

INQUIRY THROUGH



SCIENCE & ENGINEERING PRACTICES
MOOC

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MSSE INQUIRY THROUGH SCIENCE & ENGINEERING PRACTICES MOOC

The concept of providing a MOOC (massive open online course) for the Master of Science in Science Education Program (MSSE) grew out of discussions between Peggy Taylor, MSSE Program Director and John Graves, MSSE Lead Faculty.

Numerous campus experts in online development, distance delivery and registration were consulted before a decision was made to partner with Desire to Learn, MSU's online learning management system, which offers a MOOC platform called Open Courses. After extensive discussion with Open Courses, an agreement was signed to offer the MOOC. As part of the agreement, Open Courses provided course management hosting, creation of the registration website and limited promotion of the course. John Usher from Extended University (EU) was the designated Open Course liaison for MSU, working closely with the Open Courses team. The Inquiry MOOC content was created by the instructor, John Graves. In addition, Holly Thompson (MSSE) served as the course teaching assistant and Margaret Worob (EU) provided technical support not offered by Open Course.

Registration in Open Courses was handled through Edidentity, with participants creating an Edidentity account for registration. Upon registering, participants were placed in the course. The MSU MOOC team, comprised of Peggy Taylor, John Usher, Kelly Boyce, Margaret Worob, Kim Obbink, Holly Thompson, course TA, and John Graves decided to limit enrollment to 200 for the first pilot offering of the MOOC in order to provide a high quality experience for participants and to determine if the course could be scaled to larger numbers in the future.

The goals of the Inquiry MOOC included, but were not limited to, service and outreach to teachers of science who are becoming interested in the K-12 Science Framework and Next Generation Science Standards (NGSS), marketing for the MSSE Program, and additional professional development and networking opportunities for MSSE graduates. It has become increasingly clear that many science teachers are interested in the Framework and NGSS, but are not certain how to implement the strategies in their classrooms. Furthermore, inquiry, which was highly emphasized in the previous National Science Education Standards, is not included as a specific component in the new standards; rather NGSS's intent is to better explain and expand the definition of inquiry in science through cognitive, social and physical practices. One goal of the inquiry MOOC course was to incorporate NGSS's understanding of inquiry through science and engineering practices.

Advertisement for the course included targeting MSSE students, both current and graduates, and teachers who had taken National Teacher Enhancement Network (NTEN) courses. Open Courses promoted the course through their extended network. Registration was closed after a two week enrollment period when 197 participants had registered. The course began with 84 participants, with 113 no-shows after registration. The course was structured with weekly readings, written assignments and weekly online discussions. Participants were required to complete a weekly discussion rubric that detailed their online discussion involvement and reflection (Appendix A). Weekly participation in Week 1 was 84 ending with an average of 30 for Weeks 7-11 (Table 1).

Table 1.
Number of participants in discussion by week

Week 1	84
Week 2	62
Week 3	51
Week 4	43
Week 5	38
Week 6	36
Week 7	30
Week 8	31
Week 9	30
Week 10	30
Week 11	29

Participants in the MOOC were provided the option of completing the course at one of two levels. The GOLD Level requirements were the same as those of the sister course in the MSSE Program, MSSE 501 (Appendix B). Rather than completing and submitting assignments throughout the course, GOLD Level participants submitted a portfolio of their work at the completion of the MOOC. The portfolio was graded with the same rubric as assignments in the sister course. In order to receive a GOLD Level Certificate, participants needed to earn a B or better on the portfolio. The value of a GOLD Level Certificate is that it can be used to demonstrate the equivalency of the MSSE 501 course. Students may use the GOLD Level Certificate as credit for MSSE 501 by registering and paying tuition. The grade earned in the MOOC will be the grade recorded for MSSE 501 or the registered student may choose to redo portfolio assignments to earn a higher grade. Students may also use the GOLD Level Certificate to fulfill the MSSE 501 requirement and take two additional credits on their Program of Study. Finally, Montana teachers can use the GOLD Level Certificate as evidence to

receive Continuing Education Units by paying \$25. This was set up through Extended University and Montana's Office of Public Instruction. Participants who read the weekly assignment pages, participated in weekly discussions and completed weekly discussion rubrics earned a BLUE Certificate as indication of participation in the MOOC.

One criticism of MOOCs is the extremely low completion rate due to many factors including the fluid nature of course offerings, time commitments by registrants, difficulty of content, lack of interest and more (Daniel, 2014; Pomerantz, 2014; Meisenhelder, 2013). In some cases, thousands of people register for a course and only a few complete. Most researchers report MOOC completion rates of less than 10%. To provide a better understand of the success of MOOCs, multiple measures should be considered. The success of the Inquiry MOOC was measured in two ways, completion and student expectations (Kolowich, 2014). The number of *serious enrollees* was determined and used to calculate completion rate (Pomerantz, 2013). The Inquiry MOOC chose to use the submission of at least two weekly Discussion Rubrics as the *serious enrollee* criteria, setting the participation number at 54. Using that number, the completion rate for the MOOC was 56%, with 16% completing at the GOLD Level and 40% completing at the BLUE level (Table 2). At the end of the course, a total of nine MSSE-associated students completed at either the Blue Level (6) or the Gold Level (3). A total of 22 non-MSSE participants completed the course, 16 at the Blue Level and 6 at the Gold Level (Table 3).

Table 2
Number and Percentage of Submitted Discussion Rubrics per Week

Week	# of Submitted Discussion Rubric	% Completion
1	56	-
2	54*	100
3	47	87
4	42	78
5	36	67
6	33	61
7	32	59
8	31	57
9	31	57
10	31	57
11	30	56

Note. The number of *serious enrollees* was set at participants who submitted at least 2 discussion rubrics.

Table 3
Association with MSSE

Affiliation with MSSE	Week 1	End of Course
Current Students	16	2 Blue, 0 Gold
Graduates	45	4 Blue, 3 Gold
Inactive	1	----
None	22	16 Blue, 6 Gold

DISCUSSION

Considering all factors, the MSU Inquiry MOOC Team believes the Inquiry through Science and Engineering MOOC offered fall 2013 was a successful pilot. Evidence of that includes a completion rate of 56% of *serious enrollees*, with 16% of those completing at the GOLD Level and 40% at the BLUE Level. The goal of marketing the MSSE Program was met in that 22 participants who completed the MOOC had no prior affiliation with the program. The goal of providing additional professional development for MSSE graduates was met by the successful completion of the course of seven MSSE graduates, three at the Gold Level and four at the Blue Level. In addition, success of the MOOC was measured by the degree to which students' expectations were met. These data were gathered through a pre/post MOOC survey and indicated that nearly all of the respondents provided favorable feedback when asked if the MOOC met their expectations ($N=20$). One participant said, "I hoped to learn or practice different teaching strategies, which I did." Another stated that they, "learned a lot about science inquiry. It provided a lot of resources. I liked the online independent study as I could do the class at a time that was convenient for my crazy schedule." The course goal of incorporating inquiry and NGSS's understanding of science and engineering was also met. One participant said, "I learned a lot about science inquiry and plan to continue to learn more." Another stated, "It made me realize how important inquiry is for science students and gave me some good ideas for inquiry lessons." A third stated, "I am enthused about learning how to implement engineering practices in the scientific method and incorporating some inquiry activities more often in my classroom." When asked if they would recommend this MOOC to colleagues, one person said, "I think this MOOC

would be really good for some new teachers to get some ideas.” Another stated, “I think other science educators I know would benefit from the materials, as I don’t know that they have much experience with some of these ideas.” Participants commented that they found the instructor and TA to be positive additions to the course. One participant reported that, “The video podcasts were great and the twitter discussion was new and exciting for me to participate in.” Others said, “The course was organized,” “Feedback was fairly prompt” and “the TA-very helpful, answered my questions immediately.” Several participants mentioned the instructor’s absence from the discussions, “I did not feel the presence of the instructor in the discussions. It would have been interesting to hear more, but ultimately it was okay.” The MOOC Leadership Team made a decision to keep the instructor “hands-off” since this was a not-for-credit course and should model the independent learning nature of MOOCs. As the course progressed, the instructor assumed a more active role in the course, posting his email contact information and encouraging participants to ask direct questions of him. Additional comments provided by participants include, “Thanks for providing me the with my first MOOC experience. I took this one because it was offered by Montana State and specifically with John as the instructor. I knew it would be of high quality and a safe place to try it out.” Another said, “Thank you for this wonderful opportunity. I have been challenged and encouraged.” Finally, one participant reported, “Thank you for your time and for a very informative class. I hope to take another MOOC in the future.”

Plans for the future include offering the Inquiry MOOC fall 2014. Some adjustments will be made to course content and delivery based on participant feedback, but the overall approach to the next MOOC course will be similar to the pilot.

Additionally, MSSE instructors and staff have begun discussions of the possibility of offering mini-MOOCs on topics of interest to science educators. Finally, an MSSE student has committed to studying the fall offering of the Inquiry MOOC for her MSSE Capstone project. She currently plans to further investigate the results of the pilot pre/post MOOC survey, create a new survey for the next MOOC, analyze a comparison of MOOC discussions and portfolio assignments compared to those of MSSE 501, the sister course.

REFERENCES CITED

- Daniel, J. Making Sense of MOOCs: Musings in a maze of myth, paradox and possibility. Retrieved February 6, 2014 from <http://www-jime.open.ac.uk/jime/article/viewArticle/2012-18/html>
- Kolowich, S. Completion rates aren't the best way to judge MOOCs, researchers say. Retrieved February 6, 2014 from <http://chronicle.com/blogs/wiredcampus/completion-rates-arent-the-best-way-to-judge-moocs-researchers-say/49721>
- Meisenhelder, S. MOOC Mania. *The NEA Higher Education Journal, Thought & Action*. Volume 29 Fall 2013, p. 7.
- Pomerantz, J., 2014. Retrieved February 6, 2014 from <http://jeffrey.pomerantz.name/blog/>

APPENDICES

APPENDIX A

Discussion Self-Assessment

Did I respond at least once to the questions/issues raised by my Discussion Group leader?
(5)

Did I post at least two meaningful and constructive responses to other participants' messages? Please provide a **one sentence** overview of postings you made. (5)?

Did I make a connection between the readings and my classroom/school? Please provide **one sentence** describing the connection you made. (5)

Did I make connections with my new learning and the Science & Engineering Practices as they relate to the inquiry strategies I am learning? Please provide **one sentence** describing the connections you made. (5)

Did I login in early in the week, by Wednesday, to participate in discussion? (5)

If you plan to complete the course at the GOLD LEVEL, please provide a 2-3 sentence summary of the progress of your Inquiry Investigation. (25)

Do you have any Muddiest Point questions or anything else you'd like to ask the instructor?

Proposed discussion score for this week: _____ (out of 50 pts)

APPENDIX B

MSSE 501 Course Description

The Teaching Inquiry through Science & Engineering Practices course is designed for science teachers as a professional development tool to increase the effectiveness of teaching science inquiry skills to their students. Inquiry means asking questions. As teachers, we need to get out of the habit of being the ones to ask questions. This responsibility should be shifted to the students. The teacher's role then becomes one of guide and co-investigator. This course provides strategies to help achieve this shift from "sage on the stage" to "guide on the side." This course is applicable for all instructional/learning settings including classrooms, zoos, museums, planetariums, etc.

Course Objectives

The purpose of this course is to provide participants with an overview of the following topics:

- Science and Engineering Practices
- Discrepant events
- Learning cycle
- Next Generation Science Standards
- National, State & Local Testing
- Constructivism
- Misconceptions
- Models of teaching science inquiry
- Process skills
- Technology & Inquiry
- Assessment

The required texts for the course are either

- Teaching High School Science Through Inquiry, Douglas Llewellyn, ISBN 9780761939382 or
- Inquiry Within: Grades 3-8, 2nd Edition, Douglas Llewellyn, ISBN: 978-1-4129-3756-6 or
- Teaching High School Science Through Inquiry and Argumentation 2nd Edition, Douglas Llewellyn, ISBN 978-1-4522-4445-7

Choose the one that best matches your teaching assignment.

AND

- A Framework for K-12 Science Education. Available as a free [download](#).

The following guidelines will be used for assignments and participation in the course.

- Weekly online discussion postings based on the topic focus for the week. Each week you will complete a Discussion Rubric submission.
- Independent reading of assigned web resources covering the topic focus for the week.
- Other weekly assignments directly related to the topics being covered.
- Completion of an inquiry-based final project called My Inquiry Investigation. This assignment will be an on-going investigation incorporating a culmination of the course content.
- When submitting your work, please attach the assignments as a Word document file, PowerPoint or provide a link to your Prezi presentation or podcast.
- Put YOUR NAME in the file name...something like gravesweek1.doc is great.
- Since the majority of students in my online courses are enrolled in the MSSE Program, it is the expectation that all formal writing conforms to the Writing Expectations set forth by the Program. This includes standard font, Times New Roman, size 12, no bolding, proper citations of references used, etc. Please utilize the Writing Expectations page for guidance.

Course Grading

As an online course, there is an expectation that the participants will be actively engaged for 6-8 hours per week. The important components of learning include:

The graded components of this course include, but are not limited to

- Learning Cycle Lesson
- Discrepant Event
- Evidence of Knowledge of Science & Engineering Practices
- Science Notebook
- Addressing Misconceptions Lesson
- Case Study Idea
- My Inquiry Investigation
- Participation in webinars

Maintaining Intellectual Integrity (Plagiarism)

Paraphrasing or quoting another's work without citing the source is a form of academic misconduct. Even inadvertent or unintentional misuse or appropriation of another's work (such as relying heavily on source material that is not expressly acknowledged) is considered plagiarism. All sources of information that are not your original thoughts need to be cited. This includes, but is not limited to, journal articles, textbooks and online resources. Adapted from MSU Syllabus language page: <http://www.montana.edu/teachlearn/TLResources/SyllabusLanguage.html>

Course Grading Scale

- A (94-100%)

- A- (90-93%)
- B+ (87-89%)
- B (84-86%)
- B- (80-83%)
- C+ (77-79%)
- C (74-76%)
- C- (70-73%)
- D+ (67-69%)
- D (60-66%)
- F (0-59%)