, it is difficult to get them moving. At any rate, the evolution unit is drawing to a close and I have to say it has been only moderately successful for the students. Part of the problem is that this is only my second crack at teaching the subject and I do not yet feel comfortable with the curriculum no matter from where it eminates. On the other hand, I have very high regard for the PBS.org/evolution website. My students found it easy to navigate and engaging in activity. They just did not remember what they read!

I underlined what I would consider to be a justification for her belief why the lesson did not go well. I saw the writer of this message definitely linking why the lesson went bad to the underlined reason (so quasi instead of thoughtful). She could have explained this justification in more detail (so quasi instead of content).

What worked for you?:

I thought that the lab worked really well for us. We completed a natural selection lab that allowed the students to see the change in a population if an organism is allowed to adapt to an environment. The students were able to easily see the results after 10 generations.

Any challenges you faced in working in this Inquiry. Include possible next steps. Also were there any significant AH-HA moments?

When working with this lab, I didn't have enough lab supplies (colored dots). But I easily made more....not a big deal. When I do this lab again next year, I plan on changing the environments after 10 generations. The students used the same environment (a colored piece of paper) for all 10 generations. I would like to change the environment after 10 generations to see if we could get a species to return. Then the students would really be able to see how a "fit" individual will survive in an ever changing environment.

The justification for the claim of why the lab went well is underlined. It is a pragmatic and underdeveloped justification but I do not think it was just a ‘filler’ statement. I think the writer intentionally made the connection between ‘good lab’ because ‘student were able to see the results after 10 generations’ . So… I labeled this as quasi-reflective and not thoughtful. I find myself wishing the writer would have provided more explanation as to how she knew the students ‘saw results after 10 generations’ and why she thinks that students will be able to see and understand about a species returning if she tweaks the lab.

In the public school I teach in the schools are now struggling to even support the athletic teams that they once funded fully. We have some academic after school clubs, but they don't get the number of students joining that a basketball team gets. I think we should be offering a wider range of extracurricular activities.

As for our teaching - I definately think we need to reflect on that. However, I also know that in the 21 years I have been teaching that *I now am required to "Cover" more material* so I don't think I'm getting to the level of understanding I used to be able to get to. I used to use some of the GEMS books from the Lawrence Hall of Science. *They were great,* but I've had to really cut down on them because I can't fit them in. It's quite a dilemma!

Two beliefs are in italics and two pragmatic and underdeveloped justifications are underlined. The writer could have provided a lot more explanation as to why they believe this way so I labeled the message as Quasi-Reflective and not Content Reflection.

I wanted to reply to Amy's early topic about controls and variables. I would say that most biology students have that problem at my high school. This Fall, my science department chair, and myself, sat down to look at our state test scores. It turned out that my students did much better than her's in one content area, the scientific method. We were trying to think about what we did differently, because we work closely together on lesson material. *We found that the only thing I did differently was, I scheduled an individual meeting with each of my 200 students, over a 3 month period, to talk with them about their science fair project.* All of our Biology students have to do a science fair project and submit it to our schools annual science fair. I sit down with each student and go over their procedure, hypothesis and talk to them about a method of data collection. I started this last year, because my first year teaching I was very disappointed with the projects I recieved. My second year of teaching, when I implimented the interview process, I got much better results. So for the second year I am doing the interviews. It seems that when they apply the scientific method to a project they made up, it's a lot more meaningful, and it seems that overall, they were more able to apply the scientific method elsewhere at a later time. The only down side, is that I give up my lunch time for 3 months. But I'm enjoy hearing about each one of my student's projects.

The claim is in italics. The justification is underlined. It is an underdeveloped explanation as to why her students do better. I find myself wanting examples as to why she thinks this way so I labeled this quasi-reflective and not Content Reflection.

Like most of the activities I do at eMSS, this inquiry made me reflect on what I do and considered other ways to accomplish these tasks in a more effective way. Specifically, I will reconsider how I have attempted to use podcasting (in large part due to what Darlene did during this inquiry) and also how I can use web resources as alternative homework/class work assignments thanks to many of the great resources I have seen throughout this inquiry. I have attached one example I recently wrote up.

As far as insights, I have seen that technology can be used to help present content, but it also allows students to express some creativity while completing assignments. I have also been reminded of the need to protect students' identity when posting resources on the internet (which is easy to forget). I hope that next year I can use many of the resources that I bookmarked thanks to this inquiry as well as use images/video for digital microscopes and podcasting to have students present evidence of their understanding of material.Thanks to everyone for sharing so many great ideas and resources!

This message is a response to a structured prompt from the discussion area facilitator. The claim (is in italics) is that the writer has developed insights. The justifications for making this claim are underlined. These justifications are focused on content but do not provide enough explanation for me to label this as content reflection.

Content Reflection

Well, I ended up doing two labs based on the Engineering Design Protocol. As always, in every activity someone loses their form and has to start over. I use these start overs to redesign the lab report form. Now I have a form (four versions later in these two labs)that I think will work well for next year (so starting next year, I won't have to remember what worked and what didn't). It asks guiding questions under each step rather than having students refer back to the master outline which they weren't doing. I have been much clearer about the kinds of observations required, eg: include sketches and descriptions rather than make observations. I place three boxes for the "several" brainstorm ideas rather than just saying brainstorm some ideas (they invariably had only one idea) for building a structure out of paper cylinders to support books and building a paper bridge using only one sheet of paper to support three blocks. I have identified a weak spot in students' thining process; at the end the protocol says to redesign. Most students took this to mean summmarize what worked for them. It now clearly states that "whether or not your structure was successful in meeting the challenge, describe and sketch how you would improve it." I have also reduced a redundant sketch and describe step.

I am going through the PBS Design Team challenges to see which ones could be easily used with 6th graders. A little feed back came from another teacher who is using the Engineering Design Protocol for students to design a religious shelter, Sukkah. He said they knew just what to do to use the process! Yea!! Transfer of skills.

The writer of this message explains modifications to be made to a lab. The type of modifications about which he writes indicate to me that he has reflected in detail on the content of the lesson/lab. That is why I labeled it as Content Reflection and not Quasi-reflection.

In answer to Lisa's question: When all is said and done the most fatal misconceptions are not those related to facts and concepts of science. The misconception that baby birds drink their mother's milk does not seem an unsurmountable obstacle to overcome. *The*

tragic misconceptions are about the nature of the learning process itself. Here's what I mean: "A high school student does reasonably well in all their classes and on the standardized exams. When they apply for admission to the University, they write a personal statement describing how their science classes had inspired them to devote their lives to creating and implementing technical solutions to the problem of global warming. They are admitted to the university and declare a Major in Biology. In their third year at the University they enroll in a required biochemistry course. After a lecture on pH and acid-base chemistry, in which the instructor mentions the possible effect of atmospheric CO2 level on pH of seawater, the student confronts the instructor with the criticism that he had not provided a sufficient review of acid base equilibrium, and that such a review is necessary because the student (inevitably) did not remember the relevant concepts from either their HS or from their freshmen college chemistry classes, where they had received A's. The student's perspective (apparently) is that instructors must assume that students do not remember even the most basic and essential concepts from their previous coursework. Furthermore, they believe that it is natural, and inevitable, that students do not retain information from one course to another because they are never exposed to situations where they encounter the information in the interim between classes. The instructor's perspective is that a student (at least at this level) has the responsibility to actively expose themself to the material they are learning outside of a classroom situation, so that their prior learning will at least retained, if not augmented. The instructor points out the futility of, for example, a student wishing to learn a foreign language who never seeks opportunities or experience or use that language outside the classroom environment. Whose perspective is correct?"

The overarching issue, assigned by the discussion group leader, about which this message refers to is student misconceptions. This writer states his claim in the italics and then gives a well thought out explanation supporting/justifying why he believes the italicized statement. The focus is not on himself (so not content/process reflection). I think it is obvious he has reflected on the italicized statement and provides an explanation in the form of an analogy. As a side note I love this message. It makes great sense.

Some excellent points have been brought up.

- Who is responsible for learning - the student or the teacher?
- why are students less knowledgeable than in years past?
- what can we DO to help kids understand and apply what we are teaching?

I think Mike' s comment has merit.

Mike Dalbey wrote:

In the sciences it is particularly difficult for students to find venues for extracurricular application of their classroom knowledge.

In the past, kids helped a parent build things which led to an understanding of simple machines and even geometry. (I know my older daughters helped construct their playhouse and not only had to help measure, saw, and nail but when we had to move it 15 feet against the house, the were absolutely amazed we could use a lever to lift and push it into place.)

How many of our students have gardens or a compost pile? Or how about knowing about reproduction which was common knowledge to 6 year olds who grew up on a farm! Without the practical application and everyday usage of what they learn in class, kids do not remember what they are taught.

Going back to the grammar example - how many kids are corrected when they say the wrong form of a verb or a pronoun (my own are and I even caught my 15 year-old correcting one of her friends -yeah!). They may learn it in class but without PRACTICE and APPLICATION, kids cannot make it their own - so our challenge is how can we have kids practice and apply what they learn.

Lisa wrote this message. She summarizes points made previously in the discussion thread. To me, this type of summary requires the author to reflect on the content of the discussion thread. She then moves on to a different issue as she goes on to justify why she believes the claim, made by Mike and in italics, in the form of giving well thought out examples likely developed as focusing on the content of the issue of extracurricular application of classroom knowledge. I label this as Content Reflection.

Content/Process

Kristi has touched upon a major frustration of mine with the Massachusetts state frameworks. There are inquiry benchmarks, but they are not assessed on the state competency exam. As a result, I find that the momentum to focus on the nature of science has become less of a central focus to my curriculum. I hate this! When I look at my units, I make sure that I am addressing the assessed benchmarks, but I spend much less time thinking about overall inquiry, the nature of science, or general science literacy beyond what is in the frameworks. I know the nature is part of what we do, but I felt it was inadequate before the focus on the competency exam, and this year I feel it is much worse. I wish it was tested! Sorry for the venting, but this thread definitely struck a nerve.

It is a short message but definitely focused on the content of curriculum but also includes an examination of what this particular writer sees as his role in the issue so I labeled it as Content/Process Reflection

1. The lab began difficult for me. I was doing an inquiry based lab where my students were designing their own experiments to determine how they could speed up or slow down a reaction. I gave each group a different variable and they had to come up with a conclusion to share with the group. My students had a difficult time figuring out where to start designing an experiment. So I had groups initially off task because they are not used to designing their own labs. Then I had some groups that where forgetting about only testing one variable and that all other aspects should be controlled. They eventually came up with some good labs and were able to analyze and make conclusions,
2. Next time I teach this lab I will probably not give my students different variables I will just give them a question to develop an experiment for: How can I speed up or slow down a reaction? Then I will tell them what supplies are available and let them explore and see how they do without me giving them a variable. I think that is what confused them the most. I will also review designing an experiment before setting them free.
3. I know that I have to keep reviewing steps in designing an experiment because my students are not used to this type of science lab

This was a tough message for me. Her claim is that the lab was difficult (underlined). She supported this by focusing on the content of the lesson and what students did wrong. By the time she gets to #2 and #3 she starts to examine her role in making this lab better in the future. A good indicator of Content/Process Reflection is if the person, when reflecting on their role in the issue, writes comments that apply to the issue at hand but also will be helpful for other lessons. It seems to me that the writer (in #2 and #3) makes statements that will guide other labs, not just this one lab about which she is reflecting on, in the future. The reason why this message was tough for me is that she did not give any explanation for how she knew students were having trouble getting started or how she knew that they ended up with good labs so I initially wanted to place this at a lower level of reflection.

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