# Delivering a medical school elective with massive open online course (MOOC) technology

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**Introduction:** The educational technology of massive open online courses (MOOCs) has been successfully applied in a wide variety of disciplines and are an intense focus of educational research at this time. Educators are now looking to MOOC technology as a means to improve professional medical education, but very little is known about how medical MOOCs compare with traditional content delivery.

**Methods**: A retrospective analysis of the course evaluations for the Medicine as a Business elective by fourth year medical students at Southern Illinois University School of Medicine (SIU-SOM) for the 2012-2015 academic years was conducted. This course was delivered by small group flipped classroom discussions for 2012-2014 and delivered via MOOC technology in 2015. Learner ratings were compared between the two course delivery methods using routinely collected course evaluations.

**Results**: Course enrollment has ranged from 6-19 students per year in the 2012-2015 academic years. Student evaluations of the course are favorable in the areas of effective teaching, accurate course objectives, meeting personal learning objectives, recommending the course to other students, and overall when rated on a 5 point Likert scale. The majority of all student ratings (76%-95%) of this elective course are for the highest possible choice (Strongly agree or Excellent) for any criteria, regardless if the course was delivered via a traditional or MOOC format. Statistical analysis of these ratings suggests that the Effective Teacher and Overall evaluations no not statistically differ between the two delivery formats.

**Discussion:** Student ratings of this elective course were highly similar when delivered in a flipped classroom format or by using MOOC technology. The primary advantage of this new course format is flexibility of time and place for learners, allowing them to complete the course objectives when convenient for them. The course evaluations suggest this is a change that is acceptable to the target audience.

**Conclusions:**  This study suggests that learner evaluations of a fourth year medical school elective course do not significantly differ when delivered by flipped classroom group discussions or via MOOC technology in a very small single center observational study. Further investigation is required to determine if this delivery method is an acceptable and effective means of teaching in the medical school environment.

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## Introduction

11  The educational technology of massive open online courses (MOOCs) has been successfully

12  applied in a wide variety of disciplines and are an intense focus of educational research at this

13  time (Bozkurt et al, 2015).  MOOCs are a disruptive force in education because they challenge

14  the tradition of lectures and decentralize the education experience in a learner centered way.

15  Learners have embraced this approach, giving some MOOCs an enrollment of over 100,000

16  (Mehta, Hull, Young, and Stoller 2013).  Educators are now looking to MOOC technology as a

17  means to improve professional medical education (Harder 2013, Mehta; Hull, Young, and Stoller

18  2013).

20  Hundreds of medical MOOCs exist for topics ranging from the Ebola virus to medical informatics

21  (Grobusch and Browne 2015; Paton 2014; Liyanagunawardena and Williams 2014), but very

22  little is known about how these medical MOOCs compare with traditional content delivery.

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24  MOOC delivery platforms allow educators to create and deliver interactive courses with videos,

25  online resources, quizzes, virtual patients (Stathakarou , Zary, and Kononowicz 2014;

26  Kononowicz et al., 2015 ) and an ability to interact with other students taking the course.  This

27  technology could allow students to learn at a time and place of their choosing, freeing valuable

28  curricular time for hands on experiences.  Despite these potential advantages, medical schools

29  have been slow to explore MOOC technology for content delivery.

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31  This study aims to compare learner evaluations and ratings of a course that was previously

32  delivered by traditional methods (in person lecture and case discussions) that is now delivered

33  as a MOOC.  The hypothesis is that learner ratings of the course will not significantly differ

34  between the new format and the previous format.  The results of this investigation could have

35  significant implications for how medical education is delivered.

36

37  ## Materials & Methods

38  Course evaluations for the Medicine as a Business elective (Course IM 45434) by fourth year

39  medical students at Southern Illinois University School of Medicine (SIU-SOM) were collected

40  as customary for the 2012-2015 academic years.  The SIU-SOM is located in Springfield,

41  Illinois.

42  The Medicine as a Business course was offered for the first time in the 2012 academic year and

43  used small group flipped classroom format as an extended nonclinical elective at SIU-SOM.

44  Extended electives are non-overlapping and are scheduled on Thursday afternoons in 5 week

45  blocks at SIU-SOM.  The Medicine as a Business course could start every 5 weeks during the

46  academic year if two or more students wished to enroll in a specific 5 week block.  Attendance

47  and participation in all discussions was required for successful course completion.

48  This course was converted to an on demand MOOC format hosted at Udemy.com for the 2015

49  academic year to meet student requests for greater flexibility in course content delivery.

50  Course content is delivered in the form of video presentations with associated reading materials

51  and multiple choice questions that could be accessed on a smartphone, tablet, or traditional

52  computer via the internet when convenient for the student.  Completion of all course sections

53  was required for successful completion of the course.  Each student started and completed the

54  course independently and had the option of meeting with the faculty to discuss course content.

55   The MOOC content delivery system included a system to send messages to the course

56   instructor and a discussion forum accessible by learners.

57   The objectives for Medicine as a Business are:

58      Understand and apply medical documentation rules

59      Understand the medical billing process

60      Understand medical coding terminology and resources

61      Understand the medical practice revenue cycle

62      Evaluate physician productivity using a variety of measures

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64   The course is available online at http://udemy.com/business-of-medicine.  Course registration is

65   free and open to anyone.

66   SIU-SOM compiles de-identified aggregate course evaluations for elective faculty for use in

67   course improvement.  These course evaluations were compared before and after transition to

68   the MOOC format and do not include any demographic data for the students enrolled.  This data

69   was compared for differences between traditional and MOOC based content delivery.

70   The SIU-SOM elective course evaluation includes:

71      • Was the faculty an effective teacher?
72      • Stated course objectives accurately reflected the course.
73      • I was able to meet my personal learning objectives.
74      • I would recommend this elective to other students.
75      • Overall rating of the course.

76   These items are rated on a 5 point Likert scales.

77   The rating scale for the overall course rating was 1 = Poor, 2 = Below average, 3 = Average, 4 =
78   Above average, 5 = Excellent.

79   The rating scale for all other measures was 1 = Strongly disagree, 2 = Disagree, 3 = Neither
80   agree or disagree, 4 = Agree, 5 = Strongly agree.

81  Differences between items in the course evaluation questions will be compared with the t-test to
82  determine if any significant differences exist.

83  Statistical analyses were performed using SPSS version 22 (SPSS Inc., Chicago, IL, USA).

84  Two sided *P*-values < 0.05 were considered significant.

85  Cohen's d was calculated for each result using Cohen's d calculator for unequal sample sizes

86  developed by Dr. Jeremy Stangroom (Stangroom 2016).

87  Post-hoc power analysis was conducted with a Post-hoc Statistical Power Calculator for a

88  Student t-Test developed by Dr. Daniel Soper (Soper 2016).

89  Institutional review board review for this study was obtained from the Springfield Committee for

90  Research Involving Human Subjects.  This study was determined to not meet criteria for

91  research involving human subjects according to 45 CFR 46.101 and 45 CFR 46.102.

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93  Results
94  The Business of Medicine elective has been offered for four years at SIU-SOM starting in the

95  2012 academic year.  The size of the fourth year class at SIU-School of Medicine ranged from

96  69 to 75 students during the study period.  Women made up 45-54% of the fourth year class

97  during that timeframe (Table 1).   Course enrollment has ranged from 6-19 students per year as

98  shown in Figure 1 and Table 1.

99  Student evaluation distributions by course format (MOOC vs. Traditional) for the evaluation

100  criteria of Effective Teacher (Figure 2), Course Objectives Accurate (Figure 3), Met Personal

101  Objectives (Figure 4), Recommend Course (Figure 5), and Overall Evaluation (Figure 6) are

102  skewed towards the highest rating and are very similar.  No negative course ratings (Disagree,

103  Strongly disagree, Poor, or Below average) were reported for any course evaluation.  The

104    majority of all ratings (76%-95%) are for the highest possible choice (Strongly agree or

105    Excellent).

106    Student evaluations by course format (MOOC vs. Traditional) show no statistically significant

107    differences (p = NS for all criteria, Table 2).   A medium or greater effect sizes were seen for the

108    Effective Teacher (Cohen's d = 0.782), Met Personal Objectives (Cohen's d = 0.593), and

109    Overall Evaluation (Cohen's d = 1.496) criteria.  Small effect sizes were seen for the Course

110    Objectives Accurate (Cohen's d = 0.460) and Recommend Course to other students (Cohen's d

111    = 0.490) criteria.  Post-hoc power analysis indicated the results for Effective Teacher (99%) and

112    Overall evaluation (92%) had greater than 80% power to correctly reject the null hypothesis.

113    The results for all other criteria did not have sufficient power to correctly reject the null

114    hypothesis.

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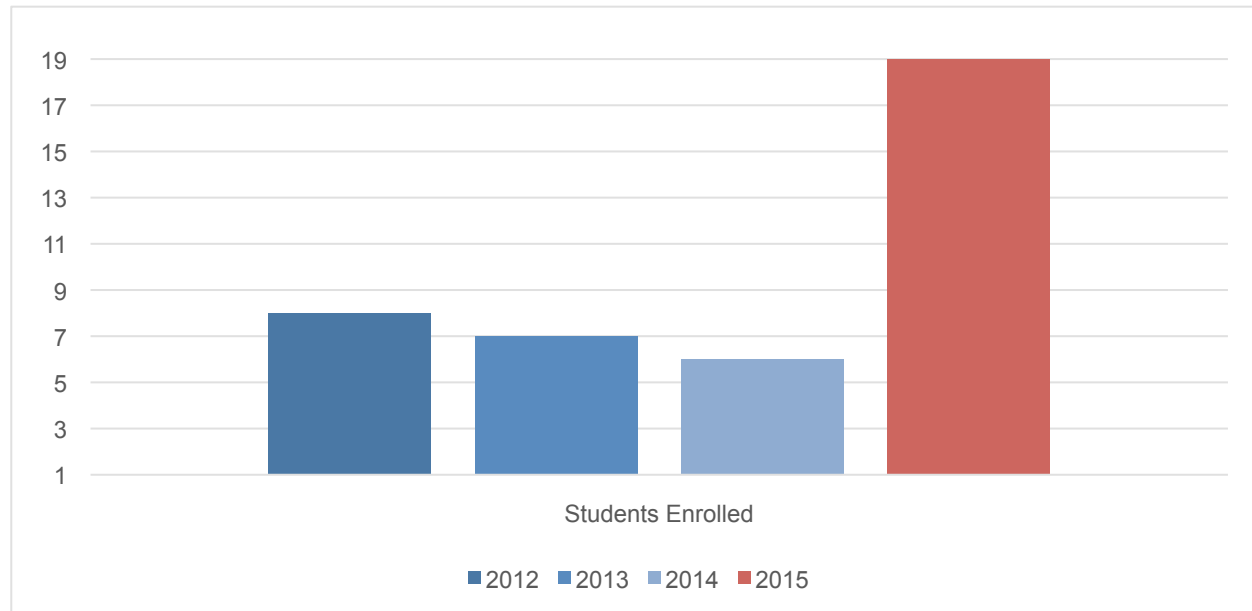
117    Figure 1.  Student enrollment in the Medicine as a Business elective by academic year.

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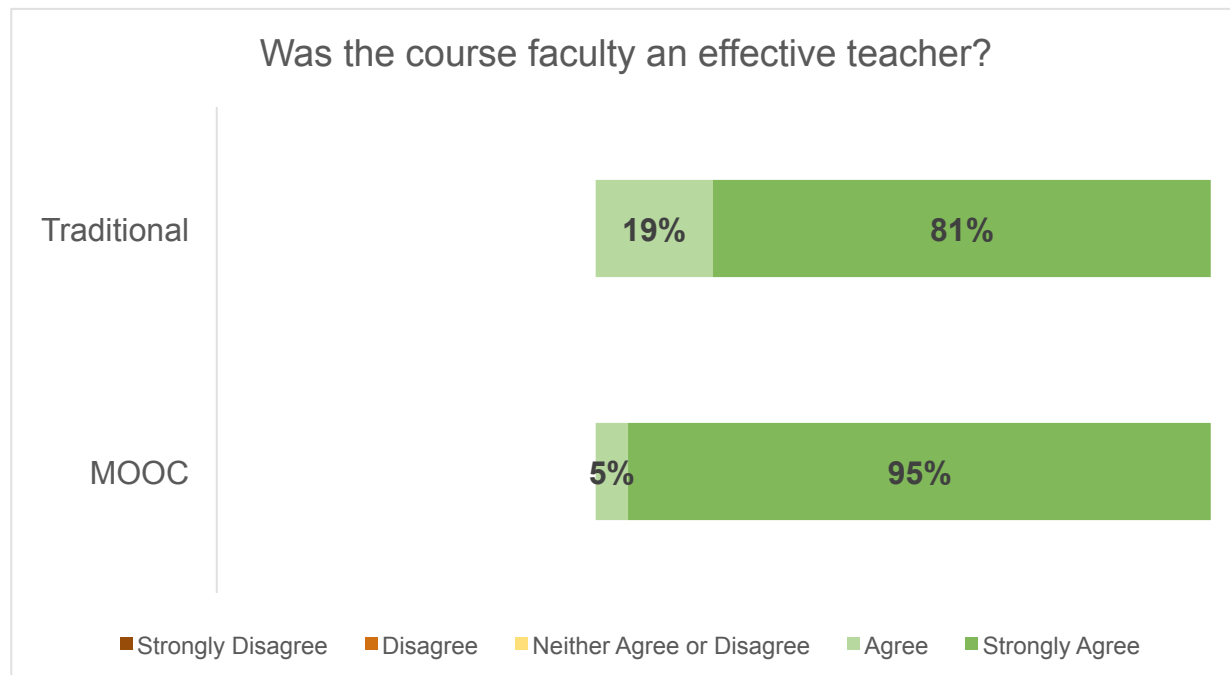
121    Figure 2.  Student ratings for "Was the course faculty an effective teacher?" by course format

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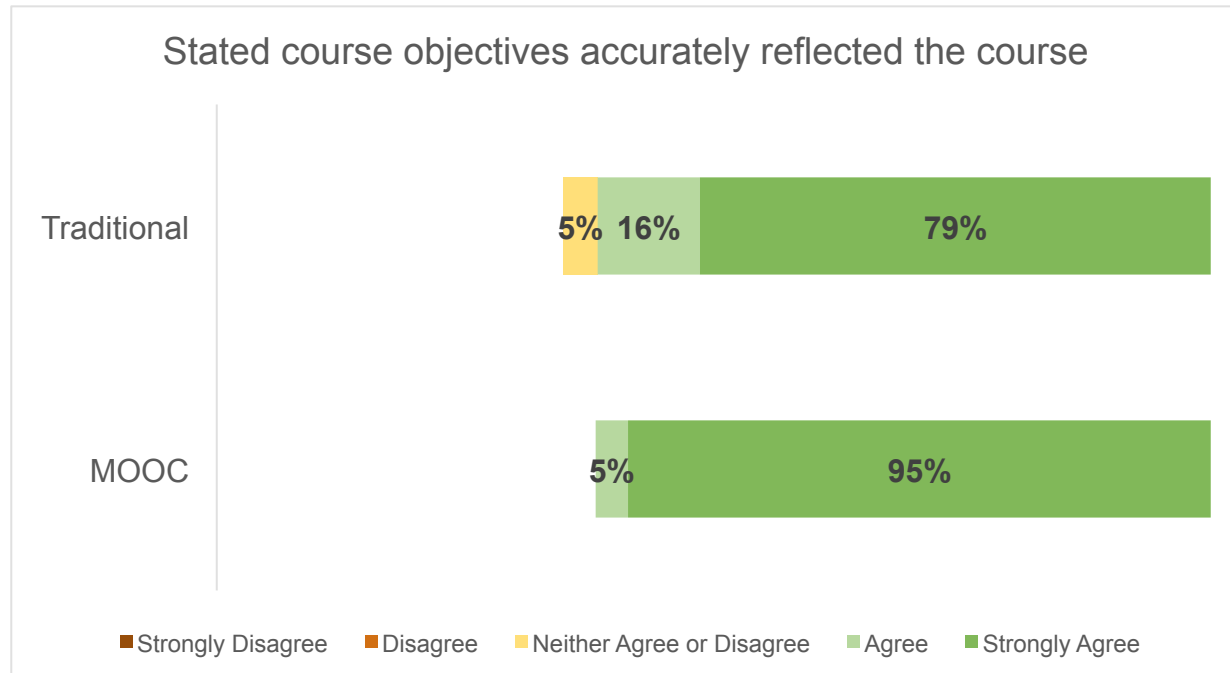
126    Figure 3.  Student ratings for "Stated course objectives accurately reflected the course" by

127    course format

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132    Figure 4.  Student ratings "I was able to meet my personal learning objectives" by course format

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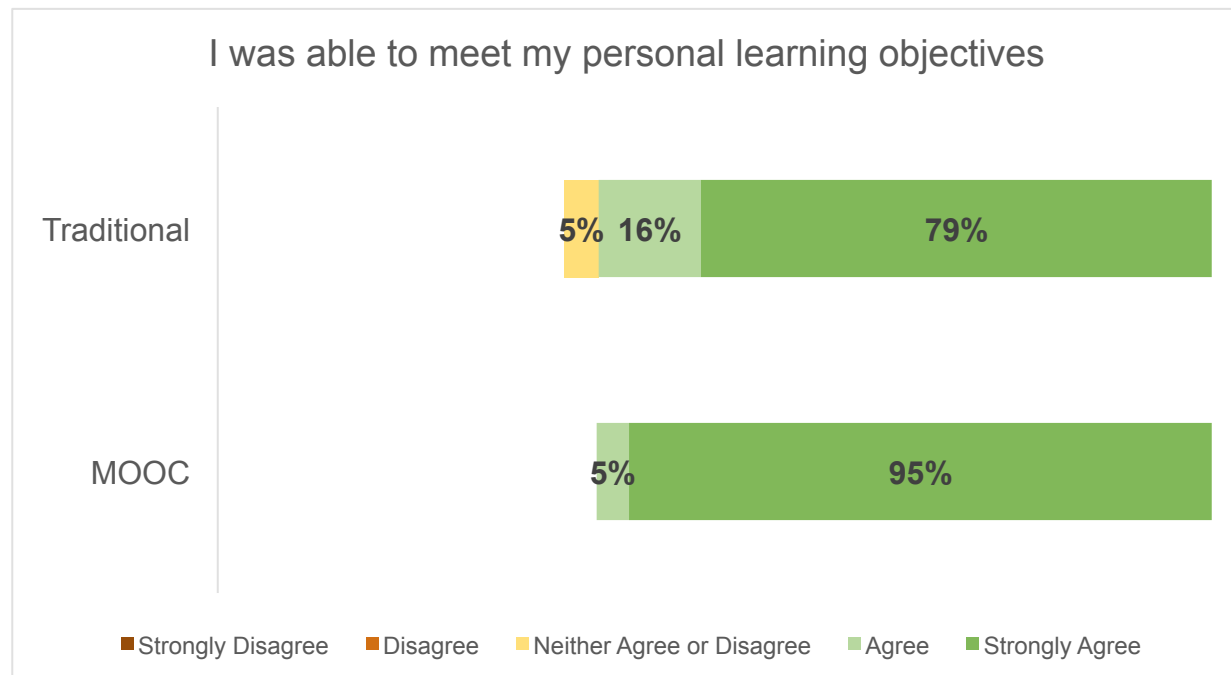
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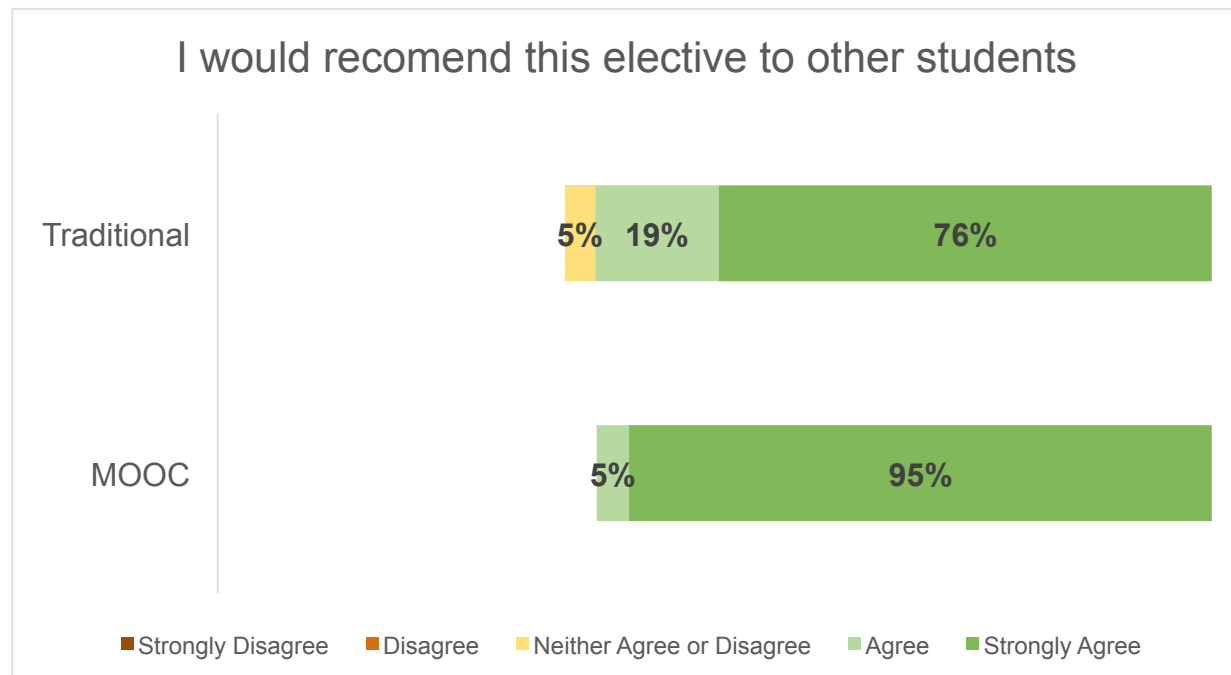
138     Figure 5.  Student ratings "I would recommend this elective to other students" by course format

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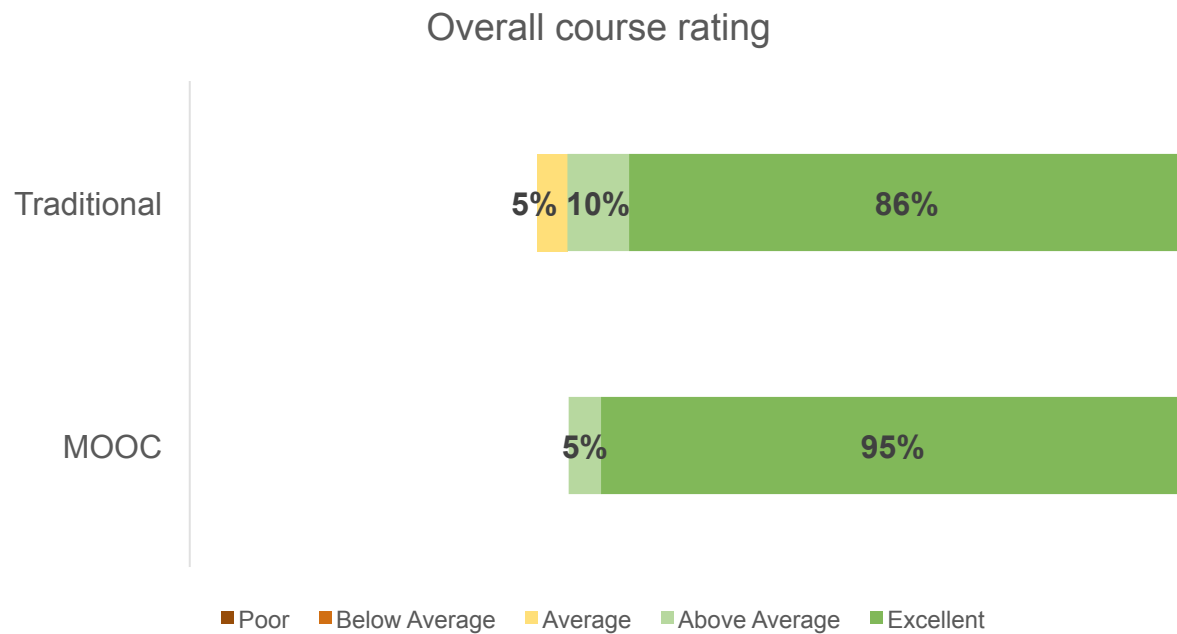
143    Figure 6.  Student ratings for Overall Evaluation by course format

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149    Table 1.  Fourth year medical student demographics by year

| Year | Students | Women | Students enrolled in Medicine as a Business elective |
|------|----------|----------|------|
| 2012 | 72 | 34 (47%) | 8 (11%) |
| 2013 | 75 | 35 (47%) | 7 (9%) |
| 2014 | 69 | 31 (45%) | 6 (9%) |
| 2015 | 70 | 38 (54%) | 19 (27%) |

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155    Table 2.  Student course ratings by course format (MOOC vs. Traditional)

| Rating | Traditional<br>Mean (SD)<br>N = 21 | MOOC<br>Mean (SD)<br>N = 19 | Significance | Power | Cohen's d |
|---|---|---|---|---|---|
| Overall evaluation | 4.81<br><br>(0.512) | 4.5 (0.229) | 0.287 | 92% | 0.782 |
| I would recommend this elective to other students | 4.71<br><br>(0.561) | 4.5 (0.229) | 0.100 | 45% | 0.490 |
| I was able to meet my personal learning objectives | 4.75<br><br>(0.550) | 4.5 (0.229) | 0.156 | 67% | 0.593 |
| Stated course objectives accurately reflected the course | 4.70<br><br>(0.571) | 4.5 (0.229) | 0.087 | 39% | 0.460 |
| Was the course faculty an effective teacher? | 4.90<br><br>(0.301) | 4.5 (0.229) | 0.620 | 99% | 1.496 |

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## Discussion

The majority of all student ratings (76%-95%) of this elective course are for the highest possible choice (Strongly agree or Excellent) for any criteria, regardless if the course was delivered via a traditional or MOOC format.  Statistical analysis of these ratings suggests that the Effective Teacher and Overall evaluations no not statistically differ between the two delivery formats.

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The primary advantage of this new course format is flexibility of time and place for learners, allowing learners to take the course when and where convenient for them instead of in 5 week blocks on campus.  The course evaluations suggest this change is acceptable to the target audience.

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Enrollment in this nonclinical elective was good, ranging from 9-27% of the students each year. It is unclear why course enrollment was highest during the 2015 academic year (27% of all 4th year students taking the elective).  This increase in enrollment may also be accompanied by other demographic changes in the students taking this elective course that may influence course ratings.  However, specific student demographics (gender, race, residency choice, and other factors) are not available for analysis to protect the anonymity of students enrolled in this course.

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178   The rating system used for electives at SIU-SOM are not ideal to evaluate a course delivered in

179   this manner.  However the highly similar Effective Teacher and Overall course ratings are likely

180   to represent an acceptance of the course format change.

181   The course subject, the business aspects of a medical practice, is likely to be more amenable to

182   delivery via MOOC technology than many other subject areas in medical education.  However,

183   the University of California-San Francisco (UCSF) has successfully offered a clinical problem

184   solving MOOC with tens of thousands of learners, suggesting that complex clinical education

185   can be delivered by this format (Harder 2013).

186   The numbers of students enrolled in this course before and after the change to the MOOC

187   format are very small, increasing the risk of a Type 2 error due to insufficient statistical power.

188   Post hoc power analysis showed a range of power from 39% to 99% for the evaluation criteria.

189   Only two measures, Effective Teacher and the Overall evaluation, had sufficient power to

190   correctly reject the null hypothesis.  Challenges with statistical power reflect the small sample

191   size in this study and a course rating distribution strongly skewed towards the highest rating for

192   all areas evaluated.

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194   This study is a single institution observational study with limited follow up.  These limitations

195   may reduce the generalizability of the results of this study.

196

197   Conclusions
198   This study suggests that learner evaluations of a fourth year medical school elective course may

199   not significantly differ when delivered in flipped classroom discussion or via MOOC technology

200   in a very small single center observational study.

201    Further investigation is required to determine if this delivery method is an acceptable and

202    effective means of teaching in the medical school environment.

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