

Friday Institute for Educational Innovation,  
NC State University

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# MOOC-ED EVALUATION FINAL REPORT

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## EXECUTIVE SUMMARY

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The overall goal of the Friday Institute’s Massive Online Open Courses for Educators (MOOC-Eds) initiative is to provide a scalable approach to professional development that helps educators better support their students in acquiring the abilities and dispositions of deeper learning. With support from the Hewlett Foundation, the Friday Institute developed three MOOC-Eds to address the effective teaching of Common Core State Standards (CCSS) content with deeper learning approaches: (1) Fraction Foundations: Helping Students Understand Fractions; (2) Disciplinary Literacy for Deeper Learning; and (3) Teaching Statistics through Data Investigations.

The purpose of the evaluation was threefold: 1) to understand the characteristics of the participating educators and how they engage with MOOC-Eds; 2) to provide formative feedback to inform the ongoing improvement of the design and implementation; and 3) to examine the impact of participation on educators’ knowledge and professional practices for integrating deeper learning in their classrooms. The findings show the Friday Institute has been largely successful in designing professionally relevant learning experiences with opportunities for both personalization and peer-support. As a result, educators have reported improvements in their knowledge and skills, as well as positive changes to their professional practice. The findings also illustrate that even well-designed MOOC-Eds face significant challenges in scaling learning that embodies the principles of effective professional development. Key findings from this report are highlighted below.

## KEY FINDINGS

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Evaluation Question 1: *What are the characteristics of participating educators and to what extent do participants engage in the MOOC-Eds? (Participation)*

*Participant Characteristics.* MOOC-Eds appealed to a wide range of educators in terms of geographic location, professional roles, and personal goals. Among the nearly 5,000 educators enrolled in MOOC-Eds, the majority of participants (88%) were located in the U.S., with representation from all 50 States. Internationally, participants enrolled from over 80 countries, with Asia (31%) and North America (25%) accounting for half of all participants outside the U.S. In terms of professional roles, educators responsible for classroom teaching accounted for over half (55%) of MOOC-Ed enrollments. Finally, the majority of participants (68%) held Masters level or Doctoral degrees, and reported acquiring new knowledge and skills (85%) and/or collecting resources and tools (64%) as their primary goals.

*Participant Engagement.* Participants engaged in MOOC-Eds to varying degrees, ranging from infrequent visits to intense and sustained activity. Participants who visited the course on four or more days, or “active users,” were clustered into one of three general categories: High, Moderate,

and Declining Activity. Among active users, 37% were categorized as High Activity participants and engaged in almost all of the main activities through the entirety of the MOOC-Ed. Participants in the Moderate Activity group (23%) regularly visited the course but did not fully engage in activities. Finally, the Declining Activity group (40%) began the course by participating in the bulk of activities, but their participation declined over time. Collectively, participants contributed 15,806 posts across 6,353 discussions, averaged roughly nine posts per participant, and connected with five of their peers. Network analyses also revealed the development of highly connected subcommunities of educators in all MOOC-Eds.

*Evaluation Question 2: In what ways and to what extent do the instructional elements of the MOOC-Eds instantiate the design principles? (Design)*

*Design Effectiveness.* Feedback from educators and course reviewers indicated that MOOC-Eds were largely effective in addressing the design principles guiding their development. Specifically, the three courses consistently provided models of effective practice, activities, and resources relevant to a range of educational contexts and roles. They also included opportunities to explore individual problems of practice and varied pathways to address participants' personal learning goals. The majority of survey respondents agreed MOOC-Eds helped them progress toward their personal learning goals (92%), supported application to their practice (91%), and promoted constructive peer interaction (85%).

*Design Highlights.* While courses were generally well aligned with the design principles, several instructional elements stood out as especially effective. In Fraction Foundations, educators frequently praised an activity called, "What would you do next?", which consisted of a short student video, classroom resources, and discussion. Educators commented on the value of being able to "see real teachers in real classroom situations" and stated that the downloadable resources and the strategies shared by peers were valuable for eliciting and addressing their own students' misconceptions. In Teaching Statistics, participants valued the approach for providing differentiated resources, activities, and assessments. Specifically, they valued the "wealth of resources" available and described the embedded course self-assessments as "excellent," "valuable," or "amazingly helpful." Finally, in Disciplinary Literacy, participants noted the ways in which the use of the conceptual framework helped them to "understand the bigger picture" and transfer their learning into practice.

*Areas for Improvement.* Findings from course reviews and participant feedback also revealed several areas where MOOC-Eds could better address the design principles and improve the learner experience. One design tension that emerged from participant feedback was the perception among educators that MOOC-Eds provided both "too much" and "not enough." Participants reported feeling both "overwhelmed" and "confused" by the sheer quantity of discussions and learning resources, while also wanting more resources and feedback specific to their educational context.

Findings also suggest a need to better provide participants with scalable approaches to gauge their learning progress, both in terms of informal feedback and more formal assessment activities.

Evaluation Question 3: *In what ways, and to what extent, has participation in MOOC-Eds deepened educators' knowledge and skills and impacted their professional practice? (Impact)*

*Knowledge & Skills.* MOOC-Eds made extensive use of discussion forums for encouraging participants to reflect, exchange ideas and resources, and engage in dialogue and debate to extend their understanding. Findings from content analysis demonstrated a range of complex cognitive and social activities encompassed by the discussions, such as the interpretation and elaboration of course concepts, adding insight or critiques to postings, and raising questions or inviting further discussion. At the end of each unit, participants were asked the extent to which they agreed the course deepened their understanding, to which 84% to 93% of educators responded positively. Moreover, a common theme to emerge from interviews was the “mind shift” participants experienced related to core concepts addressed in each MOOC-Ed.

*Impact on Practice.* On End-of-Course surveys, participants were asked how effective they felt the MOOC-Ed was in preparing them to make positive changes in their practice. Across the five MOOC-Eds implemented during the grant period, between 96% and 100% of participants responded positively. Educators were then explicitly asked if they had made changes in their practice as a result of participation, to which 96% indicated “Yes.” When asked to describe how they were applying what they learned in the MOOC-Eds to their professional practice, participants typically responded by citing one of the following applications: 1) integrating new tools and strategies, 2) implementing course projects, and 3) using course content for instructional coaching or professional development with colleagues. In addition to participant self-reports, members of the evaluation team conducted classroom observations with a small group of teachers participating in the Fraction Foundations courses. The most prevalent changes observed during observations were providing students with more time and “space” to think through and work at problems before intervening with support, using more probing questions to elicit student thinking, and increased use of fraction models and manipulatives.

In summary, the findings suggest that the MOOC-Ed developers have been largely successful in designing professionally relevant learning experiences with opportunities for both personalization and peer-support. As a result, educators have reported improvements in knowledge and skills, as well as positive changes to their professional practice. The findings also illustrate that even well-designed MOOC-Eds face significant challenges in scaling learning that embodies the principles of effective professional development. Based on the findings from this evaluation, recommendations are provided in the following five areas to support future efforts in providing a scalable approach to professional development: 1) content management; 2) peer feedback and support; 3) integration with local PD initiatives; 4) formative and summative assessment; and 4) research and evaluation.

## INTRODUCTION

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K-12 education is undergoing rapid changes, driven in part by new curriculum standards and assessments; increased recognition of the importance of deeper learning in preparing students to be college, career, and citizenship ready; and new technologies that have the potential to enhance teaching, learning, assessment, communications, and school management. Nationally, nearly 3.5 million K-12 educators (teachers and administrators in public and private schools) need opportunities to update their knowledge, skills, and practices in order to address changing requirements. While almost all educators have access to some professional development (PD) each year, over 50 percent of them express dissatisfaction with their PD opportunities, finding that PD is neither relevant nor personalized (Wei, Darling-Hammond & Adamson, 2010). Additionally, the resources available to meet the needs of educators are limited and have been declining throughout the country. Using traditional approaches is far too costly, cannot provide sufficient learning opportunities when and where educators need them, and is of limited effectiveness even for those educators that can be reached. New approaches are required – approaches that embody research-based principles of effective PD and are scalable, accessible, and flexible to meet the needs of many educators. These approaches need to incorporate the principles of deeper learning into professional learning programs for teachers and administrators.

The advent of MOOCs – Massive Online Open Courses – led us to consider their potential to help education professionals advance their expertise and improve their professional practice. Beginning in 2012, the Friday Institute launched a set of MOOCs for Educators (MOOC-Eds) to explore whether MOOC-like approaches could be adapted to address the professional learning needs of educators, providing scalable, accessible, and cost-effective PD. MOOC-Eds are similar to other MOOCs in that they can serve thousands of educators in one course, are open to all interested participants, are delivered online, and are structured like a course to provide content and activities in defined time periods. However, the Friday Institute MOOC-Eds are unique in that they are designed in accordance with the research-based principles of effective PD (Darling-Hammond, Wei, Richardson, & Orphanos, 2009) and online learning (iNACOL, 2011). MOOC-Eds are specifically designed to help adult educators meet their professional learning needs, so it is assumed that participants are literate, motivated, and self-directed. MOOC-Eds focus on supporting participants to reach their own goals, not on goals set by the course creators or on completion rates. MOOC-Ed developers value the experience and expertise of the participants and design learning activities such that educators can share their knowledge to further the learning of others. There is also an emphasis on establishing professional connections among MOOC-Ed participants, who are identified by name in all their comments and projects; participants are not able to post or give feedback anonymously. Finally, practice-based and place-based learning centers participants' work on critical problems of practice and data-informed decision making in their classrooms, schools, and districts.

## EVALUATION CONTEXT

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With support from the Hewlett Foundation, the Friday Institute developed three MOOC-Eds to address the effective teaching of Common Core State Standards (CCSS) content with deeper learning approaches: (1) Fraction Foundations: Helping Students Understand Fractions; (2) Disciplinary Literacy for Deeper Learning; and (3) Teaching Statistics through Data Investigations. These MOOC-Eds were designed to help educators better understand math and literacy core academic content. By modeling and supporting instructional practices such as inquiry-based learning and reflection with peers, they were also designed to promote collaboration, critical thinking, and problem solving in the classroom. Table 1 (below) summarizes the three MOOC-Eds.

TABLE 1: HEWLETT SUPPORTED MOOC-EDS

Course Information	Audience	Description
Fraction Foundations: Helping Students Understand Fractions  Offerings/Enrollments: 2/2,610	K-8 Educators Teacher Educators Providers of PD	This course helps educators teach fractions concepts and skills more effectively through understanding students' thinking and implementing research-based approaches in their classroom. The course will also help educators address rigorous curriculum standards for fractions.
Disciplinary Literacy for Deeper Learning  Offerings/Enrollments: 2/1,285	Grade 6 to 12 teachers in English Language Arts (ELA), Science, Social Studies, History, and Mathematics Teacher Educators Providers of PD	This course explores what it means to read, write, speak, and listen for learning and creating knowledge within a discipline. The course offers a Model for Inquiry-Based Disciplinary Literacy to help promote deeper learning and foster personalized application to local contexts. Additionally, it provides an optional PLC Facilitation Guide to assist local teams as they work through the course together.
Teaching Statistics Through Data Investigations  Offerings/Enrollments: 1/797	Teachers of Statistics and Mathematics (Middle School – Early College) Teacher Educators Providers of PD	This course prepares middle school, high school, and college educators to use data investigations to teach statistics and to help students explore data to make evidence-based claims. It provides a foundation for the future study of data science.

Each MOOC-Ed was developed based on the Friday Institute's MOOC-Ed Theory of Action, summarized in Figure 1 (following page). The Theory of Action proposed that these courses – based on four core design principles (practice-based learning, self-directed learning, peer-supported learning, and multiple voices) that are instantiated through a range of instructional elements – would strengthen educators' knowledge and application of relevant conceptual frameworks, content, pedagogy, and technologies. This, in turn, would enable participants to improve their professional practices to support the learning of students and other teachers, as well as increase participants' own use of professional resources, networks, and communities for their ongoing professional learning. All of which would lead to the final outcome of students acquiring the abilities and dispositions of deeper learning and reaching a high level of achievement on the Common Core or other rigorous State Standards. The design principles and instructional elements used in the development of each MOOC-Ed are further explained below.

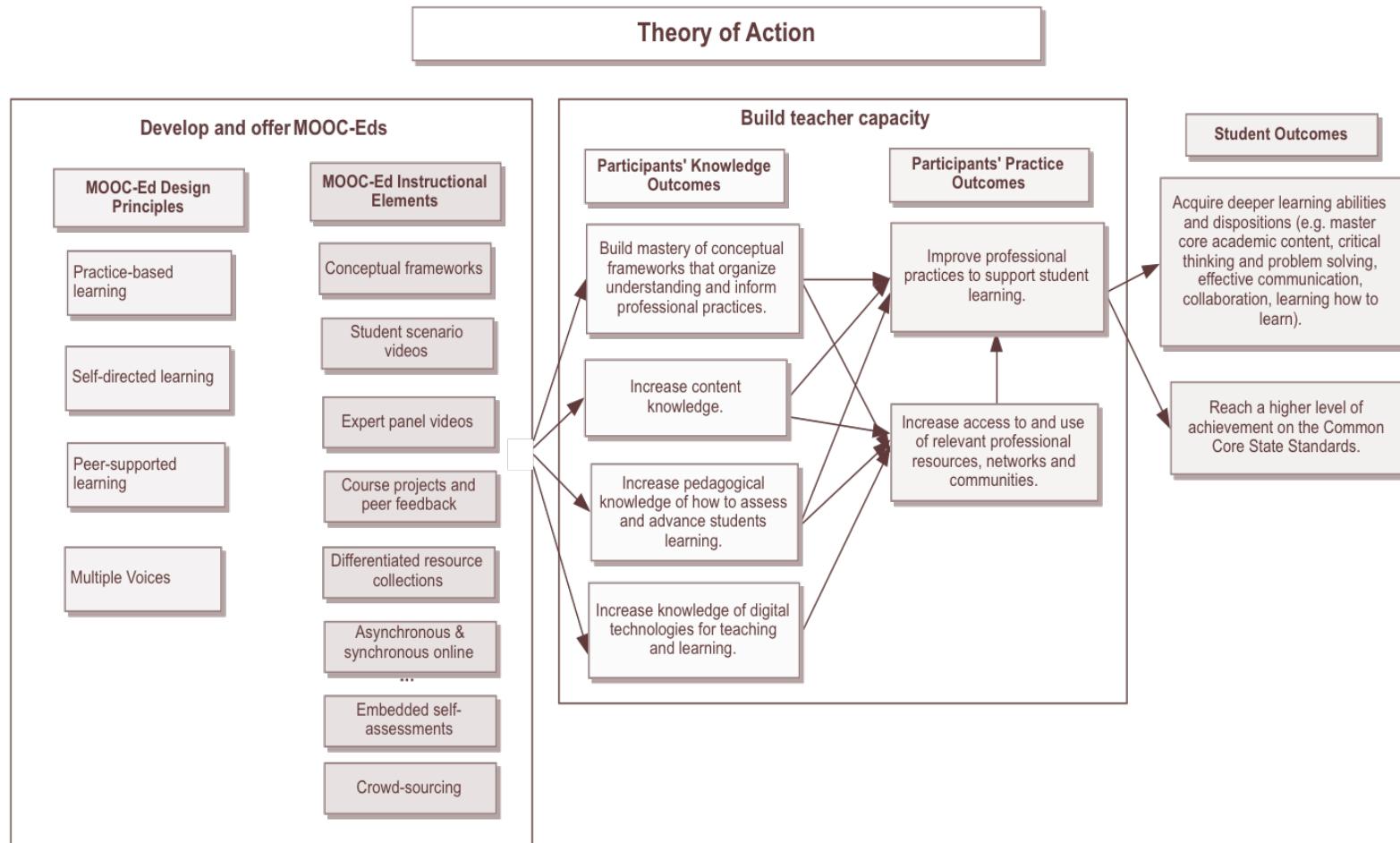


FIGURE 1: MOOC-ED THEORY OF ACTION

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## DESIGN PRINCIPLES

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The four design principles that follow are based on research-based principles of effective professional development and online learning, and provide the overarching framework guiding the development of each MOOC-Ed.

*Multiple voices* allow participants to learn about the perspectives of other teachers and administrators and those of students, researchers, and experts in the field. MOOC-Eds are purposefully *not* designed around one or two experts who present online lectures; instead, they offer a rich set of perspectives presented within the context of activities and exchanges that reflect specific design principles. Specifically, MOOC-Eds provide professional learning spaces where course content is enhanced by the expertise of practitioners and leaders in the field (e.g., expert panels, case-studies, guest Q&A, etc.). Additionally, educators are provided varied and ongoing opportunities to exchange opinions, experience, and information (e.g., discussions, Twitter chats, polls, etc.).

*Self-directed learning* enables participants to personalize their experience by identifying their own goals, selecting among a rich array of resources, and deciding whether, when, and how to engage in discussions and activities to further their own learning and meet their personal goals. Each course offers a wide range of resources, tools, and strategies to support the application of content in a variety of educational contexts. Differentiated learning experiences are provided to address varied educator experiences, roles, competencies and commitments; educators are provided opportunities to investigate self-identified problems, areas of interest, or special topics related to their professional learning needs. Additionally, educators are provided a variety of self-assessment strategies and tools to gauge their progress towards course outcomes and goals, and they are afforded flexibility in demonstrating new knowledge and skills.

*Peer-supported learning* occurs when participants engage in online discussions, review each other's projects, rate posted ideas, recommend resources, crowdsource lessons learned, and participate in Twitter chats and other exchanges appropriate to the individual course. Specifically, MOOC-Eds provide professional learning spaces where social supports (e.g., netiquette guidelines, ice breakers, tone) cultivate a general sense of collegiality and trust among participants. Discussion and reflection questions scaffold critical thinking and group problem-solving, and various strategies are used to facilitate constructive peer feedback and/or coaching at various levels of support (e.g., forum replies and ratings, project peer review). Crowdsourcing activities promote the sharing and curation of resources, tools, and effective practices. Learning activities provide opportunities for small-group work and/or collaboration on shared outcomes or goals. Further, supports are provided to facilitate the integration of MOOC-Eds within local professional development initiatives that provide face-to-face and hands-on activities, coaching, professional learning communities (PLCs), or other professional learning experiences.

*Practice-based learning* takes place through the use of case studies and classroom- and school-related projects, the development of action plans, and other activities that center participants' work on critical problems of practice and data-informed decision making in their own classrooms, schools, or districts. The purpose, goals, and learning outcomes for each MOOC-Ed are clearly communicated to participants, with support provided to help educators understand how they address their educational standards or priorities in their local, regional, and/or national context. Models of effective practice (e.g., strategies, tools, processes, etc.) are frequently provided to support the application of new learning into educators' professional settings. Authentic project-based activities result in a product or process directly connected to participants' professional practice, and data-informed activities enable participants to collect new data and/or use existing data to inform their work during and beyond the MOOC-Ed.

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## DESIGN ELEMENTS

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The Friday Institute used an extensive range of data sources to examine educators' participation, the effectiveness of the MOOC-Ed instructional design, and the impact of MOOC-Eds on participants' knowledge and practices. The following data sources are organized by the section in which each is a primary source to address the evaluation question for that section (participation, design, and impact); however, sources such as participant surveys and interviews are referenced across multiple sections as they contributed to answering multiple evaluation questions.

*Conceptual frameworks.* Conceptual frameworks are provided within each MOOC-Ed and help participants see the “big picture” and understand the structure of the course so that they can better guide their own learning. The frameworks also help participants bridge what they are learning about research and practice and provide a common language to help participants communicate about key ideas. These frameworks vary to reflect the goals, content, and audience of the MOOC-Ed.

*Student scenarios.* Student scenarios combine a video, related resources, and a discussion. Scenarios begin with a video of one or more students working through a challenge, such as a mathematics problem. The videos are selected so that, within two to four minutes, they show some things the student knows and can do, while leading to a point at which the student is puzzled, makes an error, or demonstrates a misconception. The video ends at that instructional decision point and participants discuss what they would do next. This often leads to rich discussions, the sharing of pedagogical content knowledge in interpreting what they have seen, and instructional strategies in recommending next steps.

*Expert panels.* Expert panels bring the voices of experts – researchers, school and district leaders, teachers, policymakers, and other national leaders – to MOOC-Ed participants. In an informal interview setting conducted via Google Hangouts, one of the course facilitators interviews the

expert panelists, asking them to share challenges, lessons learned, strategies, and other things they “wish they knew earlier” and believe would be of value to other educators.

*Participant projects and peer feedback.* MOOC-Eds generally incorporate one or more project options for participants that are woven through multiple units. The goal of the projects is to have participants connect what they are learning in the MOOC-Ed with their own professional responsibilities and context. The MOOC-Eds also incorporate a peer-feedback process in which participants are asked to provide constructive feedback to others’ projects; this is done in the discussion forum to allow for peer interactions about the projects (as opposed to the anonymous feedback methods used in many other MOOCs).

*Resource collections.* Resource collections are carefully selected and annotated sets of core resources in each unit. Many units also provide additional “digging deeper” resources for those who want more information about selected topics. Both types of resources typically include the following: short videos; documents (including ones that address all the same areas as the videos and, in some cases, complement the videos by providing more in-depth information); websites that provide rich resources relevant to the topic of the unit (these may focus on research, practice, or policy, depending upon the MOOC-Ed); and apps that participants may find useful.

*Asynchronous discussions and Twitter chats.* The primary vehicle for interactions during a MOOC-Ed is the discussion forum. The MOOC-Ed facilitators pose discussion starter topics; participants can contribute to those topics, start new ones, comment on prior postings, and rate messages (as described below under *Crowdsourcing*). Given the number of participants and the time flexibility required to allow 24/7 engagement across worldwide time zones, asynchronous discussions are the primary form of exchange in all the MOOC-Eds. In some MOOC-Eds, scheduled synchronous Twitter chats are also used to encourage interaction and knowledge creation. Twitter chats provide an opportunity for those who prefer this form of short, informal synchronous messages to share questions and ideas. An archive of the tweets is then provided after that chat.

*Crowdsourcing.* Crowdsourcing techniques are used to rate resources and discussions within MOOC-Eds. A “star” rating system (similar to those used by Netflix, Amazon, and others) enables participants to provide feedback on the value of different resources – videos, documents, websites, and apps. A summary of these ratings is then provided to all participants to help them select resources to explore further and share with local colleagues. Another form of crowdsourcing is used in the discussion forums where participants can choose one of four tags for a discussion posting: *critical issue, great tip, agree, and not convinced*.

*Embedded assessments.* MOOC-Ed participants were provided embedded assessments to self-assess their knowledge and skills related to the content of the course. Assessments are completely voluntary and do not in any way prevent participants from progressing in or completing the course.

*Supports for blended learning programs.* MOOC-Eds are most valuable when participants work through courses together with local colleagues and discuss how the MOOC-Ed resources and activities apply to their local contexts. For this reason, many of the aforementioned design elements provide tools and connections for blended learning programs (for example, the student scenario videos provide opportunities and supports for peer discussions and coaching).

## EVALUATION APPROACH

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The purpose of the evaluation was threefold: 1) to understand the characteristics of the participating educators and how they engage in using MOOC-Ed resources, discussions, and activities; 2) to provide formative feedback to inform the ongoing improvement of the design and implementation of each of the individual and other MOOC-Eds; and 3) to examine the impact of participation on educators' knowledge and professional practices. The following questions guided the evaluation and provide the organizational framework for this report:

1. **Participation.** What are the characteristics of participating educators and to what extent do participants engage in the MOOC-Eds?
2. **Design Principles.** In what ways and to what extent do the instructional elements of the MOOC-Eds instantiate the design principles?
3. **Educator Impact.** In what ways and to what extent has participation in MOOC-Eds deepened educators' knowledge and skills and impacted their professional practice?

The evaluation team used a mixed-methods embedded design (Creswell & Clark, 2010; Yauch & Steudel, 2003) to inform this study. This method uses quantitative and qualitative data gathered concurrently. The intent of this research design is to use qualitative data to elaborate and enhance the quantitative findings in order to provide a more complete understanding of the findings (Greene, Caracelli, & Graham, 1989; Tang & Solomon, 2001). By utilizing this design, this study can “increase the interpretability, meaningfulness and validity of the constructs and inquiry results by both capitalizing on inherent method strengths and counteracting inherent biases in methods or other sources” (David & Sutton, 2011, p. 296).

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## DATA SOURCES

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The Friday Institute used an extensive range of data sources to examine educator's participation, the effectiveness of the MOOC-Eds instructional design, and the impact of MOOC-Eds on participants' knowledge and practices. The following data sources are organized by the section in which each is a primary source to address the evaluation question for that section (participation, design, and impact); however, sources such as participant surveys and interviews, are referenced across multiple sections as they contributed to answering multiple evaluation questions.

## SECTION I: PARTICIPATION

*MOOC-Ed Registration.* All participants completed a registration form for each MOOC-Ed course. The registration form consists of self-reported demographic data – including information on professional roles and work settings, years of experience, gender, level of education, and personal learning goals.

*Google Course Builder Logs.* Course Builder is an open-source platform that runs on Google infrastructure. Course Builder includes user event log data used to track (in detail) each participant’s engagement with the unit lessons and lesson resources. A combination of applications was used to clean, merge, and format the data into usable tables; these applications access the data repository directly to produce downloadable Excel tables. Tableau and Excel were used to analyze data and generate basic descriptive statistics and visualizations.

*Vanilla Forums Analytics.* Vanilla Forum Analytics provided user event log data used to track (in detail) each participant’s engagement with the discussion forums, including their views, “reactions,” and posts. A combination of applications was used to clean, merge, and format the data into usable tables; these applications access the data repository directly to produce downloadable Excel tables. NodeXL was used to analyze data and generate basic descriptive statistics and visualizations.

## SECTION II: DESIGN

*End-of-Unit Surveys.* A brief survey was embedded at the end of each unit in all MOOC-Eds. These short forms consisted of five Likert-scaled items aligned to the evaluation questions and two open-ended items requesting participants describe the most valuable aspect of the unit and recommendations for improving the unit. Likert-scaled survey results were analyzed at the item-level using Excel software to generate descriptive statistics; open-ended responses were thematically analyzed using Atlas.ti software. The purpose of gathering unit feedback was to gauge the extent to which participation in these courses helped to strengthen participants’ knowledge and their application of the course content. Analysis of survey results consisted of item-level descriptive statistics using Excel software and thematic analysis of the open-ended responses using Atlas.ti.

*Course Reviews.* The evaluation team, with feedback from course developers and staff, developed an online MOOC-Ed Course Review Tool to help determine the extent to which the courses aligned with MOOC-Ed design principles. The tool consists of a set of design indicators for each principle that were informed by a review of the relevant literature, existing standards for online/professional learning, and desired outcomes of the initiative. Design indicators were organized into three categories: practice-based, peer-supported, and self-directed.

*Developer Interviews.* Following course reviews, an evaluation team member conducted semi-structured interviews (Drever, 1995) with course developers to gain a deeper understanding of each developer’s

vision for their course, strategies for addressing MOOC-Ed design principles, and their successes/challenges. Developers and members of the evaluation team completed an online MOOC-Ed Course Review Tool to help determine the extent to which the courses aligned with course design principles.

### SECTION III: IMPACT

*End-of-Course Surveys.* At the completion of each MOOC-Ed, participants were asked to complete an End-of-Course survey. Each survey aimed to measure the effectiveness of the MOOC-Eds by engaging participants with questions regarding the impact of each course. The completion of the survey was a requisite for participants requesting a certificate. The survey consisted of roughly 30 Likert-scaled items and four open-ended items designed to solicit participants' perceptions of the impact and effectiveness of the MOOC-Eds. Analysis of survey results consisted of item-level descriptive statistics using Excel software and thematic analysis of the open-ended responses using Atlas.ti software.

*Pre-Post Assessments.* The Fraction Foundations pre-post assessment was adapted from the Mathematical Knowledge for Teaching (MKT) assessment developed at the University of Michigan. Items included in the pre-post assessments were selected based on their alignment with the three major topics covered in the MOOC-Ed: fractions in fair-sharing contexts; fractions as measures; and understanding operations with fractions. Basic descriptive statistics were calculated in SPSS and further statistical analyses were conducted for the summative report. In Teaching Statistics, the Levels of Conceptual Understanding in Statistics (LOCUS) assessment was used to measure participants' statistical understanding prior to and at the end of each course.

*Participant Interviews.* Following a mid-course email solicitation, representative samples of 11 participants (five and six participants from the Disciplinary Literacy and Fraction Foundations MOOC-Eds, respectively) were selected based on their educational roles and the extent of their engagement in the course. Semi-structured phone interviews (lasting between 30 and 60 minutes) were conducted to gather feedback regarding participants' motivations, perceived value, recommendations, and applications to practice. Audio recordings were transcribed and open-coded by team members using Atlas.ti software; coded quotes were then consolidated into emergent themes.

*Classroom Observations.* Classroom observations were conducted with four teachers participating in the Fraction Foundations courses. Classroom observations and post-lesson interviews were conducted with these teachers both prior to and following participation in the MOOC-Ed. The evaluation team used the Classroom Observation of Early Mathematics—Environment and Teaching (COEMET) protocol to help guide classroom observations.

Greater detail on data sources, protocols, and analyses is provided in Appendices B-E.

## EVALUATION FINDINGS

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### SECTION I: PARTICIPATION

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Evaluation Question 1: *What are the characteristics of participating educators and to what extent do participants engage in the MOOC-Eds? (Participation)*

The primary purpose of this section to gain a better understanding of the audience MOOC-Eds serve by examining: 1) the characteristics of participating educators such as demographics and motivations for participation, and 2) participant use of the MOOC-Ed platform and resources to support their professional learning. Data in this section are drawn from the MOOC-Ed Registration Forms and course analytics. The registration form consisted of self-reported demographic data, including information on participants' professional roles, work settings, years of experience, gender, level of education, and personal learning goals. Site analytics were gathered from Google Course Builder and Vanilla Forums databases and include user logs to course resources and forums.

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### PARTICIPANT CHARACTERISTICS

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MOOC-Eds appealed to a wide range of educators in terms of their geographic location, professional roles, and personal goals. During registration, participants were asked to provide their country, and if located in the U.S., the state and city in which they worked. Among the nearly 5,000 educators enrolled the MOOC-Eds, the majority of participants (88%) were located in the U.S., with representation from all 50 States (Figure 2). Nearly half of U.S. enrollments came from the southeastern states of North Carolina (20%), Georgia (11%), and Virginia (9%), with the states of California (9%) and Michigan (5%) rounding out the top five.

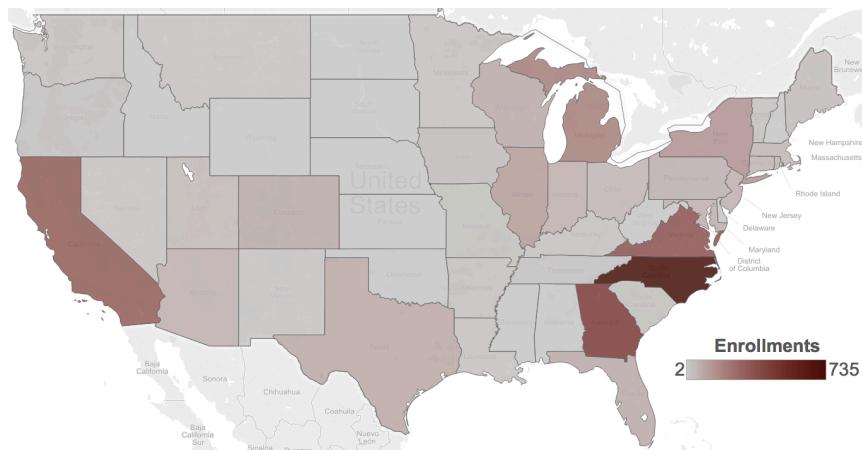


FIGURE 2: ENROLLMENTS BY STATE

Participants enrolled from over 80 countries, with participants from Asia (31%) and North America (25%, excluding the U.S.) accounting for half of all international participants (Figure 3). The three countries with the highest enrollments (beyond the U.S.) were Canada (71), Australia (55), and India (38) and accounted for nearly one-third (28%) of all international enrollments. One interesting trend in international enrollments is that English is an official language for seven of ten countries with the highest enrollments. In addition to the three countries listed above, Singapore, South Africa, Ireland, and the United Kingdom list English as an official language. The remaining three consisted of Saudi Arabia (Arabic), Honduras (Spanish), and Italy (Italian). This trend suggests MOOC-Eds may be more accessible to international participants where there is less of a language barrier.

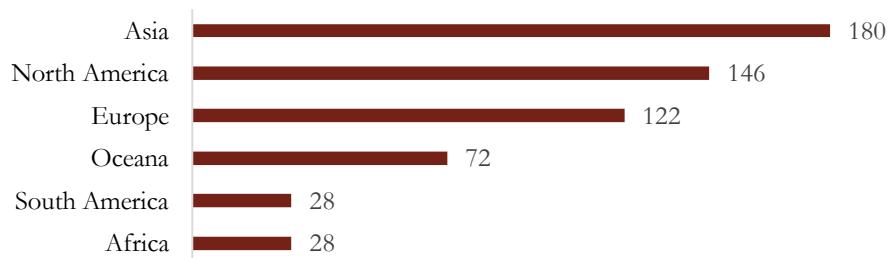


FIGURE 3: PARTICIPANT ENROLLMENTS BY CONTINENT EXCLUDING U.S.

During registration, participants were also asked to provide their primary responsibility in their school, district, or organization. Collectively, educators responsible for classroom teaching accounted for over half (55%) of MOOC-Ed enrollments. Educators in Special Education (6%) and teacher support roles such as Curriculum and Instruction (11%), Professional Development (8%), and Teacher Preparation (4%) accounted for the majority of the remaining enrollments (Figure 4).

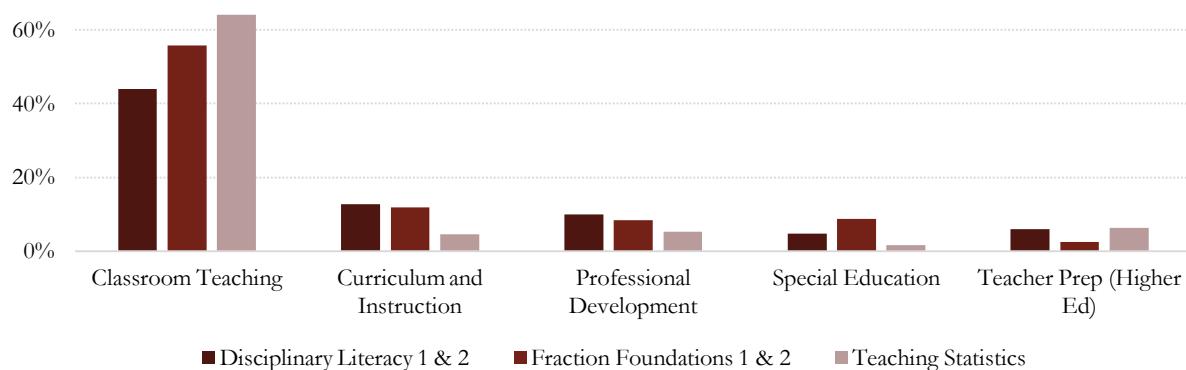


FIGURE 4: TOP FIVE ROLES OF PARTICIPATING EDUCATORS

Participants were also asked to provide their level of education. Although MOOC-Eds were designed for working educators and it was anticipated the majority would have at least a four-year degree, it was not anticipated that over two-thirds of participants would have an advanced degree. Participants with a Masters degree accounted for 59% of all enrollments, while 9% reported that they had a Doctoral Degree. As shown in Figure 5, the make-up of participants in terms of education levels was very similar across the three MOOC-Eds.

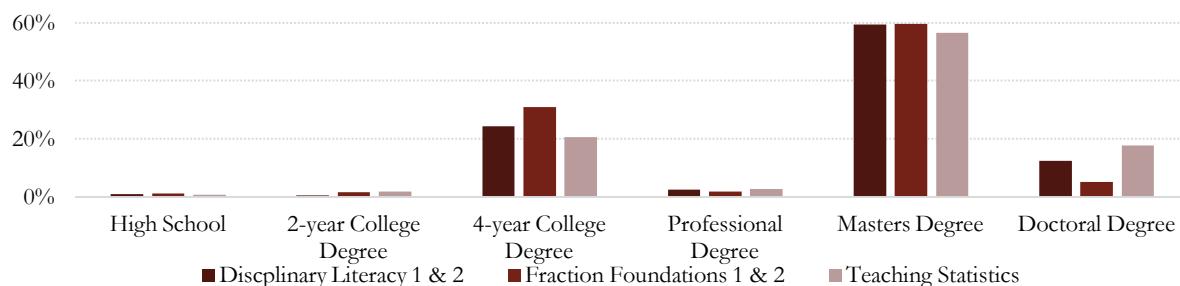


FIGURE 5: EDUCATION LEVELS OF PARTICIPATING EDUCATORS

Finally, based on an open-ended response to a survey item from prior MOOC-Eds which asked participants to state their personal goals, a new item was added to the registration form of Fraction Foundations 1 and Disciplinary Literacy 1. Specifically, participants were asked to select up to three personal goals from the options presented in Figure 6 below. Results from the registration form suggest that educators placed the greatest value on acquiring new knowledge and skills, as well as collecting resources and tools. These two goals were selected by 85% and 64% of participants, respectively. For later course offerings, including Teaching Statistics, this item was replaced with a Likert-scaled item which asked participants to rank the importance of each goal to their professional learning needs. However, most participants rated all goals as “Important” or “Very Important,” therefore the relative importance of each goal was harder to distinguish. We have since reverted back to a forced select item type as we feel this provides a better representation of participants’ priorities for participating in MOOC-Eds and is also less taxing on users to complete.

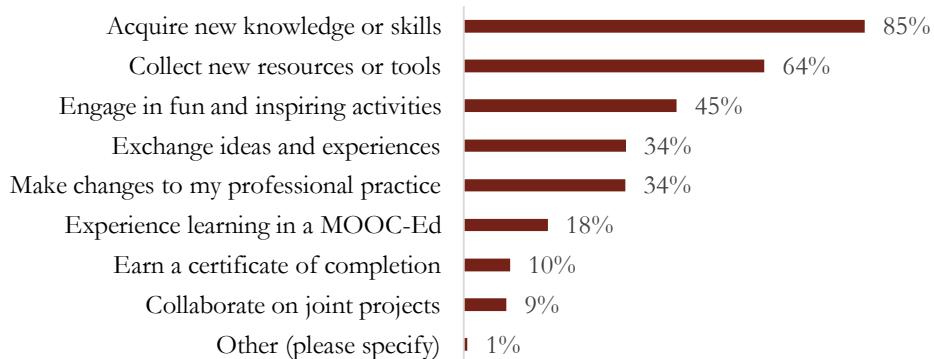


FIGURE 6: PERSONAL GOALS SELECTED BY % OF PARTICIPANTS

## PARTICIPANT ENGAGEMENT

In terms of participation in MOOC-Eds, those enrolled were categorized as either active or non-active participants. Non-active participants included those who did not return to the course after enrollment, or visited the course very infrequently (i.e., four days or fewer). Non-active participants accounted for roughly three-quarters of those enrolled, while the remaining 25% were considered participating educators and are the primary source of the data in the following sections.

TABLE 2: PARTICIPANT ENROLLMENTS AND PARTICIPATION

	<b>Enrolled</b>	<b>Non-Active Participants</b>		<b>Active-Participants</b>			<b>Certified<sup>2</sup></b>
		No-Shows	Visitors <sup>1</sup>	Participants			
<b>Disciplinary Literacy 1</b>	736	279 (38%)	300 (41%)	157 (21%)	40	(25%)	
<b>Disciplinary Literacy 2</b>	549	233 (42%)	195 (36%)	121 (22%)	36	(30%)	
<b>Fractions Foundations 1</b>	898	306 (34%)	406 (45%)	186 (21%)	48	(26%)	
<b>Fractions Foundations 2</b>	1,712	426 (25%)	739 (43%)	547 (32%)	155	(28%)	
<b>Teaching Statistics 1</b>	797	269 (34%)	348 (44%)	180 (23%)	33	(18%)	
<b>Total</b>	<b>4,692</b>	<b>1513 (32%)</b>	<b>1,988 (42%)</b>	<b>1,191 (25%)</b>	<b>312 (26%)</b>		

<sup>1</sup>Visitors were defined as enrolled users who visited the course only a small number of times (i.e. 4 days or fewer).

<sup>2</sup>Percentages for participants who received a certificate are taken as a percentage of Active-Participants, not enrollments.

To better understand participant engagement during the course, active participants were further characterized based on their use of five standard course activities each week: watching lecture videos, accessing the course resources/tools, visiting the discussion boards, posting in the forums, and commenting on a post. Participants were assigned either a zero (no use) or a one (use) for each activity so that a participant could score from zero to five for each week. For example, a participant who visited the discussion board, commented, and watched a lecture video in a given week was assigned a score of three out of a possible five for that week.

Using a longitudinal clustering technique to classify individuals based on similar trajectories of activity throughout the course, participants were grouped into one of three general categories: High Activity, Moderate Activity, and Declining Activity. Figure 7 (following page) illustrates the three participant groupings throughout the Fraction Foundations 2 course. The High Activity group engaged in almost all of the activities described above through the entirety of the MOOC-Ed. The Moderate Activity group consisted of participants who regularly visited the course, but did not fully engage in the five activities. Finally, the Declining Activity group began the course by participating in the bulk of activities, but their participation declined steeply over time.

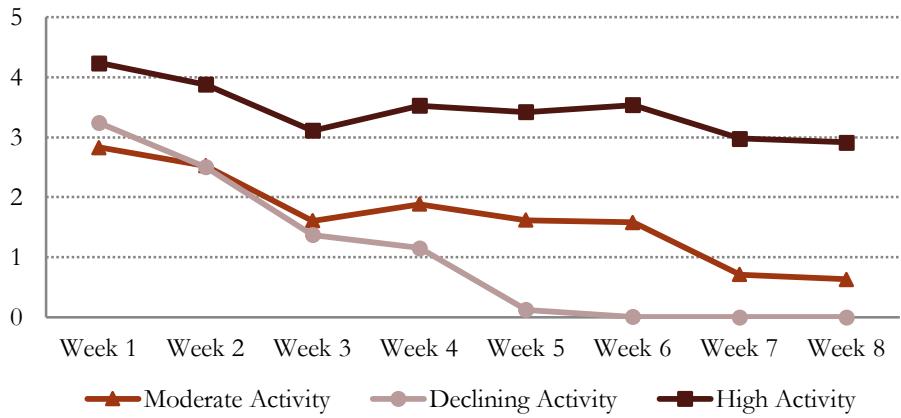


FIGURE 7: LEVELS OF ACTIVITY IN FRACTION FOUNDATIONS 2

As shown in Table 3, participants tended to fall into either the High Activity group (37%) or the Declining Activity group (40%) across the five MOOC-Ed offerings. One important point of interest in these findings is the decrease in the Declining Activity group from the first and second offerings of the Disciplinary Literacy and Fraction Foundations courses, and an increase in the proportion of users going through the entirety of the course. This suggests that changes between the first and second offerings of each course may have been effective in retaining and engaging educators. In addition, Disciplinary Literacy had a substantially larger proportion of High Activity participants than the other two courses. This may simply be a result of the relationship between the number of active users and their level of activity, as courses with a greater number of active users tended to have a smaller proportion of participants identified as High Activity. However, further investigation is warranted to determine if there were instructional elements present in the course that may have promoted the higher levels of activity observed.

TABLE 3: LEVELS OF ENGAGEMENT AMONG ACTIVE USERS

	Active Users	Moderate		
		Declining Activity	Activity	High Activity
<b>Disciplinary Literacy 1</b>	157	63 (40%)	13 (8%)	81 (52%)
<b>Disciplinary Literacy 2</b>	121	40 (33%)	13 (11%)	68 (56%)
<b>Fraction Foundations 1</b>	186	87 (47%)	36 (19%)	63 (34%)
<b>Fraction Foundations 2</b>	547	188 (34%)	207 (38%)	152 (28%)
<b>Teaching Statistics 1</b>	180	98 (54%)	-- --	82 (46%)
<b>Total</b>	<b>1,191</b>	<b>476 (40%)</b>	<b>269 (23%)</b>	<b>446 (37%)</b>

Note: Moderate Activity participants were likely so few in Teaching Statistics that they were subsumed by High Activity group by the clustering technique and effectively absorbed into the other group.

Using these same participant groupings, analyses were conducted to determine the extent to which level of engagement varied among participants' primary roles. As shown in Figure 8 below, active participants responsible for Professional Development tended to be in either the High Activity (38%) or the Moderate Activity group (45%), with relatively few (17%) in the Declining Activity group. Participants responsible for teacher preparation at the college or university level, on the other hand, tended to lean towards the Moderate and Declining groupings. Classroom teachers were more likely to fall in the High Activity or Declining Activity group, and had the highest proportion of High Activity participants across the five most common roles.

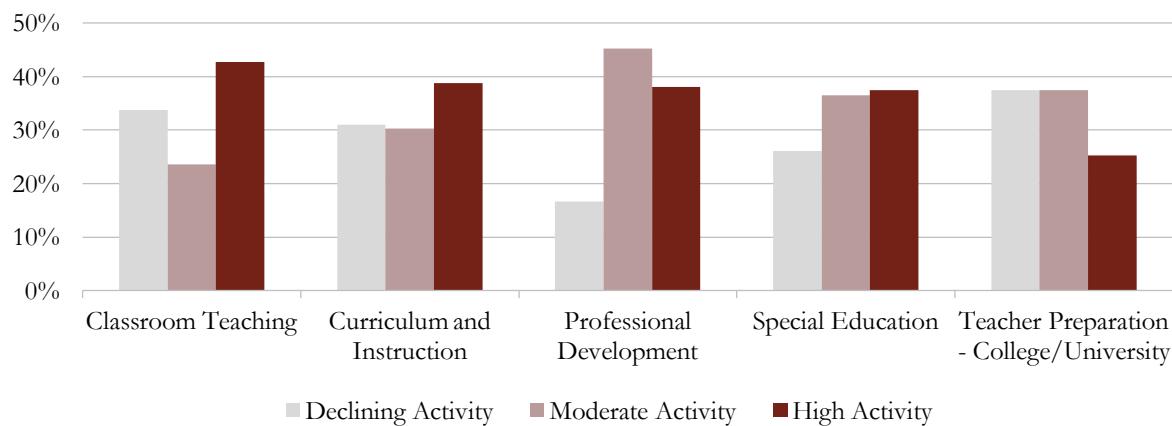


FIGURE 8: PARTICIPANT GROUPINGS WITHIN PRIMARY ROLE

Of the five activities cited above, the first three can be loosely categorized as passive engagement (e.g., watching a video), while the latter two require participants to actively contribute to the course forums (posting or replying in the discussion forum). Because of the emphasis MOOC-Eds place on peer-supported learning – both as an instructional practice and a means for scaling feedback and support – analytics were collected from the forums to determine the extent to which participants posted comments or replies, as well as the extent to which they networked among their peers.

Table 4 (following page) shows the number of participants who contributed at least one post or comment to the course forums. Note that the number of forum participants (1,781) greatly exceeds the number of participants who were defined as active participants (1,191). This is likely the result of “visitors” who contributed a post or comment to the Introductions forum or other forums early in the course, but did not return or returned infrequently. Collectively, forum participants contributed 15,806 posts across 6,353 discussions and averaged roughly nine posts per participant, including contributions to the course made by facilitators. The findings suggest that while the length of discussions tended to be short – with the typical discussion consisting of an initial post and one or two replies – participants were highly active in the forums. The actual content of these postings will be addressed in Section II.

TABLE 4: PARTICIPANT ACTIVITY IN THE COURSE FORUMS

	<b>Forum Participants</b> (Posts/Participant)	<b>Discussions</b> (Posts/Discussion)	<b>Total Posts</b>
<b>Disciplinary Literacy 1</b>	214 (8.8)	665 (2.8)	1,893
<b>Disciplinary Literacy 2</b>	184 (11.2)	725 (2.8)	2,061
<b>Fraction Foundations 1</b>	305 (8.1)	972 (2.5)	2,464
<b>Fraction Foundations 2</b>	770 (9.3)	3,061 (2.4)	7,196
<b>Teaching Statistics 1</b>	308 (7.1)	930 (2.4)	2,192
<b>Total</b>	<b>1,781 (8.9)</b>	<b>6,353 (2.6)</b>	<b>15,806</b>

Social network analyses were also conducted to examine the patterns of the relational ties between individuals. In the context of this evaluation, a tie is defined as a reply by one participant to another participant's forum post. Figure 9 illustrates these ties in Disciplinary Literacy 2 with a line connecting participants (represented as dots) in the network diagram below. Reciprocated ties illustrated by the dark lines occur when an individual returns, or reciprocates, a reply to a participant they received a reply from previously. Finally, tightly connected groups of four or more nodes in which reciprocated ties occur between all individuals are referred to as cliques and are represented by the larger star-shaped clusters. Cliques are indicative of small subcommunities within networks and are associated with positive learning outcomes such as knowledge co-construction and a sense of belonging to a learning community (Wenger, Trayner, & De Laat, 2011).

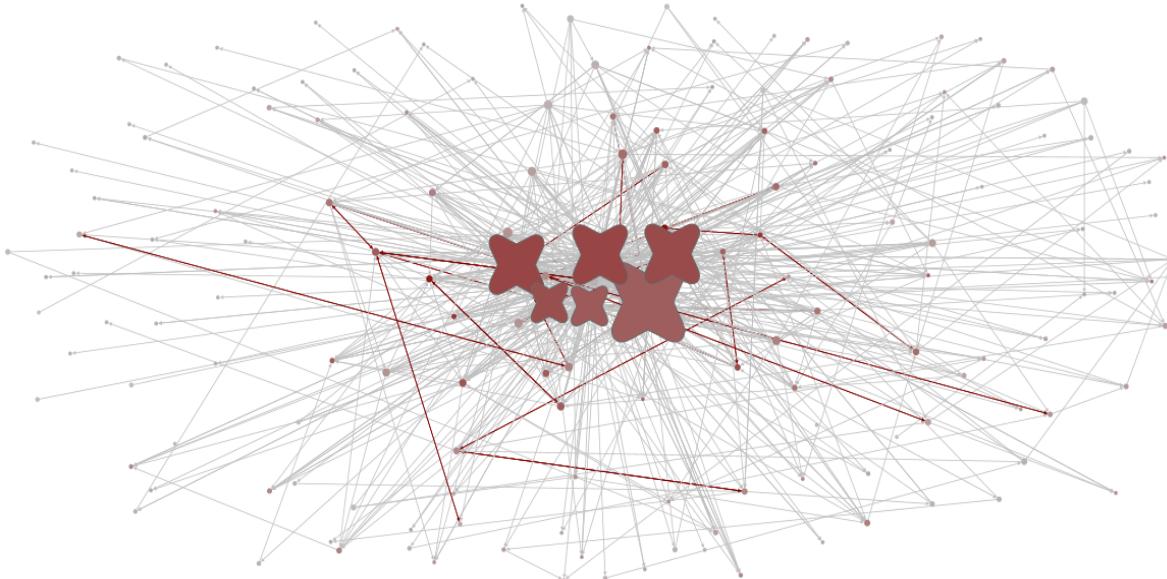


FIGURE 9: SOCIAL NETWORK DIAGRAM FOR DISCIPLINARY LITERACY 2

Table 5 (below) provides basic network statistics for the five MOOC-Eds, along with the average degree (number of individuals that people connected with) and the range of people that participants received replies from (in-degree) or sent replies to (out degree). In Fraction Foundations 2, for example, there were 2,991 unique exchanges among participants, and 11% were reciprocated. There were also 17 cliques of densely connected individuals, and educators connected with five of their peers on average. The number of individuals that each participant received replies from (in-degree) ranged between zero to 55 participants, while the number they replied to ranged from one to 55. Findings from forum activity and network analyses indicate that educators leveraged the opportunities to connect with their peers, with MOOC-Eds facilitating both casual peer networking and the development of highly connected subgroups of educators. The actual outcomes of these connections and how they supported development of new knowledge and skills will be discussed in detail in Section III.

TABLE 5: MOOC-ED SOCIAL NETWORK STATISTICS

	<b>Unique Ties (% Reciprocated)</b>	<b>Cliques</b>	<b>Avg. Degree</b>	<b>In-Degree Range</b>	<b>Out-Degree Range</b>
<b>Disciplinary Literacy 1</b>	684 (9%)	5	4.5	0-25	1-83
<b>Disciplinary Literacy 2</b>	782 (12%)	7	5.7	0-103	0-103
<b>Fraction Foundations 1</b>	1081 (11%)	5	4.7	0-46	1-38
<b>Fraction Foundations 2</b>	2,991 (11%)	17	5.0	0-51	1-55
<b>Teaching Statistics</b>	823 (9%)	3	3.7	0-34	1-89

In summary, MOOC-Eds appealed to a wide range of educators who used course materials and activities to varying degrees. These findings are consistent with the MOOC-Ed Theory of Action and the desired outcomes of the initiative. While MOOC-Eds are primarily designed for U.S. preservice and in-service teachers, who indeed accounted for the majority of enrollments, they also included accommodations and support for educators more broadly. The findings suggest courses attracted and engaged both the target audience as well as educators in non-classroom roles and beyond the U.S. In addition, MOOC-Eds were designed to accommodate educators with varying levels of commitment; as the findings demonstrate, MOOC-Ed participation varied widely, with some participants visiting infrequently and others highly engaged with both the course resources and their peers.

The following section is intended to extend the findings presented here by focusing on the MOOC-Ed design principles and their effectiveness, both from the participant perspective and the perspective of those involved in their development.

## SECTION II: DESIGN PRINCIPLES

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Evaluation Question 2: *In what ways and to what extent do the instructional elements of the MOOC-Eds instantiate the design principles?*

The purpose of this section is to examine pedagogical and instructional design elements of the courses to determine the extent to which the course-design supports and fosters opportunities for practice-based, peer-supported, and self-directed learning, enhanced by the expertise and multiple voices of practitioners and leaders in the field. For each design principle, we examine the ways and extent to which the principle was instantiated by design elements across courses. Additionally, for each principle, we highlight design elements that were particularly effective in specific courses. Because the evaluation of design principles was formative in nature, in some cases, we discuss how ongoing data collection was used to iteratively improve the course while the course was running and/or between iterations of the course. Data in this section are primarily informed by direct feedback from participants, and are drawn from the end-of-unit and End-of-Course surveys. Interviews with participants are used to help contextualize these findings.

After presenting findings for each design principle, Section II concludes with a discussion of areas identified for improvement and steps developers are considering for further improving course design. Data in the Areas for Improvement section are primarily drawn from open-ended items on End-of-Course surveys, reflective interviews with course developers, and a systematic review of courses by developers and the evaluation team.

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### PRINCIPLE 1: PRACTICE-BASED LEARNING

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MOOC-Eds are intended to help educators improve their professional practices. They provide models of effective practices, activities, resources, and peer-interactions designed to prepare participants to apply new knowledge and skills directly in their teaching, coaching, and/or leadership roles.

*Design Effectiveness.* Feedback from participants suggests that MOOC-Eds were largely successful in addressing this design principle. When asked at the end of each unit the extent to which activities supported the application of course content to their professional practice, 91% of participants from combined courses agreed to some extent (i.e., selected “somewhat agree,” “agree,” or “strongly agree). When responses were disaggregated by course, percent of participant agreement ranged from 89% for Disciplinary Literacy and Teaching Statistics to 93% for Fraction Foundations (Figure 10, following page). The similarity in responses across courses indicates that the three MOOC-Eds were equally successful in supporting educators in applying what they learned from the unit.

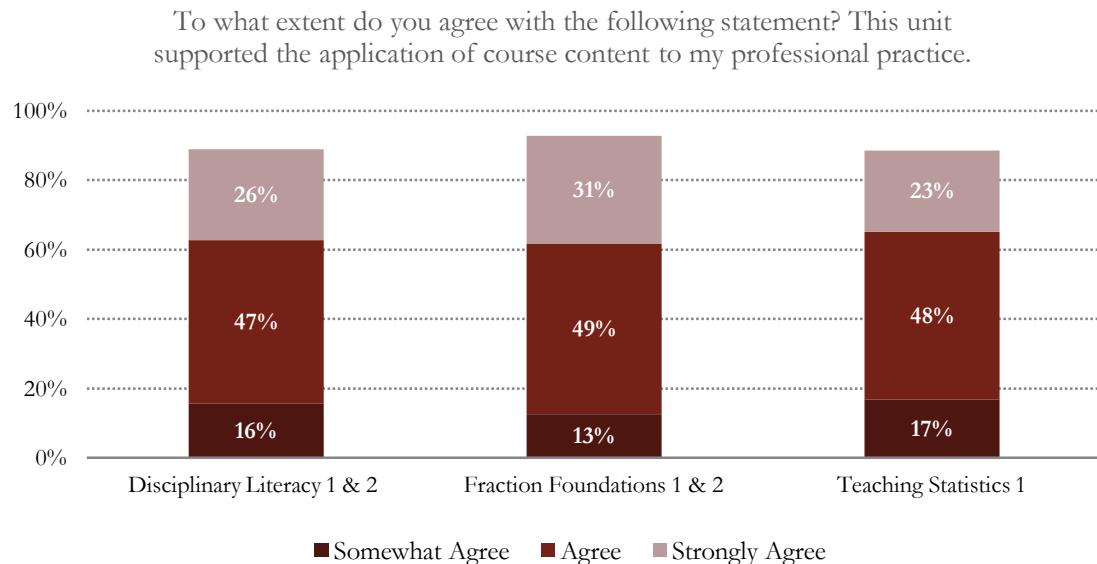


FIGURE 10: PARTICIPANTS’ APPLICATION OF CONTENT, BY COURSE

To help determine how educators’ perceptions may have changed as the course progressed, participant responses were also examined by individual course unit. Figure 11 (below) illustrates a general trend among educators to respond increasingly more positively to this item over time. For example, 85% of Disciplinary Literacy participants agreed with this statement in Unit 1, while 93% agreed with this statement by Unit 5.

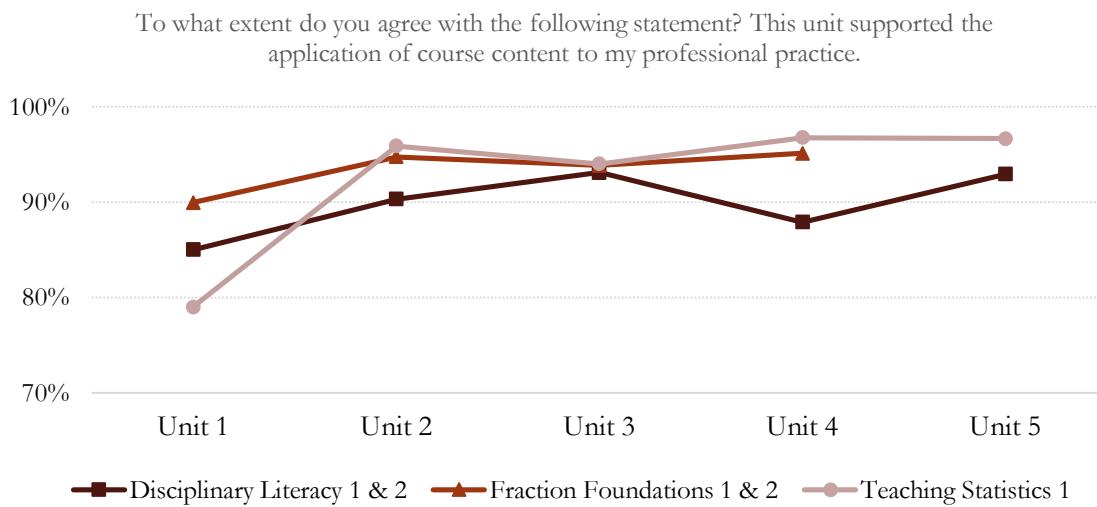


FIGURE 11: PARTICIPANTS’ APPLICATION OF COURSE CONTENT ACROSS UNITS

One possible explanation for this trend is that educators may have felt the course provided better supports for applying learning to their professional practice as the course progressed and as they gradually completed their course projects. These projects were designed to result in a product directly connected to participants' professional practice, such as the development of a lesson plan or professional development activity. Another explanation is that participants who felt neutral or disagreed with this statement may have discontinued their participation in the course – leaving only those participants who felt more positively to respond to later surveys.

Finally, on End-of-Course surveys, participants were asked to respond to items related to the effectiveness of instructional elements designed to address practice-based learning. Findings suggest the majority of educators who completed the MOOC-Ed felt these elements were effective. Across all courses, 96% of survey respondents indicated that the MOOC-Ed provided models of effective practice to support the application of course content. The vast majority (94%) also agreed that the course provided projects or activities that can be embedded in their practice (Figure 12).

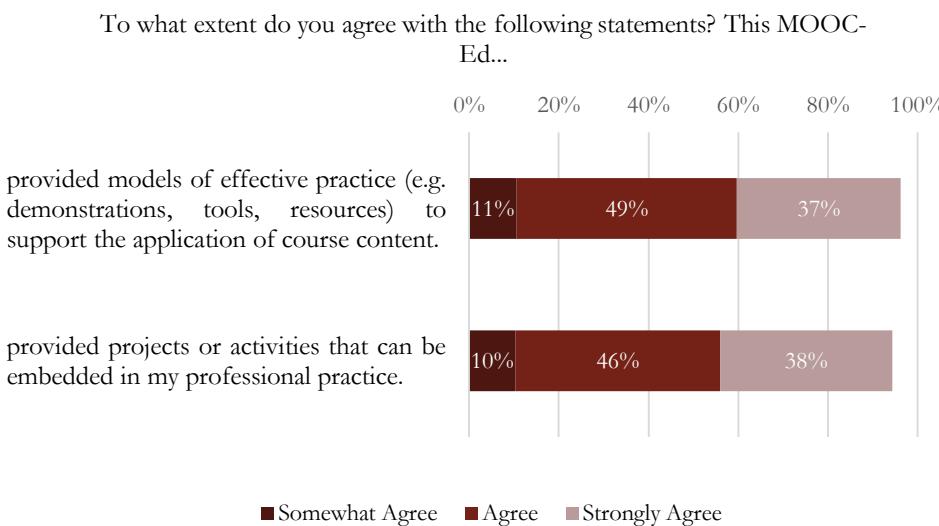


FIGURE 12: PERCENT OF POSITIVE AGREEMENT ON END-OF-COURSE SURVEY ITEMS RELATED TO PRACTICE-BASED LEARNING

*Design Highlights.* Three instructional elements stood out as being particularly effective in supporting practice-based learning: student scenario videos, conceptual frameworks and course projects. The “What would you do next?” video series, offered through the Fraction Foundations MOOC-Ed, was the design element most commonly cited as leading to professional learning and growth. Each video in this series begins with three- to five-minute video clips (Figure 13, following page) that shows students working and thinking aloud about a fraction problem. The video ends at a key instructional decision point and participants are then prompted, “Consider what the student understands or is thinking. What would you do next to address that thinking and why?” Participants

were encouraged to share their strategies in the discussion forums and, later in the course, developers and facilitators weighed in with their responses to each student scenario through short video clips.



FIGURE 13: A PUBLIC SCHOOL TEACHER MODELS QUESTIONING TO ELICIT STUDENT THINKING ABOUT FRACTIONS

Throughout this video series, Fraction Foundations participants enthusiastically engaged in discussions that pushed and extended their knowledge of students' misconceptions related to fractions. In interviews and through open-ended survey responses, participants frequently commented on the value of "sharing experiences" and "learning from other teachers." One teacher noted:

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The most valuable part of this MOOC-Ed was the "What Would You Do Next?" video series. As teachers, I think we need to see the "look fors" in students' misconceptions... For students to understand, teachers must become comfortable seeing misconceptions and addressing the understanding.

---

A second design element supporting practice-based learning is the conceptual framework provided within each MOOC-Ed. The frameworks help participants bridge what they are learning about research and practice, offer a common language to help them communicate about key ideas, and support the application of course content to practice. These frameworks vary to reflect the goals, content, and audience of the MOOC-Ed. As an example, the conceptual framework for the Disciplinary Literacy MOOC-Ed is shown in Figure 14 (following page). The Disciplinary Literacy course uses a Model for Inquiry-Based Disciplinary Learning developed by the MOOC-Ed team (Spires, Kerhoff, Graham, & Lee, 2014).

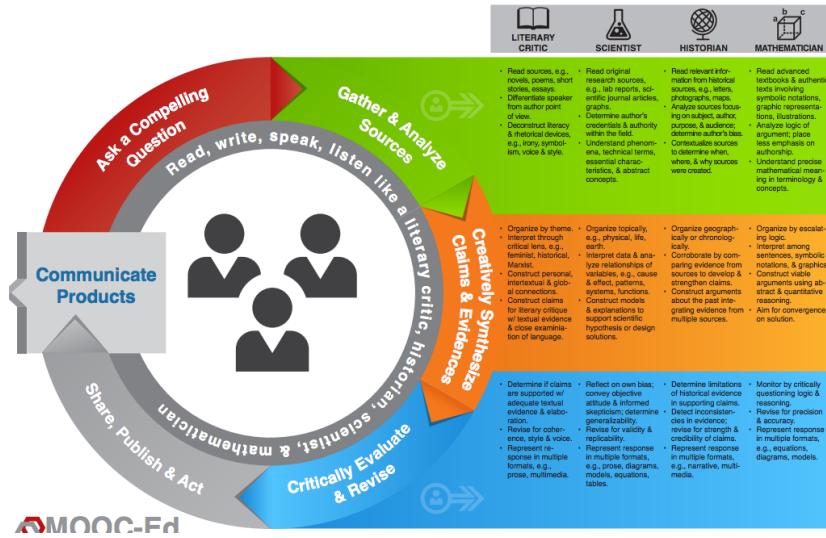


FIGURE 14: THE CONCEPTUAL FRAMEWORK FOR THE DISCIPLINARY LITERACY MOOC-ED

Disciplinary Literacy participants recounted the ways in which the framework helped them to “understand the bigger picture” and facilitated the transfer of knowledge to practice. One participant explained how the framework helped her to understand the components of inquiry-based teaching by illustrating the requirements at each stage. Similarly, Teaching Statistics MOOC-Ed participants and Fraction Foundations MOOC-Ed participants also noted the value they found through the use of conceptual frameworks to support practice-based learning. In commenting on the value of the Supporting Students’ Approaches to Statistical Investigations (SASI) Framework, one participant noted:

The SASI framework was the most useful part of the course. It is incredible. I've been telling the teachers here about it because normally we teach the Intro to Stats class only procedurally, just calculations, with no sense of equations or interpreting. But that has changed now because of using the framework.

In addition to the inclusion of a conceptual framework, each MOOC-Ed also provided participants with one or more project options. The goal of the project in each MOOC-Ed is for participants to connect what they are learning in the course with their own professional responsibilities and contexts. Participants commented on the value of working on a course project, either individually or in collaboration with other participants. When asked on End-of-Course surveys how effective the course project was in supporting their professional learning, 93% of educators indicated that it was effective. On open-ended survey items and during individual interviews, participants across MOOC-

Eds discussed how the opportunity to engage in developing a course project not only gave them a “tangible” take-away from the course, it contributed to their learning and professional growth as well. A participant from the Disciplinary Literacy course reported that the process of developing her Inquiry-Based Disciplinary Literacy (IDL) project was the most valuable aspect of the course, providing her with something that she could take back to her PLC and share with her colleagues for further tweaking. A Teaching Statistics participant noted how the course project gave her an opportunity to work with her assistant principal on a statistical investigation that would ultimately help to eliminate vandalism in the school’s restrooms. As illustrated in the following quote, several Fraction Foundations participants also indicated that the course project was a great way to apply what they were learning in the course and deepen their own understanding of course concepts.

---

I think the course project is really important. It's hard to do, and it's not something that I necessarily love, but I think it's really important because one, our curriculum doesn't really align very well, so the project is a way that I know that they're going to be understanding fractions at a deeper level, which is really important. I also think that having to come up with the course project, and having to think about how you would apply your learning, it definitely makes it a deeper learning experience for me.

---

Beyond just the reported value of the projects, the evaluation team also followed up with Fraction Foundations and Disciplinary Literacy participants who completed the course projects to help gauge the extent to which they were being used by educators. Among those surveyed, 31% indicated that they had already implemented their project, while 54% indicated they planned to implement it. More detail on how participants applied their projects is reported in Section III.

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## PRINCIPLE 2: SELF-DIRECTED LEARNING

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MOOC-Eds are intended to accommodate for the diversity of professional needs and interests inherent to an open online learning environment. Participants are encouraged to personalize their own goals, select among a rich array of varied resources, and decide whether, when, and how to engage in projects and discussions to further their own professional learning. Educators are expected to take control of their own learning to meet their own professional learning goals.

*Design Effectiveness.* Participant feedback suggests that MOOC-Eds were largely successful in accommodating for a diversity of professional learning needs. When asked the extent to which they agreed the unit helped them progress towards their personal learning goals, 92% of participants responded positively. Across the three courses, responses were again fairly similar, with the percent

of participant agreement ranging from 89% for Disciplinary Literacy to 93% for Fraction Foundations (Figure 15).

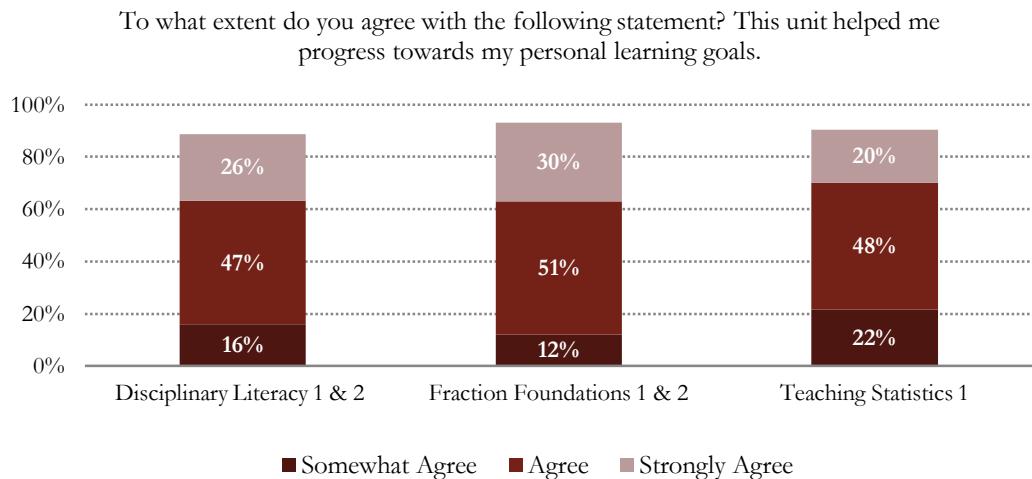


FIGURE 15: PARTICIPANTS’ PERCEPTIONS OF IMPACT ON PERSONAL LEARNING GOALS, BY COURSE

When results for this item were disaggregated by unit, they illustrated the same general trend – educators’ responses were increasingly more positive as the course progressed. For example, 83% of Teaching Statistics participants agreed with this statement in Unit 1, whereas 100% agreed with this statement by Unit 5 (Figure 16).

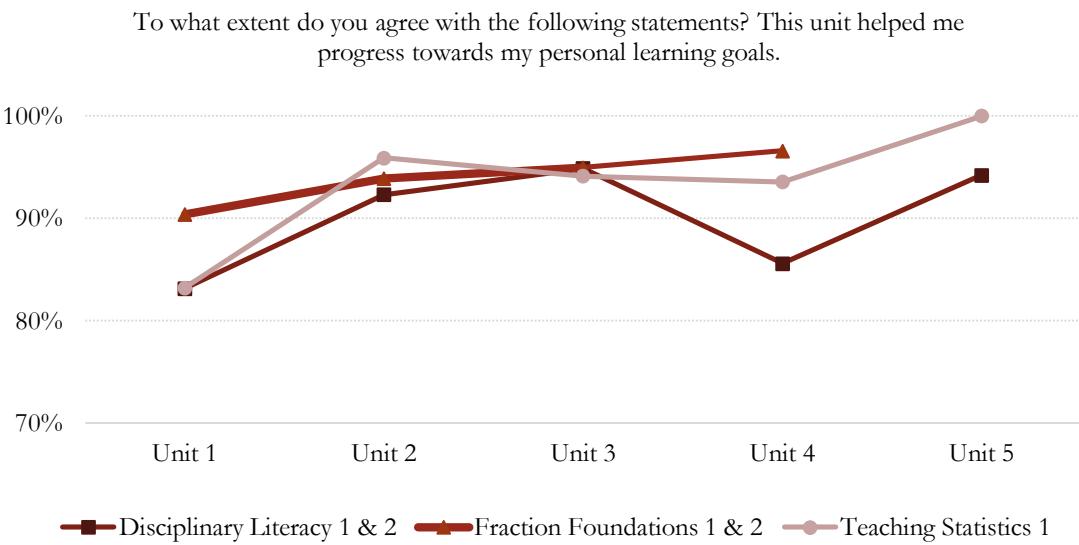


FIGURE 16: PARTICIPANTS’ PERCEPTIONS OF IMPACT ON PERSONAL LEARNING GOALS ACROSS UNITS

Finally, on End-of-Course surveys, participants were asked to respond to items related to the effectiveness of instructional elements designed to address self-directed learning. Across all courses, 92% of respondents agreed the MOOC-Ed they participated in enabled them to personalize their learning through differentiated activities and opportunities to investigate self-identified problems or areas of interest (Figure 17). In addition, over 90% of respondents felt the MOOC-Eds provided assessment and feedback opportunities to help them gauge their progress, and flexibility in demonstrating their learning.

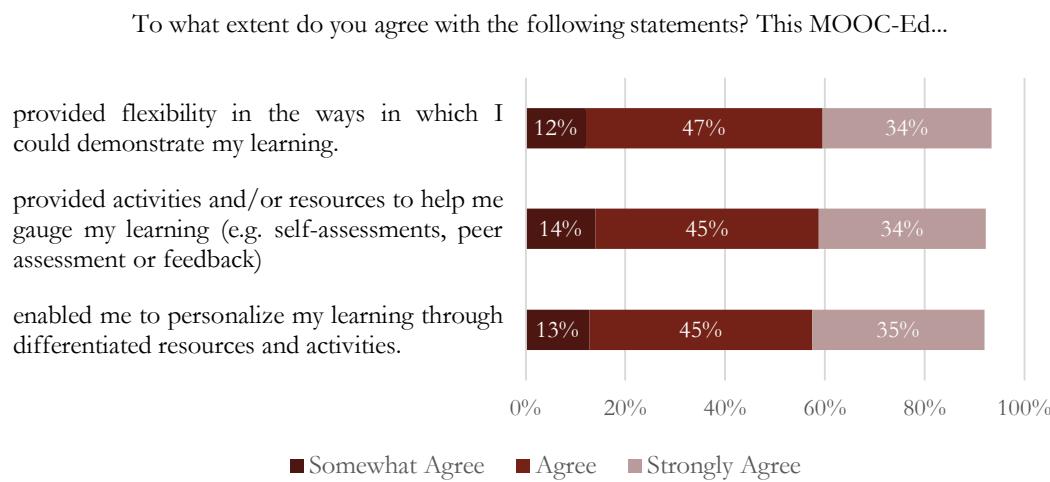


FIGURE 17: PERCENT OF POSITIVE AGREEMENT ON END-OF-COURSE SURVEY ITEMS RELATED TO PERSONALIZED LEARNING

*Design Highlights.* Two design elements that helped participants successfully tailor the course to their unique context and individual learning goals were differentiated resources and, for Teaching Statistics and Fraction Foundations, the inclusion of self-assessments. Each MOOC-Ed contains carefully selected and annotated sets of core resources in each unit. Many units also provide additional “digging deeper” resources for those who want more information about selected topics. Both types of resources typically include short videos, documents, websites, apps, and recommended activities for local professional development teams. Far more resources are provided than any one participant would be expected to use; the objective is to provide resources that meet the variety of goals and interests of the participants while providing information that enables them to select those resources that are more valuable to them. Though common across all courses, the provision of differentiated resources to support self-directed learning was especially well executed in the Teaching Statistics MOOC-Ed. The course provided course projects to address the range of grade levels and educational contexts in which educators worked. Resources for classroom use such as lesson plans (Figure 18, following page), online tools, and student assessment items were also consistently provided for different grade ranges.

**Lesson Plans**

**Extension 3: Middle School: How Random is the iPod's Shuffle?**  
 Source: [www.amstat.org/education/stew](http://www.amstat.org/education/stew)  
 In this activity students will use data given to them to predict if an iPod Shuffle's random features is indeed random.

How useful was this resource?  
 Average Rating: 4.03

**Extension 4: High School: Using Dice to Introduce Sampling Distributions**  
 Source: [www.amstat.org/education/stew](http://www.amstat.org/education/stew)  
 In this activity students will explore the number of times die land on 6 when rolling a different amount of times.

How useful was this resource?  
 Average Rating: 3.88

**Extension 5: Science: Cricket Songs**  
 Source: [www.cpalms.org](http://www.cpalms.org)

FIGURE 18: DIFFERENTIATED CLASSROOM LESSON PLANS

It was evident from participant feedback that educators from all courses appreciated the “wealth of resources” available for different educational contexts. Specifically, educators noted that having a range of resources easily identifiable as appropriate to their context enabled them to “pick and choose the most applicable.” One participant noted:

---

I really enjoy having many resources to look at and use. I like how they range by grade/instructional level and that it is not mandatory to review them all. After all, we do not all work with the same levels of students.

---

Both the Fraction Foundations course and the Teaching Statistics course provided self-assessments to help participants gauge their knowledge and progress. For example, in Fraction Foundations, units included an embedded assessment asking participants to consider students’ responses to a fraction problem and identify which student(s) were correct based on their response. In addition, self-assessments provided solutions and feedback for incorrect responses (Figure 19, following page).

Participants in Teaching Statistics, as well as in Fraction Foundations, frequently described the embedded course self-assessments as “excellent,” “valuable,” or “amazingly helpful.” One participant noted:

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The self-appraisal activities helped me see what knowledge I have and where I need improvement.

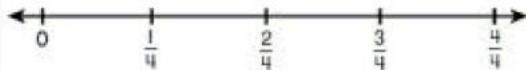
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In addition to using the embedded assessments to assess their own knowledge, as illustrated in the quote below, participants also indicated using them with their students.

I like doing the self-assessments to make sure I am reasoning out the answers before I present them. I also liked doing the three [self-assessment] problems with my students.

**Item 3**

Ms. Anita asked her students to locate the approximate position of the fraction  $\frac{5}{6}$  on a number line shown below:



Her students came up with different answers. Which of the following students' responses should she accept as correct?

- A. Audrey: It should be after  $4/4$  because 5 is greater than 4 and 6 is greater than 4.
- B. Binsar: It is between  $2/4$  and  $3/4$  because it is more than half.
- C. Celia: You cannot find it in this number line because there are only fourths and the fraction is in sixths
- D. Diego: It is between  $3/4$  and  $4/4$  because  $5/6$  is almost a whole and closer to a whole than  $3/4$  is.

**Hide Solution**

The correct option is D. Diego may know that  $5/6$  is only  $1/6$  away from a whole while  $3/4$  is  $1/4$  from a whole. Since  $1/4$  is a bigger piece than  $1/6$  (think of sharing a candy bar with more 6 people will result in each person getting a smaller piece than when it is shared with 4 people), Diego was right that  $5/6$  is closer to 1 (or  $4/4$ ) than  $3/4$  is to 1.

Options A, B, and C are incorrect. In option A, Audrey compared the numerators and the denominators separately, thinking of a fraction as consisting of two numbers rather than one number. In option B, Binsar understood that  $5/6$  is more than half but then could not determine that it is more than  $3/4$  as well. In option C, Celia could not use the number line showing only fourths to determine the relative position of  $5/6$  with the fourths.

This task addresses both equivalence and comparison of fractions in a measurement context. It also presents an opportunity for estimation, as is seen in Diego's response.

View Full Assessment and Solutions: [\[PDF\]](#) [\[DOCX\]](#)

FIGURE 19: FRACTION FOUNDATIONS SELF-ASSESSMENT UNIT ACTIVITY

### PRINCIPLE 3: PEER-SUPPORTED LEARNING

The Friday Institute designs MOOC-Eds to create an engaged community of educators. Participants are encouraged to share ideas, ask questions, rate resources, suggest additional resources, provide peer feedback, and work collaboratively towards shared goals with peers and facilitators. Activities provide time for, and encourage a culture of, reflection, exploration, and experimentation.

*Design Effectiveness.* When asked the extent to which they agreed that each unit promoted constructive peer interaction, 86% of participants agreed. When responses were disaggregated by course, results ranged from 80% for Teaching Statistics to 89% for Fraction Foundations (Figure 20, following page). Though slightly less positive than results for other design indicators, these results suggest units were still largely effective in promoting constructive peer interaction.

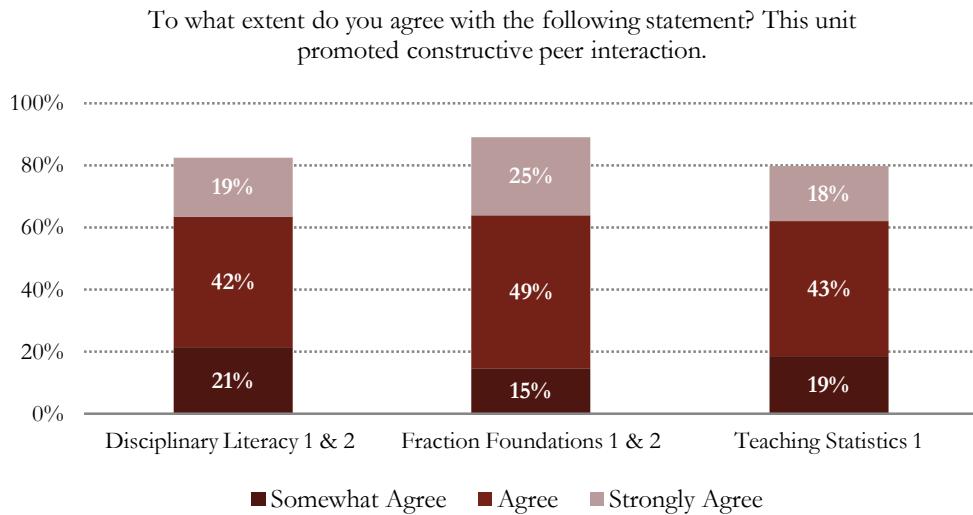


FIGURE 20: PARTICIPANTS’ PERCEPTIONS OF PEER INTERACTION, BY COURSE

When results for this item were disaggregated by unit, they illustrated the same general trend noted earlier, with the exception of Teaching Statistics. In that course, after a substantial increase from Unit 1 (78%) to Unit 2 (86%), the percent of participants who agreed the course promoted constructive peer interaction declined to 73% by Unit 5 (Figure 21). As will be discussed in more detail in the Areas for Improvement section below, this decline may be in response to the number of postings that received little or no responses from peers.

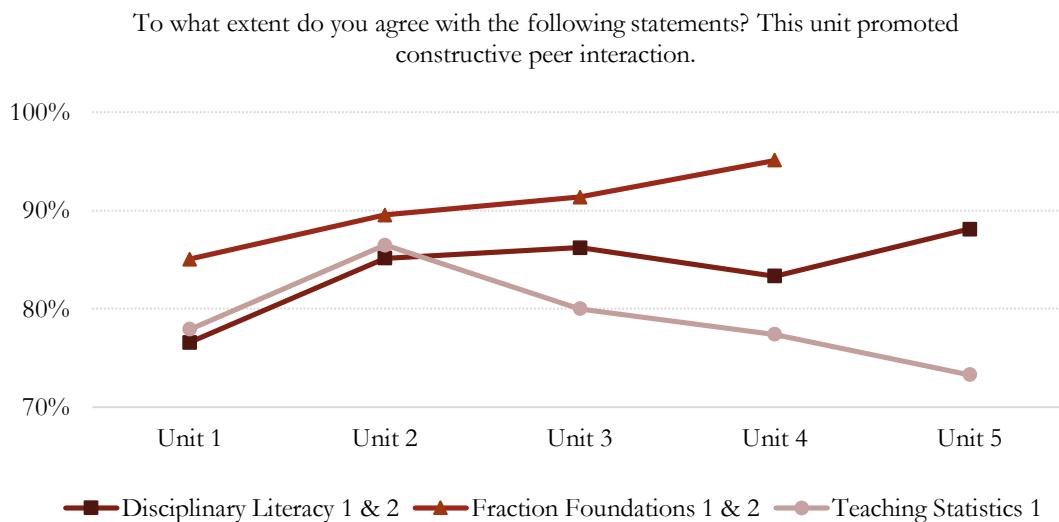


FIGURE 21: PARTICIPANTS’ PERCEPTIONS OF PEER INTERACTIONS ACROSS UNITS

On End-of-Course surveys, participants were also asked to provide feedback on the extent to which the course aligned with additional aspects of peer-supported learning. The vast majority of respondents (94%) agreed the MOOC-Ed they participated in promoted critical thinking and problem solving through discussion and activities, and 83% of respondents felt the MOOC-Eds provided supports for small-group work or collaboration around shared goals (Figure 22).

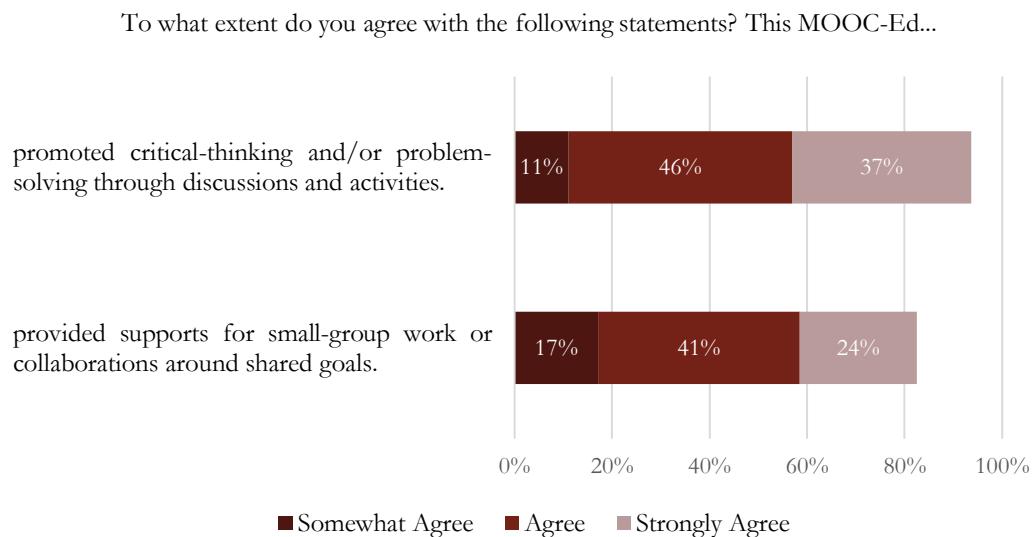


FIGURE 22: PERCENT OF POSITIVE AGREEMENT ON END-OF-COURSE SURVEYS

*Design Highlights.* Asynchronous discussion forums, opportunities for collaboration, and blended learning supports for integrating MOOC-Ed content and activities with local face-to-face PD emerged as the design elements that best instantiated the design principle of peer-supported learning. In open-ended survey items and interviews, participants from across courses frequently reflected on the ways and the extent to which the online discussion forums provided a valuable form of peer-supported learning. The discussions enabled participants to network with and learn from educators around the world, decreasing the sense of isolation that educators often experience. When asked to describe the most valuable aspects of the course, across the three MOOC-Eds, Fraction Foundations participants most often commented on the value of the discussion forums. The following two quotes illustrate the ways in which participants found value through engagement with their peers.

---

Reading classmates' posts. I learned a lot of new things that I can use in my classroom and share with my colleagues. Reading other teachers' responses about frustrations, wins and losses with their own classes. That we are all on the same playing field, swinging for the fence, even if we feel like we are still in the dug out.

---

---

I appreciated reading the postings of other educators; I hadn't thought about using the number lines to show fractions in numbers. As a Resource teacher I also found myself asking the other educators how they were addressing the needs of their ELL and Resource students; I learned I wasn't the only Resource teacher searching for a way to make the concepts of comparing fractions easier for the Resource and ELL students to understand. It was most helpful reading how other educators were addressing this issue.

---

While some participants confessed to reading posts more frequently than posting in the discussion forums, they indicated that this form of participation was still valuable.

---

I enjoyed the discussions and I probably read more than I participated – so I think that was still a valuable part. As I observed the exchange that was going on, I could see that teachers were truly learning from each other.

---

Learning activities across MOOC-Eds provided opportunities for small-group work and/or collaboration on shared outcomes and goals. As illustrated in the following quotes, participants valued the opportunities for collaboration.

---

For our project, another participant and I collaborated to create three lessons for our class. She teaches pre-service high school teachers and I teach high school kids.... The last two summers we have worked together in other online classes and kind of clicked. So I signed up for this MOOC and she signed up for it too, then we said, "Hey, let's do our projects together." We've collaborated on some other stuff, so we're pretty good at emailing, calling, texting.

The most valuable part was the online collaboration happening with teachers around the world. I know a lot of teachers don't have time to collaborate anymore, and especially with statistics since very few math teachers ever teach statistics. It was nice to be able to communicate about statistics in a safe forum.

---

Supports were also provided to facilitate the integration of MOOC-Eds within local PD initiatives that provide face-to-face and hands-on activities, coaching, PLCs, or other professional learning experiences. One participant noted the ways in which the supports were leveraged by her PLC:

The research articles have been very supportive during the PLCs with other teachers. The PLC questions for discussion were great too - they really sparked some nice discussion within my cohort.

#### PRINCIPLE 4: MULTIPLE VOICES

The Friday Institute MOOC-Eds allow participants to learn about the perspectives of other teachers and administrators and those of students, researchers, and experts in the field. MOOC-Eds are purposefully *not* designed around one or two experts who present online lectures; instead, they are about a rich set of perspectives presented within the context of activities and exchanges that reflect specific design principles. Specifically, MOOC-Eds provide professional learning spaces where course content is enhanced by the expertise of practitioners and leaders in the field (e.g., expert panels, case-studies, guest Q&A, etc.). Additionally, educators are provided varied and ongoing opportunities to exchange opinions, experience, and information (e.g., discussions, Twitter chats, polls, etc.).

On End-of-Course surveys, the majority of respondents (93%) agreed the MOOC-Ed they participated in provided meaningful opportunities to share ideas, resources, and experiences; additionally, 93% of respondents' experiences were enhanced by the expertise of practitioners (Figure 23, following page).

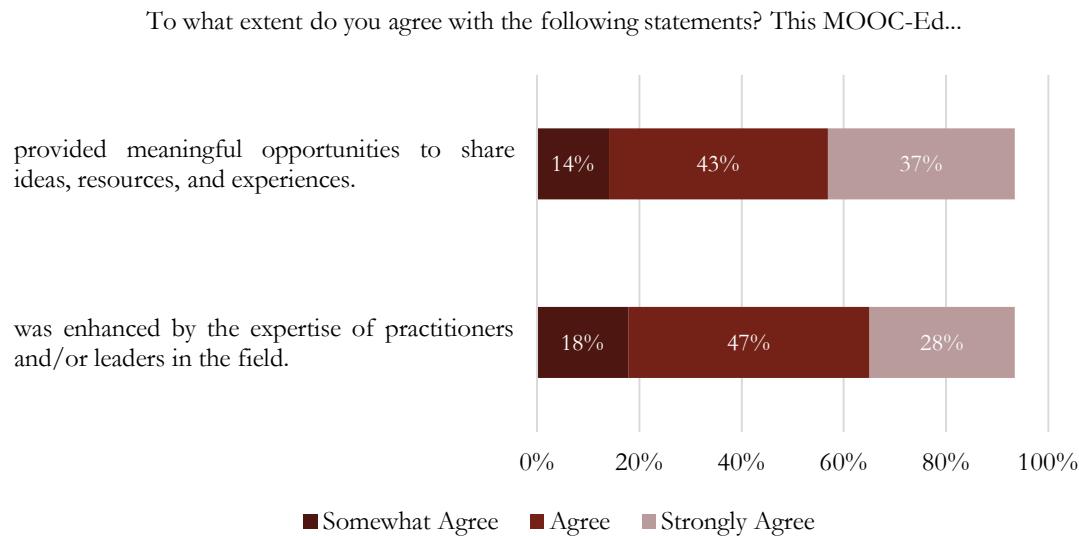


FIGURE 23: PERCENT OF POSITIVE AGREEMENT ON END-OF-COURSE SURVEYS

*Design Highlights.* While many of the aforementioned design elements are used as vehicles for translating the design principle of “multiple voices” into MOOC-Ed materials and activities, the expert panel videos provide an exemplary instantiation of the principle. In general, the videos were the most popular course component across all MOOC-Eds. For busy educators, the videos were easily “digestible” and provided a welcome relief from reading – a task they frequently engage in throughout the day. One Disciplinary Literacy participant explained how the use of a medium other than print was a welcome relief:

---

I have to say, as much as I appreciate the documents – the PDF documents in the core resources – they’re helpful, but I think the videos are probably the best because they reinforce what was presented in the PDF file in a condensed and compact way, and that visual medium is really good for me to reinforce the concept. Sometimes, I’ll be reading that at the end of the day, I’m kind of tired and it’s all I can do to get as much reading done as possible, so the videos are really helpful for reinforcing what I’ve read or seen.

---

Expert panel videos were highly effective in enabling participants to learn about the perspectives of others in the field. This design element brings the voices of experts – researchers, school and district leaders, teachers, policymakers, and other national leaders – to the MOOC-Ed participants through an informal interview conducted and recorded via Google Hangouts. As illustrated in the following quotes, participants, particularly from more remote geographic regions, noted the value they found in hearing and learning from the multiple perspectives of experts in the field.

---

The most valuable aspect of the course for me were the expert panels videos. Because of where we are in Montana, we just don’t hear people – leading, cutting edge people, or leaders in mathematics education – up here really ever, so to be able to hear the expert panel was really good.

---

As a math teacher, I had trouble imagining what exactly disciplinary literacy meant to my topic. The introduction by Dr. Erin Krupa and her comments in the “Listen to the Experts” section made the ideas more relevant to me. I understand better what disciplinary literacy means in mathematics.

---

## AREAS FOR IMPROVEMENT

As part of the formative evaluation process, the evaluation team, with feedback from course developers and staff, developed an online MOOC-Ed Course Review Tool to help determine the extent to which the courses aligned with MOOC-Ed design principles. The tool consists of a set of design indicators (see Appendix A) for all principles that were informed by reviews of the relevant literature, existing standards for online/professional learning, and desired outcomes of the initiative. Course developers and members of the evaluation team reviewed each course and assigned one of the following ratings to each indicator:

- (0) Missing = Course does not address this indicator.
- (1) Emerging = Course addresses this indicator, but in a superficial or very limited way.
- (2) Developing = Course addresses this indicator, but is lacking in some aspects.
- (3) Accomplished = Course addresses this indicator well.
- (4) Exemplary = Course serves as a model for MOOC-Eds on this indicator.

The ratings for each indicator were combined across courses and their averages are presented in Figure 24 (following page). As illustrated in Figure 24, the average ratings of course developers and external reviewers often fell at or near three, or “Accomplished,” with some exceptions. Overall, results suggest that MOOC-Eds were generally well-aligned with the design principles guiding their development and suggest a few areas where they could better align, such as better supports for integration into local professional development initiatives. These areas – by reviewers, as well instructional course elements identified by participants for improvement – are discussed in detail below.

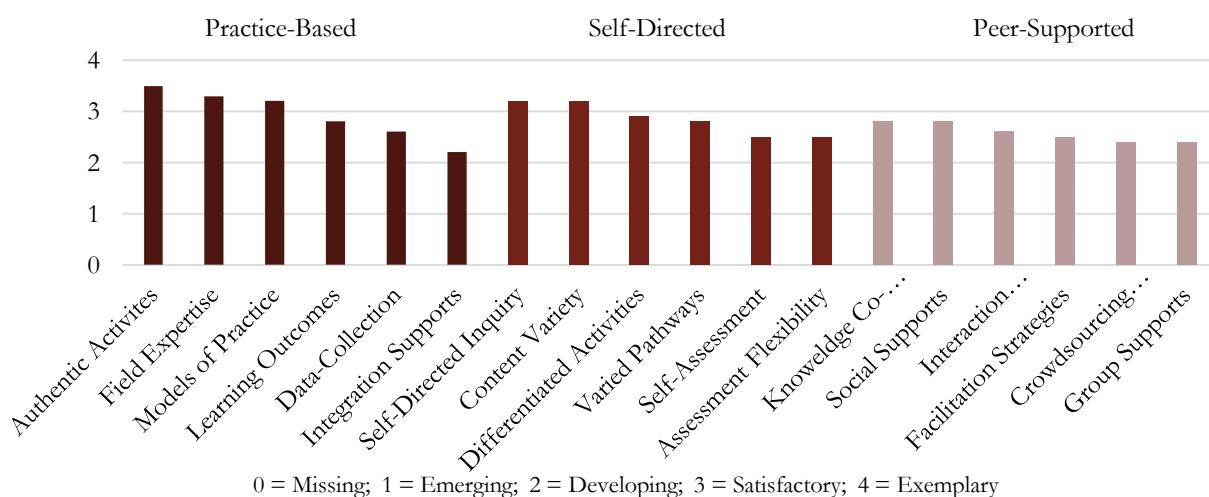


FIGURE 24: AVERAGE COURSE REVIEW RATING BY DESIGN INDICATOR

Beyond numerical ratings for design indicators, developers were also asked to provide a rationale for their selection on the review form. The evaluation team also followed up with developers to discuss their responses in greater detail. Qualitative findings from course reviews combined with participant feedback revealed several specific areas where MOOC-Eds could better address the design principles and improve the learner experience. The following subsections highlight specific course elements for each design principle.

## PRACTICE-BASED LEARNING

*More Models and Concrete Examples.* Participants frequently requested more examples of how principles or concepts presented in MOOC-Eds might be applied in classrooms or educational settings. For example, participants in Fraction Foundations desired more “practical tips,” lessons, or strategies for addressing student misconceptions introduced in the course. In Disciplinary Literacy, participants also called for more examples of “compelling questions,” student assessment items, and completed course projects. Finally, participants suggested even more videos of current classroom teachers demonstrating the strategies or concepts introduced.

---

It would have been nice to see more examples of how to set things up in the classroom. I understand that it is difficult with so many disciplines, but a few examples would help you mold it to your needs.

---

One participant noted that the Inquiry-Based Disciplinary Literacy (IDL) project examples felt “overdone” in terms of technology integration and “did not represent the teaching context of most public school educators.”

---

When looking at the examples of IDL projects shared for my discipline, I felt as if they were “overdone.” In other words, they were developed in ideal circumstances (lots of technology tools) and probably did not represent the teaching context of most public school educators. I wanted to see one that was more realistic. In other words, show me an example that uses minimal technology to make it happen. I also wished that more of the videos were from teachers that were in the day-to-day classroom (not university professors).

---

Part of this request stemmed from a desire for resources that were specific to teachers’ grade levels and subject areas, or more geared towards their professional roles. The following quote from Disciplinary Literacy, which addresses a range of grade levels and content areas, illustrates the challenge of meeting the needs of a wide range of educators that MOOC-Eds attract:

---

I would like some divisional/grade level suggestions or progressions examples and guidance. For instance, a compelling question for grade 5 students is very different than grade 10 students, yet the topic may be very similar (Chemistry).

---

### SELF-DIRECTED LEARNING

*Content Management.* As previously noted, differentiated resources were a key design element supporting self-directed learning. However, while the differentiated resources helped participants successfully tailor the course to their unique context and individual learning goals, in some cases, participants indicated being overwhelmed by the quantity of resources. When asked to provide recommendations for improving the MOOC-Ed, there was a constant tension between “too much” and “not enough.” One participant noted:

---

It feels like there are too many resources. I get lost and overwhelmed in the video links so I feel I am not getting the most out of the content.

---

Others reported being overwhelmed by the “number and length of the readings,” with one participant lamenting, “too many materials, too little time.” Participants frequently recommended culling the existing resources and discussions, or finding better ways to filter and navigate them, as they felt some overlapped or duplicated one another, or were simply not relevant to their context. Neatly summarizing this issue, one participant asked, “Is there any way to make it more manageable?”

*Feedback & Assessment.* Findings from course reviews and educators suggest a need to better provide participants with scalable approaches to gauge their learning progress, both in terms of informal feedback and more formal assessment approaches. A common issue noted by developers and an occasional complaint among participants was the quantity, quality, and timeliness of feedback. Developers expressed concerns that many forum posts went without responses, and educators often noted that feedback from peers was “lacking” or “superficial” and they desired more feedback from the instructors and “experts in the field.”

---

Many discussions have no responses despite several viewings and that is not helpful to the person who authored the discussion... most of the feedback on projects was very superficial.

---

To address these issues, in the second iteration of the Disciplinary Literacy course, developers recruited subject-specific discussion facilitators. These facilitators were able to more actively provide feedback in the forums and on course projects. End-of-Course survey results from the second

iteration of the Disciplinary Literacy course suggest that additional facilitators, and subject-specific facilitators in particular, improved the user experience.

Developers in both Fraction Foundations and Teaching Statistics also reported limitations of the pre- and post-assessments selected to help participants identify areas for improvement and assess their growth. In Teaching Statistics, developers noted that assessments, while of high quality, were not directly aligned with the goals and objectives of the course. This limited their utility as an evaluation measure and as a tool for participants to assess their progress. For example, while Teaching Statistics focused primarily on instructional strategies and statistics pedagogy, the assessment was focused on statistics content. Although developers hoped they might see an indirect improvement of statistics content knowledge as a result of participating in the course, the main rationale for providing educators with the assessment was to familiarize them with the types of problems their students would likely see on an assessment.

In both mathematics courses, participants also noted limited access to their assessments results, which hindered their utility as an instructional tool. Unlike the feedback provided on self-assessment problems embedded in the Fraction Foundations course, participants did not have access to their pre- and post-assessments for the course due to constraints in their intended use for a dissertation research study. For example, one participant noted how access would have better enabled them to know what they needed to focus on during the course:

---

[It] would have helped me to be able to see results from the pre-assessment. Had I viewed results, I would have known more about what to focus on...I may not know what I don't know...and I may not remember when I see it in the context of the units.

---

## PEER-SUPPORTED LEARNING

*Participant Engagement.* Participants noted the need for additional supports to facilitate peer interaction and engagement. Specifically, participants recommended that consideration be given to grouping people in different ways and finding approaches to increase interaction within groups. In discussing how to make the discussions and groups more interactive, participants suggested alternate grouping methods such as groups based on educational roles or forming smaller “work teams” for those interested and committed to fully participating. Additionally, participants indicated that it would be helpful if expectations for engagement in the discussion forums were made more explicit and additional guidelines and/or encouragement for engagement in the forums were provided. For example, one participant suggested emphasizing the importance of engaging in the discussions in a timely manner so as not to delay or disrupt the momentum of the conversations. Another suggested that participants might need more encouragement for commenting on posts rather than simply

viewing them, as many posts in the forums had a high number of views, but no comments in response to their post.

*Local Integration and Group Supports.* Finally, findings from course reviews and developer interviews indicated that greater attention could be paid to embedding opportunities for small group supports, including blended approaches for integrating MOOC-Eds into local professional development initiatives. One developer noted that while supports for integrating MOOC-Eds into local PD initiatives were limited in her course, she had worked with several teacher education faculty after the course to assist them in using the course resources in a local training they were conducting for teachers during the summer.

To illustrate the potential impact of blending MOOC-Eds with local initiatives, consider the following responses from three educators in Disciplinary Literacy; the first is from a participant who states that they find online learning environments challenging and clearly had difficulty connecting with other educators:

---

I find online courses can be challenging because you are working alone and are not gaining the level of learning one attains from social interaction and discussion.

---

The second quote, from an educator who participated in the MOOC-Ed with other teachers from her school, provides a stark contrast:

---

Some of the articles I read had great ideas in them, but the most valuable aspect of this unit – that I was not expecting – was the reading of and then the discussion of the reading approach for the ACT passage. Thirteen 9th and 10th grade English teachers at the school where I teach participated during our most recent PLC meeting. Thought processes were revealed and process of elimination strategies were revealed. The teachers who are advocates of skimming a passage to “find” answers did not do so well when answering specific questions about the text. This was a big time eye-opener, I think.

---

When asked what they found to be the most valuable aspect of the MOOC-Ed, another educator pointed out the value of not only enhancing their local PLC, but also connecting with other educators around the world:

---

The most valuable aspect of this MOOC-Ed was learning about the value of online courses and how effective they are to our professional learning communities as well as being able to make authentic connections with educators from around the world.

---

The above areas for improvement illustrate the challenges that even well-designed MOOC-Eds face in scaling effective online professional development. The section that follows presents findings on the impact of MOOC-Eds on deepening educators' knowledge and skills, and promoting changes in their professional practice.

### SECTION III: EDUCATOR IMPACT

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Evaluation Question 3: *In what ways, and to what extent, has participation in MOOC-Eds deepened educators' knowledge and skills and impacted their professional practice?*

The MOOC-Ed Theory of Action states that online professional development courses designed around educators' professional practice with supports for self-directed learning and peer-interaction will strengthen their knowledge and application of relevant conceptual frameworks, content, pedagogy, and technologies. The purpose of Section II was to determine the extent to which MOOC-Eds aligned to these principles guiding their design. Overall, findings from course reviews and participant feedback indicated that MOOC-Eds were largely successful at providing professional learning experiences described in the Theory of Action. The intent of Section III is to gauge the extent to which participation in these courses helped to strengthen participant knowledge and application of the course content. This section begins by presenting findings from an analysis of the discussions forums – a core component designed to facilitate knowledge sharing and application – and then examines the extent to which participation results in participant learning and application to practice.

*Knowledge Sharing and Creation.* MOOC-Eds made extensive use of discussion forums for encouraging participants to reflect on course videos and readings, to share their knowledge and experience, and to engage in dialogue and debate to further extend their understanding. Ultimately, these activities were intended to help facilitate deeper learning and application to practice. The discussion forums are also a primary means for participants to demonstrate their comprehension of unit concepts, and for course designers and facilitators to gauge participant understanding.

To help determine the extent to which forum participation resulted in these outcomes, the evaluation team examined a random sample (approximately 30%) of discussion threads in each course. The team used the Productive Online Discussion Model (Gao, Zhang, & Franklin, 2013) as a framework for the analysis. This framework highlights four learner dispositions that encompass a variety of cognitive and social activities: comprehension, critique, knowledge construction, and community. For example, *Disposition 1: Discussion to Comprehend* states that learners actively engage in cognitive processes such as interpretation, elaboration, and making connections to prior knowledge as demonstrated by the following learner actions:

- a) Interpreting or elaborating on ideas by making connection to the learning materials
- b) Interpreting or elaborating on ideas by making connection to personal experience
- c) Interpreting or elaborating on ideas by making connection to other sources or references

Two evaluation team members – following analysis guidelines proposed by Lombard, Snyder-Duch, and Bracken (2002) to help ensure accuracy and consistency – reviewed and coded each posting in the sampled discussions. Instances of learner actions described in the framework were coded with a

“1” if present and a “0” if absent and then postings assigned to each learner action and dimension were reviewed to look for common themes. The total instances for each learner action are presented in Figure 25 below and illustrate the range of cognitive and social activities encompassed by the discussions. A complete description of learner actions and dispositions, as well as examples of participant postings assigned to each, can be found in Appendix E.

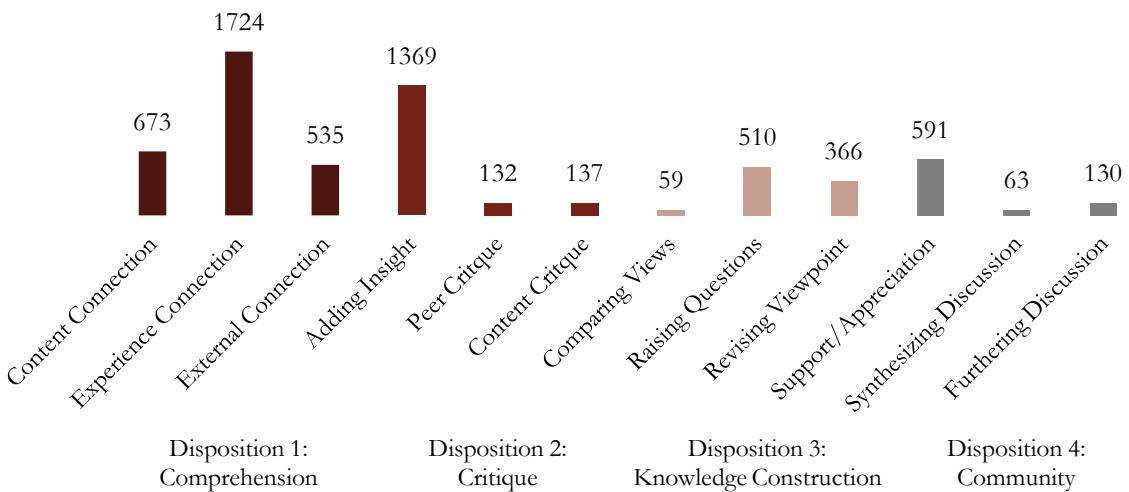


FIGURE 25: TOTAL FORUM POSTINGS PER LEARNER ACTION

The following discussion thread demonstrates a typical exchange between educators in the MOOC-Eds and illustrates a progression of learner actions across the four dispositions. In Unit 1 of Fraction Foundations, participants were asked to reflect on student misconceptions about fractions they've experienced in light of the assigned readings. Participant 1 initiates a new thread by interpreting the misconceptions introduced in the readings through her own experience with students, and further elaborates by proposing a potential explanation for this misconception and solution for addressing this issue:

---

Participant 1: What a great article! I agree that our students lack competence in dealing with fractions and I also agree that we as teachers struggle with fractions too! One of the misconceptions in the article I am currently seeing in my class is looking at the fraction as two separate numbers (numerator and denominator) when comparing fractions. In my opinion, the author's first recommendation is so important in fractions instruction. Students already come to us knowing sharing and proportionality. They know when someone gets a bigger piece of cake or when their neighbor gets more stickers than they did. We have to build upon this innate knowledge before adding numbers

and symbols to what they are doing. We are too quick to show the symbol for one-half and teach the fraction. We as teachers need to slow down! Students that can show fractions through pictures can just as easily order them on a line from least to greatest without having a number associated with their representation. Then they may be more apt to use their own representations to solve more complex fraction problems (multiplying fractions) with these representations that make sense to them rather than the invert and multiply procedure. Just my thoughts!

---

In response to this post, Participant 2 shows her support and appreciation by agreeing with Participant 1 and addressing her by name. She then builds upon this by sharing her own experience and misconceptions and then invites further discussion with an indirect question at the end of her post:

---

Participant 2: I agree with you [Participant 1]. I too think we are too quick to teach fractions with symbols and numbers. We are using a program in my school called “STMath” to help students with math. I too see students thinking that the numerator and denominator are whole numbers. This misconception is more evident when they have to show fractions on a number line. Loved reading all the articles. I was wondering if we rush to the symbolic representation sometimes due to our own insecurities with this topic!

---

Next, Participant 3 adds additional insight by sharing an approach for addressing this problem discussed at a staff development conference she attended, while also suggesting that an additional component is needed to address this problem is teacher training:

---

Participant 3: I have been to really good SDE conferences that discussed the importance of teaching students in order. Start with a hands-on manipulative once they master that then move on to a pictorial representation and only after mastering pictorial are they ready to move to abstract symbols. I find that a lot of the elementary teachers who are responsible for teaching these core concepts haven’t had the appropriate training to be effective. Common Core is much more demanding and if it is to be implemented properly our teachers need real staff development!

---

Finally, Participant 4 chimes in with further support and appreciation, while also restating and rephrasing solutions raised in this short thread:

---

Participant 4: I agree with this [Participant 3]! It is extremely beneficial to take a CRA (Concrete Representational/Pictorial Abstract) approach when teaching ALL math concepts. We have to start where they are and lead them to where we want them to be.

---

As a result of exchanges like these – as well as their engagement with the learning materials and resources provided throughout the course – it was anticipated that participants would strengthen their understanding of the core concepts and skills addressed in each unit, and be better prepared to make changes in their instructional practice. The remainder of this section addresses the extent to which these outcomes were accomplished.

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## KNOWLEDGE & SKILLS

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*Reported Improvements in Knowledge and Skills.* Participants were asked at the end of each unit the extent to which they agreed with the following statement, “This unit deepened my understanding of the topic(s) addressed.” Across the five MOOC-Eds offered, between 84% (Teaching Statistics 1) and 93% (Fraction Foundations 1) of educators responded positively, while 5% to 13% felt “neutral” and less than 4% disagreed with this statement across all MOOC-Eds (Figure 26, following page). Educators were also asked in more specific items at the end of each course about the extent to which they agreed that participation strengthened their knowledge and skills. Educator perceptions on these course-specific items mirrored the positive responses on the unit feedback item. In Fraction Foundations 1 and 2, for example, 98% of respondents agreed that their participation deepened their understanding of common student difficulties and misconceptions about fractions. In terms of improved skills, 96% of survey respondents in Teaching Statistics 1 agreed they have improved their ability to use rich data sources to support investigations. In Disciplinary Literacy 1 and 2, 90% and 96% of respondents respectively agreed that as a result of their participation, they have improved their ability to design and evaluate Inquiry-Based Disciplinary Literacy lessons.

While End-of-Course survey results were likely to be skewed more towards positive responses – given that educators found it valuable enough to voluntarily participate over the six- to eight-week duration of the course – positive feedback on surveys from early in the course suggest that even those who may not have continued found the course useful for deepening their understanding of the topics addressed. More detailed results on unit feedback and End-of-Course survey items related to knowledge and skills can be found in Appendix C.

To what extent do you agree with the following statement? This unit deepened my understanding of the topic(s) addressed.

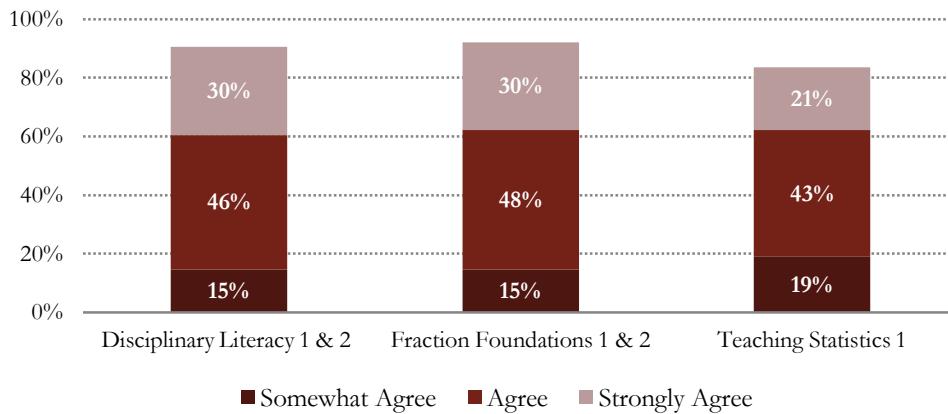


FIGURE 26: REPORTED IMPROVEMENTS IN PARTICIPANT UNDERSTANDING

Through surveys and individual interviews, participants described developing a deeper understanding of core concepts presented in the course and experiencing a “mind shift” related to those core concepts. Disciplinary Literacy participants, for example, frequently noted the ways in which disciplinary literacy differs from content literacy. Additionally, some participants indicated that the MOOC-Ed has led them to think differently about their teaching methods.

I had no idea at all what was meant by the term disciplinary literacy when I started this course. It began as a means to an end because I needed a literacy credit for certificate renewal. In the process I have learned so much that challenges me to be more aware of teaching my students to read and think like a mathematician – not just to learn a math procedure and be done! It has helped me grow in my drive to be a better teacher.

Fraction Foundations MOOC-Ed participants described deepening their own conceptual understanding of fractions and increasing their awareness of student misconceptions related to fractions. While some participants entered the MOOC-Ed knowing that they struggle with teaching fractions, others reported entering the MOOC-Ed confident in their ability to teach fractions only to experience a “rude awakening” that pushed them to rethink their approach to teaching fractions.

This unit pushed me to think deeper about the meaning behind multiplying and dividing fractions. I was challenged to sharpen my own conceptual understanding of real world problems. I learned more of

how to teach correctly incorporating models before quickly moving to the “steps” or just computational rules.

---

In reference to better understanding students’ misconceptions about fractions, another educator noted:

---

Before taking this course, I was unaware of students’ misconceptions regarding fractions. I did not understand how they saw fractions, but after taking this course I am more aware of their lack of understanding... It is interesting to see how much more clear fractions are for me too.

---

Teaching Statistics MOOC-Ed participants appreciated being introduced to a more structured, logical approach to teaching statistics. As a result of their engagement in the course, some participants described a shift in their overall approach to teaching statistics.

---

My whole frame of mind and approach to statistics is very different now. Rather than just having the kids ask pointless questions about favorite color or soda, I am encouraging them to ask meaningful questions and I’m trying to show them the importance and wide use of statistics in their daily life.

---

*Assessment Results.* Beyond self-report measures, participants in both Fraction Foundations and Teaching Statistics were administered a pre- and post-course assessment adapted from the Mathematical Knowledge for Teaching (MKT) and the Levels of Conceptual Understanding in Statistics (LOCUS) assessments, respectively. Despite the limitations of these assessments described in Section II, it was anticipated there might still be an indirect impact on educators’ knowledge and skills in areas measured by the MKT and LOCUS as a result of participation in the course. Figure 27 (following page) shows the mean percent of total items participants answered correctly on both the pre- and post-assessments. Results from a paired samples t-test demonstrate a small but significant improvement for participants in Fraction Foundations from pre-assessment ( $M = .616$ ,  $SD = .17$ ) to post-assessment ( $M = .656$ ,  $SD = .17$ ),  $t(165) = 5.012$ ,  $p < .001$ ,  $d = .38$ . On average, the number of correct responses across all items increased by four percentage points. Differences between pre- and post-assessment scores in Teaching Statistics were minimal (-0.2%); however, one explanation for the lack of difference in Teaching Statistics results may have been the purpose of the assessment. While the course focused primarily on instructional strategies and statistics pedagogy, the assessment was focused on statistics content.

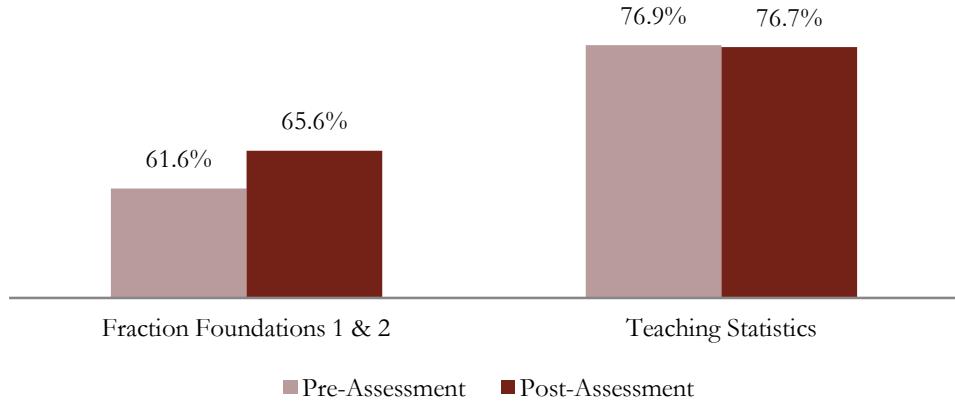


FIGURE 27: MEAN PERCENT CORRECT ON PRE- AND POST-COURSE ASSESSMENTS

As reported in Section I, participants were classified based on the similarities in their activity throughout the course and were grouped into one of three general categories: High Activity, Moderate Activity, and Declining Activity. In light of these different levels of participation, we further examined pre- and post-score assessments results. As shown in Figure 28 (below), participants belonging to the High Activity group showed, on average, slightly greater gains on the MKT post-assessment than Moderate Activity participants, while those whose activity declined over time had lower mean scores on the post-assessment than on the pre-assessment. In Teaching Statistics, all participants who participated in both the pre- and post-course assessments were identified as part of the High Activity group so comparisons between groups could not be made.

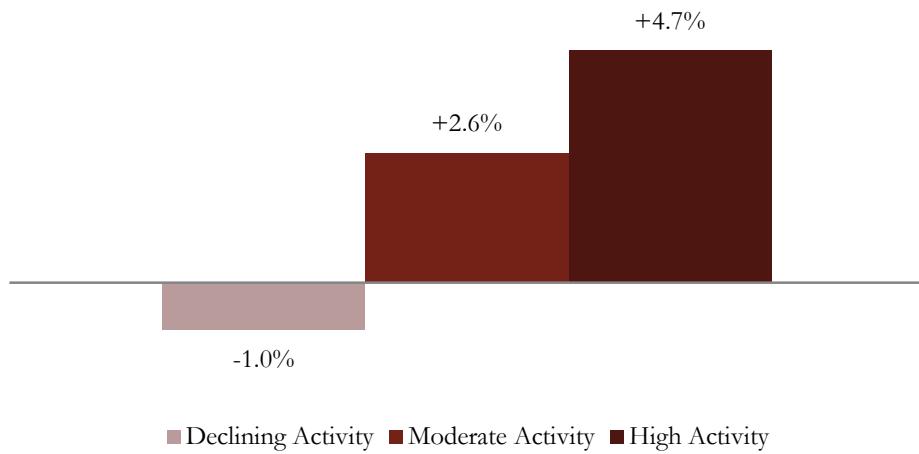


FIGURE 28: AVERAGE PERCENT DIFFERENCE ON PRE-POST ASSESSMENTS ACROSS FRACTION FOUNDATIONS PARTICIPANT CLUSTERS

## IMPACT ON PRACTICE

The knowledge and skills educators gain through their participation in MOOC-Eds create “knowledge capital.” Leveraging this knowledge capital requires adapting and applying it to different situations or in different contexts (Wenger, Trayner, & deLaat, 2011). Through survey questions and individual interviews, participants were asked to describe ways in which they adapted or applied knowledge they had gained through the course in their practice and, if possible, describe the impact of application on their practice.

*Reported Impact on Practice.* On End-of-Course surveys, participants were asked how effective they felt the MOOC-Ed was in preparing them to make positive changes in their practice. Across the three MOOC-Eds, between 96% (Fraction Foundations) and 98% (Disciplinary Literacy and Teaching Statistics) of participants responded positively (Figure 29). As a follow-up to this question, educators were then explicitly asked if they had made changes in their practice as a result of participation, to which 96% indicated “Yes.”

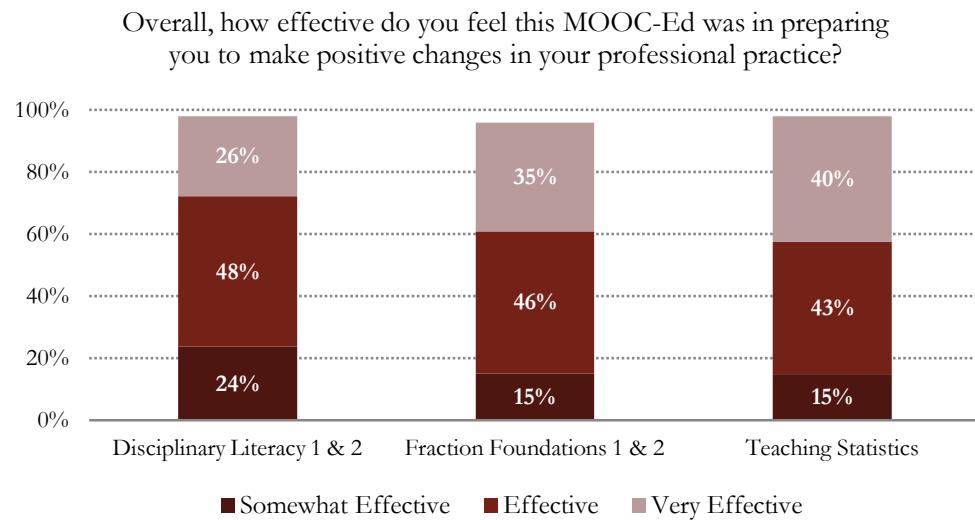


FIGURE 29: STUDENTS REPORTED IMPROVEMENTS IN BLENDED LEARNING SKILLS

To better understand the ways in which they were applying their learning in classroom and schools, participants were asked on open-ended survey items and during follow-up interviews to describe how they were applying what they learned in the MOOC-Eds to their professional practice. Participants typically responded by citing one of the following applications: 1) integrating new tools and strategies, 2) implementing course projects, and 3) using course content for instructional coaching or PD.

Integrating new tools and strategies. As a result of their participation in the Disciplinary Literacy MOOC-Ed, participants reported developing a deeper understanding of disciplinary literacy practices and applying those practices in their lessons. In describing their use of disciplinary literacy practices, for example, teachers most often cited their application of close reading strategies with students, in addition to increased use of digital technologies to support inquiry.

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Although I always modeled a type of close reading for my students, I now use it more and have my students practice it, now that I know there is research to back this tool.

I have changed the way I read a text and the approach I use to read a text with the students. Also, the questions I ask to stir their thinking are different.

I have become much more mindful of what internet resources I use with the students with a view to increasing close reading practices and I have implemented a close read with each lesson in my statistics class.

---

A common application of knowledge to practice for Fraction Foundations MOOC-Ed participants was teachers' use of activities from the course with their students. Many participants indicated that they are now using fair sharing activities and number line activities from the course with their students. Additionally, participants noted using more manipulatives and multiple representations for fractions introduced through the course. Fraction Foundations participants frequently reported that deepening their understanding of common misconceptions about fractions and learning new strategies for teaching fractions has enabled them to become more effective teachers. Participants indicated that they are now allowing students more time to explore problems without rushing to the algorithm and taking time to explain the "why" behind algorithms. Additionally, participants reported increasing their use of interviews to better understand student thinking and adjust instruction.

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I have begun to facilitate learning of fractions versus teaching the students about fractions. I am now having students take their time and explore concepts in different ways rather than rushing through and trying to teach an algorithm.

I now interview my students to see how they think through the problem before actual instruction begins. I have learned to better listen to how students think about fraction problems, and I am more confident in being able to help students to understand fractions.

---

Finally, Teaching Statistics MOOC-Ed participants reported an “overhaul” in their approach to planning for and teaching statistics. In particular, participants frequently noted their willingness to use “richer and messier data.”

---

I used to worry about giving students data that was messy and realistic. Now, I look forward to these opportunities because they prompt interesting conversations and engage my students.

Since starting the class, I have had my students use richer and messier data in their investigations and I have also put more of an emphasis on understanding the results and being able to analyze findings.

---

Implementation of course project. During the course of the Disciplinary Literacy MOOC-Ed, participants engaged in the design, development, and evaluation of Inquiry-Based Disciplinary Literacy lessons for their particular content areas. As reported in Section II, the evaluation team also followed up with Fraction Foundations and Disciplinary Literacy participants who completed the course projects to help gauge the extent to which they applied them in their practice. Among those surveyed, 31% indicated that they had already implemented their project, while 54% indicated they planned to implement their project in the following school year.

On open-ended survey items and during interviews, participants further described how they used their projects. One Fraction Foundations participant, for example, described how she was adapting the instructional tasks she developed during the course for remediation with her special education students.

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More for my personal goal of teaching fractions the very best way I possibly can than a request from my principal, I participated in this class. The result is that I feel really strong in this area, and I think our series of problems will be an asset for our special education department and for remediation. I just got a student that I am going teach with our project plans! She got a poor score on her fractions test, and I intend for her to rock by SOL [Standards of Learning Test] time.

---

It was also clear from our findings that projects proved useful even for educators who did not directly participate in the MOOC-Ed. In describing the school-wide impact of the project they developed during the course, another educator noted:

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I implemented the project with my teaching team. After discussing the results of the project with the building principal, we decided to

continue the project school-wide. We will have in-service training this summer to help implement it. I would have liked to have had this training and began the project at the start of the school year and not have waited until close to the end. I think results from data might have been better.

---

Use of course content for instructional coaching or PD. Instructional coaches and professional development providers who enrolled in the MOOC-Eds reported applying content from the course to support teachers in the use of resources and skills from the courses. For example, in Disciplinary Literacy, participants reported helping teachers by building awareness of disciplinary literacy practices and supporting them in the use of those practices. Similarly, instructional coaches and professional development providers who enrolled in the Fraction Foundations course also reported applying content from the course in their professional practice. In particular, these participants noted that having a better understanding of students' common misunderstandings has enabled them to be a more effective resource for teachers.

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I lead secondary mathematics teachers and as our standards have called for a greater demand of teaching through application, I have used examples from the class such as the “what would you do next” scenarios with my team to guide their work as they coach teachers and in our professional development sessions. Moreover, using fraction models has been an area of opportunity and I have been able to support the teaching of this more effectively by sharing the work with models, the number line, and having teachers seek to truly understand the students’ thinking by creating multiple opportunities for students to make their thinking explicit.

---

*Classroom Observations.* In addition to participant self-reports, members of the evaluation team conducted classroom observations with a small group of teachers participating in the Fraction Foundations courses. Ten elementary participants were originally recruited from Fraction Foundations to participate in a small case study, but only four remained due to attrition. The remaining teachers were all veteran educators with 18 to 29 years of teaching experience, though they worked in demographically diverse elementary schools across North Carolina. Classroom observations and post-lesson interviews were conducted with these teachers both prior to and following participation in the MOOC-Ed. To help guide classroom observations, the evaluation team used the Classroom Observation of Early Mathematics—Environment and Teaching (COEMET) protocol.

Findings from classroom observations and post-lesson interviews revealed several common themes among participants in how they approached teaching fractions. The most prevalent change observed during observations and discussed in interviews was providing students with more time and “space” to think through and work at problems before intervening with support. Teachers noted that this helped students to develop their own ideas, formulate explanations, and develop their reasoning about solutions. As one teacher explained:

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[The MOOC-Ed] has helped me to close my mouth sometimes and just listen. I've always been one to jump in and you know, I want them to get it...and it's helped me realize, 'Okay, just stop, stop and let them talk more about what's going on.'

---

Related to this change, teachers also reported and were observed using more probing questions and eliciting and listening to students thinking as they worked through problems. In discussing the changes in her practice as a result of participation, another teacher noted:

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I hope it's starting to change how I'm questioning children as far as probing them, so that's really what I want to try to focus on is pulling some smaller groups of kids, and asking those kinds of questions because I think I probably lead them to the water more often than letting them search for it themselves.

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Finally, another common change reported by teachers and confirmed by observations was an increased emphasis on manipulatives and models to help students better conceptualize fractions. Specifically, participants reported incorporating more ways of representing fractions into their instruction and incorporating more and different types of manipulatives in classroom activities.

---

I think it made me realize that I could use the pattern blocks as manipulatives. I really hadn't thought of using the pattern blocks as much... especially when we were doing mixed numbers to improper fractions, and especially with this corrective reading group. I think it really helped a lot and hearing other people [in the MOOC-Ed] use the pattern blocks when they were working problems and talking about what they were doing in their class.

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## CONCLUSION AND RECOMMENDATIONS

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The purpose of the evaluation was threefold: 1) to understand the characteristics of the participating educators and how they engage with MOOC-Eds; 2) to provide formative feedback to inform the ongoing improvement of the design and implementation; and 3) to examine the impact of participation on educators' knowledge and professional practices for integrating deeper learning in their classrooms. The findings suggest that the MOOC-Ed developers have been largely successful in designing professionally relevant learning experiences that appealed to a wide range of educators. Participants engaged in MOOC-Eds to varying degrees, ranging from infrequent visits to intense and sustained activity. As a result of participation, educators have reported improvements in their knowledge and skills, as well as positive changes to their professional practice. Specifically, educators reported experiencing a "mind shift" in their thinking about core academic content, integrating new tools and strategies into their instruction, and better supporting critical thinking and problem-solving with their students. Findings from course assessments and classroom observations provided additional information to support these reports, and collectively the findings illustrate the potential of MOOC-Eds in supporting the professional learning needs of educators.

This report also illustrates that even well-designed MOOC-Eds face significant challenges in scaling learning that embodies the principles of effective professional development. One design tension that emerged was accommodating for the diverse contexts and needs of educators that MOOC-Eds attract, while preventing participants from feeling overwhelmed by the sheer quantity of content. An additional design challenge was developing scalable approaches to help participants gauge their learning progress, both in terms of informal feedback and more formal assessment activities. The following recommendations are provided to support future efforts in providing a scalable approach to professional development that helps educators better support their students in acquiring the abilities and dispositions of deeper learning:

- 1. Consider design changes for both presentation and management of course content and discussions.* One ongoing tension reported in the current and previous report was the perception that MOOC-Eds provided both "too much" and "not enough." Educators reported feeling both overwhelmed and confused by the extent of resources provided and yet, not unreasonably, wanted more resources (e.g., videos, lessons, tools) to support their application to practice and additional resources and feedback more specific to their educational context. To address this tension, it is recommended that developers continue to explore approaches to developing learner pathways through the MOOC-Eds that limit immediately visible content and discussions to those most likely to be relevant to educators' context.
- 2. Continue to explore additional approaches for scaling peer supports.* Another tension that emerged from the findings was the somewhat polarizing nature of the forums. Educators both highly praised the discussions that resulted, yet they were also one of the most common sources of complaint and consistently rated lower on surveys. As MOOC-Eds continue to expand, it will be critical to develop

approaches for scaling peer-support that is manageable for both participants and instructors. It is recommended that developers continue to explore changes to forum management, as well as approaches to peer assessment.

*3. Develop further supports for integrating MOOC-Eds with local professional development initiatives.* In addition to peer support, it will be critical to strengthen supports for embedding MOOC-Eds within local initiatives. Like other forms of online learning, MOOC-Eds are most effective when integrated with local opportunities for professional peer groups to discuss and apply the information and practices learned in the course. Local integration can also help address the issue of ready access to feedback from staff with knowledge and expertise of educators' local context. It is recommended that developers continue to develop out supports (e.g., local facilitation guides, modular units) to help schools, districts, and organizations more easily embed MOOC-Eds into their professional development and teacher preparation programs.

*4. Revise formative feedback and summative assessment approaches to more efficiently and effectively capture participant learning.* This report highlighted both successful approaches to help participants gauge their learning, as well as some of the limitations of current approaches. Quality feedback and assessments are not only critical to help participants in goal-setting and progress-monitoring, but as MOOC-Eds push forward with badging and microcredentialing, having efficient methods that more accurately capture participant learning will be critical. Course developers, in partnership with evaluators and researchers, should work on revising the current approaches to feedback and assessment that serves both learners and external stakeholders.

*5. Continue research and evaluation efforts, and establish a data pipeline for supporting these efforts.* Mentioned in this report were some of the limitations of this evaluation and areas where a better understanding of participant learning is needed. Related to the above recommendation, future evaluation and research efforts should rely less extensively on participant self-report and focus on more objectively determining the impact on teaching and learning, as well as the conditions that facilitate or impede these outcomes. To support these efforts, the Friday Institute should identify and/or develop new measures and establish a data pipeline to expedite the collection, analysis, and reporting of data, as well as the creation of data products (e.g., dashboards, web apps, recommendation engines) to support instructors and learners.

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## APPENDICES

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### APPENDIX A: MOOC-ED COURSE REVIEW PROTOCOL

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The evaluation team, with feedback from course developers and staff, developed an online MOOC-Ed Course Review Tool to help determine the extent to which the courses aligned with MOOC-Ed design principles. The tool consists of a set of design indicators for each principle that were informed by a review of the relevant literature, existing standards for online/professional learning, and desired outcomes of the initiative. Design indicators were organized into three categories: Practice-Based, Peer-Supported, and Self-Directed.

#### **MOOC-Ed Course Review Protocol Instrument**

##### Reviewer Information

Please specify the MOOC-Ed are you reviewing.

- Coaching Digital Learning | Cultivating a Culture of Change
- Digital Learning Transition
- Disciplinary Literacy for Deeper Learning 1
- Disciplinary Literacy for Deeper Learning 2
- Fraction Foundations 1
- Fraction Foundations 2
- Leadership in Blended Learning
- Learning Differences 1
- Learning Differences 2
- Statistics 1
- Statistics 2

What is your role on this MOOC-Ed?

- Development Team Member
- Evaluation Team Member
- External Review

## Review Key

Please use the following key to assess the extent to which each indicator is addressed by the MOOC-Ed under review:

- (0) Missing = Course does not address this indicator.
- (1) Emerging = Course addresses this indicator, but in a superficial or very limited way.
- (2) Developing = Course addresses this indicator, but is lacking in some aspects.
- (3) Accomplished = Course addresses this indicator well.
- (4) Exemplary = Course serves as a model for MOOC-Eds on this indicator.

## Practice-Based

	Extent Addressed					Rationale
	0	1	2	3	4	
Purpose, goals, and learning outcomes are clearly communicated, with support provided to help educators understand how they address educational standards or priorities in their local, regional, and/or national context.	<input type="radio"/>	Please briefly explain your selection.				
Models of effective practice (e.g. strategies, tools, processes, etc.) are frequently provided to support the application of new learning into educators' professional settings.	<input type="radio"/>					
Course content is enhanced by the expertise of practitioners and leaders in the field (e.g. expert panels, case-studies, guest Q&A, etc.).	<input type="radio"/>					
Authentic project-based activities result in a product or process directly connected to participants' professional practice.	<input type="radio"/>					
Data-informed activities enable participants to collect new data and/or use existing data to inform their work during and beyond the MOOC-Ed.	<input type="radio"/>					

Supports are provided to facilitate the integration of MOOC-Eds within local PD initiatives that provide face-to-face and hands-on activities, coaching, PLCs, or other professional learning experiences.	<input type="radio"/>				
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Peer-Supported

	Extent Addressed					Rationale:
	0	1	2	3	4	
Discussion/Reflection questions scaffold critical-thinking and group problem-solving.	<input type="radio"/>					
Crowdsourcing activities promote the sharing and curation of resources, tools, and effective practices.	<input type="radio"/>					
Strategies are used to facilitate constructive peer feedback and/or coaching at various levels of support (e.g. forum replies and ratings, project peer review).	<input type="radio"/>	Please provide a brief explanation for your selection.				
Educators are provided varied and ongoing opportunities to exchange opinions, experience, and information (e.g. discussions, twitter chats, polls, etc.).	<input type="radio"/>					
Learning activities provide opportunities for small-group work and/or collaboration on shared outcomes or goals.	<input type="radio"/>					
Social supports (e.g. netiquette guidelines, ice breakers, overall tone) cultivate a general sense of collegiality and trust among participants.	<input type="radio"/>					

Self-Directed

	Extent Addressed					Rationale:
	0	1	2	3	4	
Differentiated learning experiences are provided to address varied educator experience, role, competency and commitment.	<input type="radio"/>	Please provide a brief explanation for your selection.				
A wide range of tools, strategies, and/or resources are available to support application of content in a variety of educational contexts appropriate to the intended audience.	<input type="radio"/>					
Course clearly provides learners logical and varied pathways to help navigate the course based on their personal and professional learning goals.	<input type="radio"/>					
Educators are provided opportunities to investigate self-identified problems, areas of interest, or special topics related to their professional learning needs.	<input type="radio"/>					

Educators are provided flexibility in demonstrating new knowledge and skills with ongoing opportunities for feedback.	<input type="radio"/>					
Educators are provided a variety of self-assessment strategies and tools to help monitor progress towards course outcomes and personal goals.	<input type="radio"/>					

Course Review Tool Feedback What recommendations do you have for improving this tool?

TABLE A.1: COURSE RATINGS FOR PRACTICE-BASED LEARNING

Design Indicator	0	1	2	3	4	Mean (N=13)
<b>Authentic Activities.</b> Authentic project-based activities result in a product or process directly connected to participants' practice.	0%	0%	0%	54%	46%	3.5
<b>Field Expertise.</b> Course content is enhanced by the expertise of practitioners and leaders in the field.	0%	0%	8%	54%	39%	3.3
<b>Models of Practice.</b> Models of Effective practice are frequently provided to support the application of new learning into educators' professional settings.	0%	0%	8%	62%	31%	3.2
<b>Learning Outcomes.</b> Purpose, goals, and learning outcomes are clearly communicated, with support provided to help educators understand how they address educational standards or priorities in their professional context.	0%	0%	31%	62%	8%	2.8

<b>Data-Collection.</b> Data-informed activities enable participants to collect new and/or use existing data to inform their work during and beyond the MOOC-Ed.	0%	8%	39%	39%	15%	2.6
<b>Integration Supports.</b> Supports are provided to facilitate the integration of MOOC-Eds within local PD initiatives that provide F2F activities, coaching, PLCs, etc.	0%	23%	46%	23%	8%	2.2

Note: 0 = Missing; 1 = Emerging; 2 = Developing; 3 = Satisfactory; 4 = Exemplary

TABLE A.2: COURSE RATINGS FOR PRACTICE-BASED LEARNING

Design Indicator	0	1	2	3	4	Mean (N=13)
<b>Content Variety.</b> A wide range of tools, strategies, and/or resources are available to support application of content in a variety of educational contexts appropriate to their audience.	0%	0%	15%	46%	39%	3.2
<b>Self-Directed Inquiry.</b> Educators are provided opportunities to investigate self-identified problems, areas of interest, or special topics related to their professional learning needs.	0%	0%	23%	39%	39%	3.2
<b>Varied Pathways.</b> Course clearly provides learners logical and varied pathways to help navigate the course based on their personal and professional learning goals.	0%	0%	23%	62%	15%	2.9
<b>Differentiated Activities.</b> Differentiated learning experiences are provided to address varied educator experience, role, competency and commitment.	0%	0%	31%	54%	15%	2.8
<b>Self-Assessment.</b> Educators are provided a variety of self-assessment strategies and tools to help monitor progress towards course outcomes and personal goals.	0%	8%	46%	39%	8%	2.5
<b>Assessment Flexibility.</b> Educators are provided flexibility in demonstrating new knowledge and skills with ongoing opportunities for feedback.	0%	8%	39%	54%	0%	2.5

Note: 0 = Missing; 1 = Emerging; 2 = Developing; 3 = Accomplished; 4 = Exemplary

TABLE A.3: COURSE RATINGS FOR PRACTICE-BASED LEARNING

Design Indicator	0	1	2	3	4	Mean (N=13)
<b>Social Supports.</b> Social supports (e.g. netiquette guidelines, ice breakers, overall tone) cultivate a general sense of collegiality and trust among participants.	0%	8%	8%	77%	8%	2.8
<b>Knowledge Co-Construction.</b> Discussion/Reflection questions scaffold critical-thinking and group problem-solving;	0%	0%	31%	62%	8%	2.8
<b>Interaction Opportunities.</b> Educators are provided varied and ongoing opportunities to exchange opinions, experience, and information (e.g. discussions, twitter chats, polls, etc.).	0%	0%	54%	31%	15%	2.6
<b>Facilitation Strategies.</b> Strategies are used to facilitate constructive peer feedback and/or coaching at various levels of support (e.g. forum replies and ratings, project peer review).	0%	0%	54%	39%	8%	2.5
<b>Group Supports.</b> Learning activities provide opportunities for small-group work and/or collaboration on shared outcomes or goals.	8%	8%	39%	31%	15%	2.4
<b>Crowdsourcing Activities.</b> Crowdsourcing activities promote the sharing and curation of resources, tools, and effective practices.	0%	15%	46%	23%	15%	2.4

Note: 0 = Missing; 1 = Emerging; 2 = Developing; 3 = Accomplished; 4 = Exemplary

## APPENDIX B: MOOC-ED UNIT FEEDBACK QUANTITATIVE RESULTS

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Unit feedback forms were embedded at the end of each unit in both MOOC-Eds. These short forms consisted of five close-ended items aligned to the evaluation questions and two open-ended items requesting participants describe the most valuable aspect of the unit and recommendations for improving the unit. Overall, embedded surveys were recorded by a range of 2374 to 2389 unique users. Analysis of survey results consisted of item-level descriptive statistics using Excel software and thematic analysis of the open-ended responses using Atlas.ti software. The intent of the unit feedback is to gauge the extent to which participation in these courses helped to strengthen participant knowledge and application of the course content. Both the unit feedback results with frequencies and percentages tables are included below.

*Table B.1 Unit Feedback with Frequencies*

The Online Module/ Webinar...	DSDL 1 n=332- 335	DSDL2 n=361-365	FF 1 n=360- 361	FF 2 n=1000- 1004	TSDI 1 n=321- 324	TOTAL n=2374- 2389
<b>To what extent do you agree with the following statements? This unit provided engaging activities.</b>						
Strongly Disagree	1.2%	1.6%	0.8%	1.2%	0.0%	1.0%
Disagree	1.2%	0.8%	0.6%	0.7%	1.2%	0.8%
Somewhat Disagree	3.0%	1.9%	1.4%	1.9%	0.9%	1.8%
Neutral	11.0%	8.5%	6.4%	6.8%	5.6%	7.4%
Somewhat Agree	19.7%	19.2%	11.9%	14.6%	20.4%	16.4%
Agree	46.3%	46.3%	52.1%	47.7%	51.5%	48.5%
Strongly Agree	17.6%	21.6%	26.9%	27.1%	20.4%	24.0%
<b>This unit deepened my understanding of the topic(s) addressed. (Actual Number of Respondents: Total=2,386)</b>						
Strongly Disagree	0.9%	1.1%	1.1%	1.2%	0.0%	1.0%
Disagree	0.3%	1.1%	0.3%	0.5%	1.2%	0.6%
Somewhat Disagree	2.1%	0.3%	1.1%	1.1%	2.5%	1.3%
Neutral	7.2%	6.0%	5.0%	5.2%	12.7%	6.6%
Somewhat Agree	17.3%	12.1%	14.1%	14.9%	18.9%	15.3%
Agree	44.2%	47.3%	49.0%	47.1%	43.2%	46.5%
Strongly Agree	28.1%	32.1%	29.4%	30.0%	21.4%	28.8%
<b>This unit supported the application of course content to my professional practice. (Actual Number of Respondents: Total=2,377)</b>						
Strongly Disagree	0.6%	1.4%	0.6%	1.2%	0.0%	0.9%
Disagree	1.5%	0.8%	0.6%	0.2%	1.2%	0.7%
Somewhat Disagree	1.8%	1.4%	1.4%	0.6%	0.3%	1.0%
Neutral	9.0%	5.8%	3.3%	5.8%	9.9%	6.4%
Somewhat Agree	17.2%	14.4%	14.4%	12.0%	16.8%	14.1%
Agree	45.8%	48.3%	47.1%	49.7%	48.4%	48.4%
Strongly Agree	24.1%	27.9%	32.7%	30.5%	23.3%	28.6%

**This unit promoted constructive peer interaction. (Actual Number of Respondents: Total=2,374)**

Strongly Disagree	1.2%	1.7%	0.6%	1.2%	0.0%	1.0%
Disagree	1.2%	0.8%	0.3%	0.4%	0.9%	0.6%
Somewhat Disagree	2.4%	1.7%	1.1%	1.1%	2.2%	1.5%
Neutral	16.6%	10.0%	9.4%	8.2%	17.1%	11.0%
Somewhat Agree	21.4%	21.3%	15.3%	14.4%	18.7%	17.1%
Agree	40.7%	43.5%	48.3%	49.6%	43.3%	46.4%
Strongly Agree	16.6%	21.1%	25.0%	25.1%	17.8%	22.3%

**This unit helped me progress towards my personal learning goals. (Actual Number of Respondents: Total=2,384)**

Strongly Disagree	0.9%	1.4%	0.6%	1.2%	0.0%	0.9%
Disagree	0.9%	0.8%	0.6%	0.2%	0.9%	0.5%
Somewhat Disagree	1.5%	1.1%	1.4%	0.9%	1.9%	1.2%
Neutral	10.2%	5.8%	3.6%	4.9%	6.8%	5.8%
Somewhat Agree	16.5%	15.3%	11.7%	12.5%	21.7%	14.6%
Agree	46.5%	47.9%	52.8%	50.1%	48.4%	49.5%
Strongly Agree	23.4%	27.7%	29.4%	30.3%	20.2%	27.4%

Table B.2 Unit Feedback Percent Only

The Online Module/ Webinar...	DDDL 1	DDDL2	FF 1	FF 2	TSDI 1	TOTAL
	n=332-335	n=361-365	n=360-361	n=1000-1004	n=321-324	n=2374-2389

**To what extent do you agree with the following statements? This unit provided engaging activities.**

Strongly Disagree	1.2%	1.6%	0.8%	1.2%	0.0%	1.0%
Disagree	1.2%	0.8%	0.6%	0.7%	1.2%	0.8%
Somewhat Disagree	3.0%	1.9%	1.4%	1.9%	0.9%	1.8%
Neutral	11.0%	8.5%	6.4%	6.8%	5.6%	7.4%
Somewhat Agree	19.7%	19.2%	11.9%	14.6%	20.4%	16.4%
Agree	46.3%	46.3%	52.1%	47.7%	51.5%	48.5%
Strongly Agree	17.6%	21.6%	26.9%	27.1%	20.4%	24.0%

**Deepened my understanding of the topic(s) addressed.**

Strongly Disagree	0.3%	1.1%	0.3%	0.5%	1.2%	0.6%
Disagree	2.1%	0.3%	1.1%	1.1%	2.5%	1.3%
Somewhat Disagree	7.2%	6.0%	5.0%	5.2%	12.7%	6.6%
Neutral	17.3%	12.1%	14.1%	14.9%	18.9%	15.3%
Somewhat Agree	44.2%	47.3%	49.0%	47.1%	43.2%	46.5%
Agree	28.1%	32.1%	29.4%	30.0%	21.4%	28.8%
Strongly Agree	0.6%	1.4%	0.6%	1.2%	0.0%	0.9%

**Supported the application of course content to my professional practice.**

Strongly Disagree	1.5%	0.8%	0.6%	0.2%	1.2%	0.7%
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Disagree	1.8%	1.4%	1.4%	0.6%	0.3%	1.0%
Somewhat Disagree	9.0%	5.8%	3.3%	5.8%	9.9%	6.4%
Neutral	17.2%	14.4%	14.4%	12.0%	16.8%	14.1%
Somewhat Agree	45.8%	48.3%	47.1%	49.7%	48.4%	48.4%
Agree	24.1%	27.9%	32.7%	30.5%	23.3%	28.6%
Strongly Agree	1.2%	1.7%	0.6%	1.2%	0.0%	1.0%

<b>Promoted constructive peer interaction</b>						
Strongly Disagree	1.2%	0.8%	0.3%	0.4%	0.9%	0.6%
Disagree	2.4%	1.7%	1.1%	1.1%	2.2%	1.5%
Somewhat Disagree	16.6%	10.0%	9.4%	8.2%	17.1%	11.0%
Neutral	21.4%	21.3%	15.3%	14.4%	18.7%	17.1%
Somewhat Agree	40.7%	43.5%	48.3%	49.6%	43.3%	46.4%
Agree	16.6%	21.1%	25.0%	25.1%	17.8%	22.3%
Strongly Agree	0.9%	1.4%	0.6%	1.2%	0.0%	0.9%

<b>Helped me progress towards my personal learning goals.</b>						
Strongly Disagree	0.9%	0.8%	0.6%	0.2%	0.9%	0.5%
Disagree	1.5%	1.1%	1.4%	0.9%	1.9%	1.2%
Somewhat Disagree	10.2%	5.8%	3.6%	4.9%	6.8%	5.8%
Neutral	16.5%	15.3%	11.7%	12.5%	21.7%	14.6%
Somewhat Agree	46.5%	47.9%	52.8%	50.1%	48.4%	49.5%
Agree	23.4%	27.7%	29.4%	30.3%	20.2%	27.4%
Strongly Agree						

## APPENDIX C: MOOC-ED END OF COURSE SURVEY AND QUANTITATIVE RESULTS

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At the completion of each MOOC-Ed, participants were asked to complete an end of course survey. Completion was a requisite for participants requesting a certificate. The survey consisted of roughly 25 closed-ended items and 5 open-ended items designed to solicit participants' perceptions of the impact and effectiveness of the MOOC-Eds. Analysis of survey results consisted of item-level descriptive statistics using Excel software and thematic analysis of the open-ended responses using Atlas.ti software.

### **MOOC-Ed End of Course Survey Instrument**

Q1.1 Thank you for your participation in the End-of-Course Survey. We encourage your open and candid responses. Your feedback is critical to helping us improve the course for future participants. All responses are kept strictly confidential and will be combined with the responses of others during reporting to prevent the identification of participants. Your participation is entirely voluntary and you may exit the survey at any time. We appreciate your willingness to participate and thank you in advance for your insight. If you have questions or technical difficulty while completing the survey, please contact Shaun Kellogg at shaun.kellogg@ncsu.edu.

#### Answer If course Is Empty

Q1.2 Please specify the MOOC-Ed in which you participated.

- Coaching Digital Learning
- Digital Learning Transition
- Disciplinary Literacy
- Fraction Foundations
- Learning Differences
- Teaching Statistics through Data Investigations

Q1.3 As a whole, how effective was this MOOC-Ed in supporting your personal and/or professional learning goals?

- Very Ineffective
- Ineffective
- Somewhat Ineffective
- Neutral
- Somewhat Effective
- Effective
- Very Effective

Q1.4 How effective were the following components of this MOOC-Ed in supporting your professional learning:

	Very Ineffective	Ineffective	Somewhat Ineffective	Neutral	Somewhat Effective	Effective	Very Effective	Not Applicable
Course Videos	<input type="radio"/>							
Course Readings	<input type="radio"/>							
Discussion Forums and/or Online Chats (e.g. Twitter)	<input type="radio"/>							
Practitioner Tools (e.g. rubrics, apps, websites, classroom aids, planning templates, etc.)	<input type="radio"/>							
Self-Assessment and/or Peer-Assessment Activities	<input type="radio"/>							
Course Project	<input type="radio"/>							

Q1.5 What was the most valuable aspect of this MOOC-Ed in supporting your personal or professional learning goals?

Q1.6 What recommendations do you have for making this course more valuable to future participants? Please explain.

Answer If Please specify the MOOC-Ed in which you participated. Teaching Statistics through Data Investigations Is Selected Or course Is Equal to 18

Q2.1 To what extent do you agree with the following statements? As a result of my participation in this MOOC-Ed, I have improved my knowledge and/or skills related to...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
Strengthen my understanding of how to engage students in a statistical investigation process.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Deepen my understanding of how students reason with data to make evidence-based claims.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve my ability to use a framework to guide my planning and teaching of statistical investigations to promote deeper data explorations for my students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve my ability to use rich data sources to support investigations of questions that are of interest to me and my students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improve my ability to use dynamic tools to visualize and analyze data.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Answer If Please specify the MOOC-Ed in which you participated. Fraction Foundations Is Selected Or course Is Equal to 3 Or course Is Equal to 15

Q2.2 To what extent do you agree with the following statements? As a result of my participation in this MOOC-Ed, I have improved my knowledge and/or skills related to...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
fraction content standards.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
common student difficulties and misconceptions about fractions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
analysis of student thinking about fractions to inform instruction.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
effective use of fair-sharing activities to help students understand key fraction concepts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
effective use of measurement and number line activities to help children understand key fraction concepts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
effective use of fair-sharing and measurement activities to help students understand computations with fractions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
addressing student learning differences when teaching fraction content and skills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Answer If Please specify the MOOC-Ed in which you participated. Disciplinary Literacy Is Selected Or course Is Equal to 2 Or course Is Equal to 17

Q2.4 To what extent do you agree with the following statements? As a result of my participation in this MOOC-Ed, I have improved my knowledge and/or skills related to...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
disciplinary literacy practices (e.g., close reading, constructing and supporting claims).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
the Model for Inquiry-Based Disciplinary Literacy and how it can promote deeper learning for your students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
use of technology to support disciplinary literacies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
assessment practices for disciplinary literacy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
how to design, critically evaluate, and share Inquiry-Based Disciplinary Literacy lessons.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Answer If Please specify the MOOC-Ed in which you participated. Learning Differences Is Selected Or course Is Equal to 11 Or course Is Equal to 14

Q2.5 To what extent do you agree with the following statements? As a result of my participation in this MOOC-Ed, I have improved my knowledge and/or skills related to...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
what learning differences are and how they affect all students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
how to foster a growth mindset or problem solving approach among educators as they work with students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
working memory and its impact on learning and behavior in classrooms.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
student motivation and its impact on learning and behavior in classrooms.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
executive functioning skills and their impact on learning and behavior in classrooms.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
strategies or solutions to address learning differences and better support students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Answer If Please specify the MOOC-Ed in which you participated. Digital Learning Transition Is Selected Or course Is Equal to 16

Q2.6 To what extent do you agree with the following statements? As a result of my participation in this MOOC-Ed, I have improved my knowledge and/or skills related to...

	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
the potential of digital technologies to enhance teaching and learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
digital learning best practices in other schools and districts.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
elements that must be addressed for a successful digital learning transition.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
approaches to K-12 infrastructures and devices.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
leading change in my school or district.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
finding good resources to support planning, implementing and evaluating digital learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
setting digital learning goals and actions needed in my school or district.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
planning more effective professional development for teachers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
understanding and planning for the financial realities of DLT initiatives.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q2.7 Overall, how effective do you feel this MOOC-Ed was in preparing you to make positive changes in your professional practice?

- Very Ineffective
- Ineffective
- Somewhat Ineffective
- Neutral
- Somewhat Effective
- Effective
- Very Effective

Q2.8 Have you attempted to make any changes in your professional practice as a result of your participation in this MOOC-Ed?

- Yes
- No
- Not Applicable

Answer If Have you attempted to make changes in your own practice as a result of your participation in the MOOC-Ed? Yes Is Selected

Q2.9 Please describe any changes you have made to your practice, including how you have applied the knowledge, skills, and/or resources you gained in this course?

Answer If Have you attempted to make changes in your practice as a result of your participation in the MOOC... No Is Selected

Q2.10 In what ways, if any, do you anticipate applying the knowledge, skills, and/or resources you acquired from this course to your professional practice?

Answer If Please specify the MOOC-Ed in which you participated. Fraction Foundations Is Selected Or course Is Equal to 3

Q2.11 To what extent have you attempted to make changes in each of the following areas of practice as a result of participating in the MOOC-Ed?

	No Change	Minor Change	Moderate Change	Significant Change	Not Applicable
Mathematics curriculum content	<input type="radio"/>				
Mathematical language I use	<input type="radio"/>				
Collaboration on instructional planning	<input type="radio"/>				
Approaches to assessing students' mathematical proficiency	<input type="radio"/>				
Approaches to address the diversity of student mathematical proficiency	<input type="radio"/>				

Answer If Please specify the MOOC-Ed in which you participated. Fraction Foundations Is Selected Or course Is Equal to 3

Q2.12 When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent did you encounter any of the following issues?

	Not at All	Small Extent	Moderate Extent	Fairly Great Extent	Great Extent
Insufficient planning time	<input type="radio"/>				
Resistance from other teachers	<input type="radio"/>				
Resistance from administrators	<input type="radio"/>				
Curricular or pacing guide constraints	<input type="radio"/>				
Other (please describe)	<input type="radio"/>				

Q3.1 To what extent do you agree with the following statements? This online professional development experience...

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
was enhanced by the expertise of practitioners and/or leaders in the field.	<input type="radio"/>						
provided models of effective practice (e.g. demonstrations, tools, resources) to support the application of course content.	<input type="radio"/>						
provided projects or activities that can be embedded in my professional practice.	<input type="radio"/>						
provided meaningful opportunities to share ideas, resources, and experiences.	<input type="radio"/>						
promoted critical-thinking and/or problem-solving through discussions and activities.	<input type="radio"/>						

provided supports for small-group work or collaborations around shared goals.	<input type="radio"/>						
enabled me to personalize my learning through differentiated resources and activities.	<input type="radio"/>						
provided opportunities to investigate self-identified problems or areas of interests.	<input type="radio"/>						
provided flexibility in the ways in which I could demonstrate my learning.	<input type="radio"/>						
provided activities and/or resources to help me gauge my learning (e.g. self-assessments, peer assessment or feedback)	<input type="radio"/>						
clearly communicated the purpose, goals, and expectations of this course.	<input type="radio"/>						

Q3.2 What additional course features, activities, and/or resources would have helped you utilize this MOOC-Ed more effectively?

Q4.1 Were you able to complete all of the activities that you wanted to complete in this course?

- Yes
- No. Please explain. \_\_\_\_\_

Q4.2 On average, how many hours per unit did you spend on MOOC-Ed activities?

- 1-2 hours per unit
- 3-4 hours per unit
- 5-6 hours per unit
- 7-8 hours per unit
- more than 8 hours per unit

Q4.3 Have you discussed or shared what you learned in this MOOC-Ed with any of the following? Please select all that apply.

- Colleagues in my school, district, or organization who participated in the MOOC-Ed
- Colleagues in my school, district, or organization who did not participate in the MOOC-Ed
- Colleagues in my professional learning network outside of my school, district, or organization
- Other (please describe) \_\_\_\_\_

Q4.4 MOOC-Eds are often used as part of a professional development blended learning model. Which of the following best describes any peer groups with which you participated and/or collaborated outside of this MOOC-Ed?

- I did not participate and/or collaborate with anyone outside of the MOOC-Ed
- School or district-based professional learning team
- Online professional learning network (e.g. Twitter, Facebook group)
- Informal group of colleagues
- Other (please describe) \_\_\_\_\_

Q5.1 I would like to request a certificate of completion for this course in order to earn CEUs. I certify that I have (1) spent at least 20 hours participating in the course, (2) participated in the discussions and entered at least six postings, (3) submitted at least three artifacts of participation, and (4) am submitting an Instructional Technology Coaching Action Plan below.

- Yes
- No

Answer If I would like to request a certificate of completion for this course in order to earn CEUs. I cer... Yes Is Selected

Q5.2 Name as you would like it to appear on your certificate:

Answer If I would like to request a certificate of completion for this course in order to earn CEUs. I cer... Yes Is Selected

Q5.3 Submit your Coaching Action Plan here. Please note that this may not work on mobile devices. You may also email your plan to [cdl@mooc-ed.org](mailto:cdl@mooc-ed.org).

*Table C.1 End Of Course with Frequencies*

	DLL1	DLL2	FF 1	FF 2	TSDI 1	TOTAL
<b>The Online Module/ Webinar...</b>	n=20-354	n=0-48	n=0-54	n=0-159	n=0-48	n=20-354
<b>As a whole, how effective was this MOOC-Ed in supporting your personal and/or professional learning</b>						
Very Ineffective	0.0%	2.1%	0.0%	0.6%	0.0%	0.6%
Ineffective	0.0%	0.0%	1.9%	0.6%	0.0%	0.6%
Somewhat Ineffective	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neutral	6.4%	2.1%	0.0%	2.5%	0.0%	2.3%
Somewhat Effective	12.8%	12.8%	14.8%	14.5%	14.9%	14.1%
Effective	51.1%	48.9%	42.6%	47.8%	42.6%	46.9%
Very Effective	29.8%	34.0%	40.7%	34.0%	42.6%	35.6%
<b>How effective were the following components of this MOOC-Ed in supporting your professional learning - Course Videos</b>						
Very Ineffective	0.0%	4.2%	1.9%	2.5%	0.0%	2.0%
Ineffective	0.0%	0.0%	0.0%	0.0%	2.1%	0.3%
Somewhat Ineffective	0.0%	0.0%	0.0%	2.5%	0.0%	1.1%
Neutral	6.5%	0.0%	0.0%	1.9%	0.0%	1.7%
Somewhat Effective	8.7%	14.6%	13.0%	6.9%	12.8%	9.9%
Effective	30.4%	41.7%	24.1%	29.6%	29.8%	30.5%
Very Effective	54.4%	39.6%	61.1%	56.6%	55.3%	54.5%
<b>How effective were the following components of this MOOC-Ed in supporting your professional learning - Course Readings</b>						
Very Ineffective	0.0%	4.2%	1.9%	1.3%	0.0%	1.4%
Ineffective	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Somewhat Ineffective	2.2%	4.2%	0.0%	1.3%	2.1%	1.7%
Neutral	6.5%	2.1%	1.9%	5.7%	2.1%	4.2%
Somewhat Effective	17.4%	6.3%	16.7%	17.1%	8.3%	14.4%
Effective	28.3%	56.3%	33.3%	48.1%	39.6%	43.2%
Very Effective	45.7%	27.1%	46.3%	26.0%	47.9%	34.8%
<b>How effective were the following components of this MOOC-Ed in supporting your professional learn... - Discussion Forums and/or Online Chats (e.g. Twitter)</b>						
Very Ineffective	0.0%	4.4%	1.9%	1.3%	4.4%	2.0%
Ineffective	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%
Somewhat Ineffective	2.2%	4.4%	0.0%	1.3%	4.4%	2.0%
Neutral	10.9%	0.0%	7.6%	6.4%	6.7%	6.3%

Somewhat Effective	23.9%	21.7%	26.4%	20.4%	22.2%	22.2%
Effective	37.0%	41.3%	32.1%	37.6%	46.7%	38.3%
Very Effective	26.1%	28.3%	32.1%	31.2%	15.6%	28.2%

**How effective were the following components of this MOOC-Ed in supporting your professional learn... - Practitioner Tools (e.g. rubrics, apps, websites, classroom aids, planning templates, etc.)**

Very Ineffective	0.0%	4.2%	3.8%	1.9%	0.0%	2.0%
Ineffective	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Somewhat Ineffective	0.0%	0.0%	1.9%	0.6%	0.0%	0.6%
Neutral	11.1%	2.1%	3.8%	4.5%	2.2%	4.6%
Somewhat Effective	15.6%	4.2%	7.6%	11.5%	6.5%	9.7%
Effective	35.6%	50.0%	30.2%	38.9%	37.0%	38.4%
Very Effective	37.8%	39.6%	52.8%	42.0%	54.4%	44.4%

**How effective were the following components of this MOOC-Ed in supporting your professional learn... - Self-Assessment and/or Peer-Assessment Activities**

Very Ineffective	0.0%	4.4%	1.9%	1.3%	2.1%	1.7%
Ineffective	0.0%	0.0%	0.0%	1.3%	2.1%	0.9%
Somewhat Ineffective	2.2%	2.2%	0.0%	1.9%	4.2%	2.0%
Neutral	11.1%	4.4%	7.4%	2.5%	2.1%	4.6%
Somewhat Effective	24.4%	13.3%	16.7%	22.2%	14.6%	19.4%
Effective	44.4%	57.8%	33.3%	41.8%	47.9%	43.7%
Very Effective	17.8%	17.8%	40.7%	29.1%	27.1%	27.7%

**How effective were the following components of this MOOC-Ed in supporting your professional learn... - Course Project**

Very Ineffective	0.0%	6.8%	2.0%	2.0%	2.2%	2.4%
Ineffective	0.0%	0.0%	0.0%	0.7%	0.0%	0.3%
Somewhat Ineffective	2.3%	0.0%	0.0%	2.0%	0.0%	1.2%
Neutral	6.8%	0.0%	2.0%	3.9%	4.4%	3.6%
Somewhat Effective	9.1%	6.8%	9.8%	8.5%	17.4%	9.8%
Effective	34.1%	36.4%	39.2%	42.5%	39.1%	39.6%
Very Effective	47.7%	50.0%	47.1%	40.5%	37.0%	43.2%

**To what extent do you agree with the following statements? As a result of my participation... - Strengthen my understanding of how to engage students in a statistical investigation process.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Somewhat Agree	0.0%	0.0%	0.0%	0.0%	18.8%	18.8%
Agree	0.0%	0.0%	0.0%	0.0%	41.7%	41.7%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	37.5%	37.5%

To what extent do you agree with the following statements? As a result of my participation... - Deepen my understanding of how students reason with data to make evidence-based claims.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	20.8%	20.8%
Agree	0.0%	0.0%	0.0%	0.0%	45.8%	45.8%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	29.2%	29.2%

To what extent do you agree with the following statements? As a result of my participation... - Improve my ability to use a framework to guide my planning and teaching of statistical investigations to promote deeper data explorations for my students.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	16.7%	16.7%
Agree	0.0%	0.0%	0.0%	0.0%	43.8%	43.8%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	33.3%	33.3%

To what extent do you agree with the following statements? As a result of my participation... - Improve my ability to use rich data sources to support investigations of questions that are of interest to me and my students.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	12.5%	12.5%
Agree	0.0%	0.0%	0.0%	0.0%	41.7%	41.7%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	41.7%	41.7%

To what extent do you agree with the following statements? As a result of my participation... - Improve my ability to use dynamic tools to visualize and analyze data.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%

Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	18.8%	18.8%
Agree	0.0%	0.0%	0.0%	0.0%	35.4%	35.4%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	37.5%	37.5%

To what extent do you agree with the following statements? As a result of my participation... - fraction content standards.

Strongly Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Disagree	0.0%	0.0%	1.9%	1.4%	0.0%	1.5%
Somewhat Disagree	0.0%	0.0%	0.0%	1.4%	0.0%	1.0%
Neither Agree nor Disagree	0.0%	0.0%	5.7%	7.0%	0.0%	6.7%
Somewhat Agree	0.0%	0.0%	15.1%	22.5%	0.0%	20.5%
Agree	0.0%	0.0%	56.6%	47.2%	0.0%	49.7%
Strongly Agree	0.0%	0.0%	20.8%	19.7%	0.0%	20.0%

To what extent do you agree with the following statements? As a result of my participation... - common student difficulties and misconceptions about fractions.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	0.7%	0.0%	1.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Somewhat Agree	0.0%	0.0%	5.6%	14.8%	0.0%	12.2%
Agree	0.0%	0.0%	50.0%	47.2%	0.0%	48.0%
Strongly Agree	0.0%	0.0%	42.6%	35.9%	0.0%	37.8%

To what extent do you agree with the following statements? As a result of my participation... - analysis of student thinking about fractions to inform instruction.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	0.7%	0.0%	1.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	1.4%	0.0%	1.0%
Somewhat Agree	0.0%	0.0%	9.3%	16.2%	0.0%	14.3%
Agree	0.0%	0.0%	50.0%	50.0%	0.0%	50.0%
Strongly Agree	0.0%	0.0%	38.9%	31.0%	0.0%	33.2%

To what extent do you agree with the following statements? As a result of my participation... - effective use of fair-sharing activities to help students understand key fraction concepts.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%

Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	1.9%	1.4%	0.0%	1.5%
Somewhat Agree	0.0%	0.0%	7.4%	10.6%	0.0%	9.7%
Agree	0.0%	0.0%	48.2%	44.4%	0.0%	45.4%
Strongly Agree	0.0%	0.0%	42.6%	42.3%	0.0%	42.4%

To what extent do you agree with the following statements? As a result of my participation... - effective use of measurement and number line activities to help children understand key fraction concepts.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	1.9%	3.5%	0.0%	3.1%
Somewhat Agree	0.0%	0.0%	7.4%	13.4%	0.0%	11.7%
Agree	0.0%	0.0%	46.3%	43.7%	0.0%	44.4%
Strongly Agree	0.0%	0.0%	44.4%	38.0%	0.0%	39.8%

To what extent do you agree with the following statements? As a result of my participation... - effective use of fair-sharing and measurement activities to help students understand computations with fractions.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	1.4%	0.0%	1.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	1.9%	2.1%	0.0%	2.0%
Somewhat Agree	0.0%	0.0%	11.1%	16.9%	0.0%	15.3%
Agree	0.0%	0.0%	53.7%	45.8%	0.0%	48.0%
Strongly Agree	0.0%	0.0%	33.3%	33.1%	0.0%	33.2%

To what extent do you agree with the following statements? As a result of my participation... - addressing student learning differences when teaching fraction content and skills.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	1.4%	0.0%	1.5%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	2.1%	0.0%	1.5%
Somewhat Agree	0.0%	0.0%	13.2%	23.2%	0.0%	20.5%
Agree	0.0%	0.0%	54.7%	48.6%	0.0%	50.3%
Strongly Agree	0.0%	0.0%	30.2%	23.9%	0.0%	25.6%

To what extent do you agree with the following statements? As a result of my participation... - disciplinary literacy practices (e.g., close reading, constructing and supporting claims).

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	6.5%	0.0%	0.0%	0.0%	0.0%	3.3%
Somewhat Agree	15.2%	10.9%	0.0%	0.0%	0.0%	13.0%
Agree	37.0%	52.2%	0.0%	0.0%	0.0%	44.6%
Strongly Agree	41.3%	34.8%	0.0%	0.0%	0.0%	38.0%

**To what extent do you agree with the following statements? As a result of my participation... - the Model for Inquiry-Based Disciplinary Literacy and how it can promote deeper learning for your students.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	2.2%	0.0%	0.0%	0.0%	0.0%	1.1%
Somewhat Agree	21.7%	13.0%	0.0%	0.0%	0.0%	17.4%
Agree	37.0%	50.0%	0.0%	0.0%	0.0%	43.5%
Strongly Agree	39.1%	34.8%	0.0%	0.0%	0.0%	37.0%

**To what extent do you agree with the following statements? As a result of my participation... - use of technology to support disciplinary literacies.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	6.5%	2.2%	0.0%	0.0%	0.0%	4.4%
Somewhat Agree	21.7%	23.9%	0.0%	0.0%	0.0%	22.8%
Agree	47.8%	47.8%	0.0%	0.0%	0.0%	47.8%
Strongly Agree	23.9%	23.9%	0.0%	0.0%	0.0%	23.9%

**To what extent do you agree with the following statements? As a result of my participation... - assessment practices for disciplinary literacy.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	2.2%	4.4%	0.0%	0.0%	0.0%	3.3%
Neither Agree nor Disagree	2.2%	8.7%	0.0%	0.0%	0.0%	5.4%
Somewhat Agree	34.8%	17.4%	0.0%	0.0%	0.0%	26.1%
Agree	39.1%	50.0%	0.0%	0.0%	0.0%	44.6%
Strongly Agree	21.7%	17.4%	0.0%	0.0%	0.0%	19.6%

**To what extent do you agree with the following statements? As a result of my participation... - how to design, critically evaluate, and share Inquiry-Based Disciplinary Literacy lessons.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	2.2%	0.0%	0.0%	0.0%	0.0%	1.1%

Somewhat Disagree	0.0%	4.4%	0.0%	0.0%	0.0%	2.2%
Neither Agree nor Disagree	0.0%	6.5%	0.0%	0.0%	0.0%	3.3%
Somewhat Agree	19.6%	15.2%	0.0%	0.0%	0.0%	17.4%
Agree	45.7%	41.3%	0.0%	0.0%	0.0%	43.5%
Strongly Agree	32.6%	30.4%	0.0%	0.0%	0.0%	31.5%

**Overall, how effective do you feel this MOOC-Ed was in preparing you to make positive changes in...**

Very Ineffective	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ineffective	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Somewhat Ineffective	0.0%	0.0%	1.9%	1.9%	0.0%	1.1%
Neutral	4.4%	0.0%	1.9%	1.9%	2.1%	2.0%
Somewhat Effective	28.3%	19.2%	14.8%	15.2%	14.9%	17.3%
Effective	39.1%	57.5%	48.2%	44.9%	42.6%	46.0%
Very Effective	28.3%	23.4%	33.3%	35.4%	40.4%	33.2%

**Have you attempted to make any changes in your professional practice as a result of your participation...**

Yes	92.7%	90.2%	100.0%	96.0%	100.0%	95.9%
No	7.3%	9.8%	0.0%	4.1%	0.0%	4.1%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Mathematics curriculum content**

No Change	0.0%	0.0%	13.0%	0.0%	0.0%	13.0%
Minor Change	0.0%	0.0%	8.7%	0.0%	0.0%	8.7%
Moderate Change	0.0%	0.0%	56.5%	0.0%	0.0%	56.5%
Significant Change	0.0%	0.0%	21.7%	0.0%	0.0%	21.7%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Mathematical language I use**

No Change	0.0%	0.0%	2.1%	0.0%	0.0%	2.1%
Minor Change	0.0%	0.0%	14.9%	0.0%	0.0%	14.9%
Moderate Change	0.0%	0.0%	51.1%	0.0%	0.0%	51.1%
Significant Change	0.0%	0.0%	31.9%	0.0%	0.0%	31.9%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Collaboration on instructional planning**

No Change	0.0%	0.0%	6.4%	0.0%	0.0%	6.4%
Minor Change	0.0%	0.0%	19.2%	0.0%	0.0%	19.2%
Moderate Change	0.0%	0.0%	34.0%	0.0%	0.0%	34.0%
Significant Change	0.0%	0.0%	40.4%	0.0%	0.0%	40.4%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Approaches to assessing students' mathematical proficiency**

No Change	0.0%	0.0%	2.1%	0.0%	0.0%	2.1%
Minor Change	0.0%	0.0%	12.8%	0.0%	0.0%	12.8%
Moderate Change	0.0%	0.0%	34.0%	0.0%	0.0%	34.0%
Significant Change	0.0%	0.0%	51.1%	0.0%	0.0%	51.1%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Approaches to address the diversity of student mathematical proficiency**

No Change	0.0%	0.0%	2.1%	0.0%	0.0%	2.1%
Minor Change	0.0%	0.0%	8.5%	0.0%	0.0%	8.5%
Moderate Change	0.0%	0.0%	44.7%	0.0%	0.0%	44.7%
Significant Change	0.0%	0.0%	44.7%	0.0%	0.0%	44.7%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Insufficient planning time**

Not at All	0.0%	0.0%	12.2%	0.0%	0.0%	12.2%
Small Extent	0.0%	0.0%	18.4%	0.0%	0.0%	18.4%
Moderate Extent	0.0%	0.0%	36.7%	0.0%	0.0%	36.7%
Fairly Great Extent	0.0%	0.0%	22.5%	0.0%	0.0%	22.5%
Great Extent	0.0%	0.0%	10.2%	0.0%	0.0%	10.2%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Resistance from other teachers**

Not at All	0.0%	0.0%	42.9%	0.0%	0.0%	42.9%
Small Extent	0.0%	0.0%	24.5%	0.0%	0.0%	24.5%
Moderate Extent	0.0%	0.0%	22.5%	0.0%	0.0%	22.5%
Fairly Great Extent	0.0%	0.0%	8.2%	0.0%	0.0%	8.2%
Great Extent	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Resistance from administrators**

Not at All	0.0%	0.0%	67.4%	0.0%	0.0%	67.4%
Small Extent	0.0%	0.0%	16.3%	0.0%	0.0%	16.3%
Moderate Extent	0.0%	0.0%	12.2%	0.0%	0.0%	12.2%
Fairly Great Extent	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%
Great Extent	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Curricular or pacing guide constraints**

Not at All	0.0%	0.0%	8.2%	0.0%	0.0%	8.2%
Small Extent	0.0%	0.0%	32.7%	0.0%	0.0%	32.7%
Moderate Extent	0.0%	0.0%	30.6%	0.0%	0.0%	30.6%
Fairly Great Extent	0.0%	0.0%	12.2%	0.0%	0.0%	12.2%
Great Extent	0.0%	0.0%	16.3%	0.0%	0.0%	16.3%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Other (please describe)**

Not at All	0.0%	0.0%	80.0%	0.0%	0.0%	80.0%
Small Extent	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Moderate Extent	0.0%	0.0%	5.0%	0.0%	0.0%	5.0%
Fairly Great Extent	0.0%	0.0%	5.0%	0.0%	0.0%	5.0%
Great Extent	0.0%	0.0%	10.0%	0.0%	0.0%	10.0%

**To what extent do you agree with the following statements? This online professional development... - was enhanced by the expertise of practitioners and/or leaders in the field.**

Strongly Disagree	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%
Disagree	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%
Somewhat Disagree	2.2%	2.1%	1.9%	1.3%	0.0%	1.4%
Neither Agree nor Disagree	0.0%	2.1%	0.0%	6.4%	2.2%	3.4%
Somewhat Agree	28.3%	19.2%	16.7%	17.3%	8.7%	17.8%
Agree	37.0%	40.4%	44.4%	51.3%	54.4%	47.3%
Strongly Agree	32.6%	36.2%	37.0%	19.9%	34.8%	28.4%

**To what extent do you agree with the following statements? This online professional development... - provided models of effective practice (e.g. demonstrations, tools, resources) to support the application of course content.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	1.3%	0.0%	0.9%
Somewhat Disagree	2.2%	2.1%	0.0%	0.0%	0.0%	0.6%
Neither Agree nor Disagree	4.4%	2.1%	0.0%	2.6%	2.1%	2.3%
Somewhat Agree	15.2%	12.8%	9.3%	9.6%	8.5%	10.6%
Agree	45.7%	48.9%	40.7%	51.9%	53.2%	49.1%
Strongly Agree	32.6%	34.0%	48.2%	34.6%	36.2%	36.6%

**To what extent do you agree with the following statements? This online professional development... - provided projects or activities that can be embedded in my professional practice.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	2.1%	1.9%	1.3%	0.0%	1.1%
Somewhat Disagree	2.2%	0.0%	0.0%	0.0%	0.0%	0.3%

Neither Agree nor Disagree	8.7%	0.0%	5.6%	4.5%	2.1%	4.3%
Somewhat Agree	19.6%	10.6%	5.6%	9.6%	8.5%	10.3%
Agree	37.0%	42.6%	46.3%	47.4%	51.1%	45.7%
Strongly Agree	32.6%	44.7%	40.7%	37.2%	38.3%	38.3%

To what extent do you agree with the following statements? This online professional development... - provided meaningful opportunities to share ideas, resources, and experiences.

Strongly Disagree	0.0%	0.0%	0.0%	0.6%	2.1%	0.6%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	2.2%	4.3%	0.0%	0.0%	2.1%	1.1%
Neither Agree nor Disagree	8.7%	0.0%	3.7%	5.1%	6.4%	4.9%
Somewhat Agree	15.2%	19.2%	14.8%	12.8%	10.6%	14.0%
Agree	39.1%	36.2%	42.6%	46.2%	42.6%	42.9%
Strongly Agree	34.8%	40.4%	38.9%	35.3%	36.2%	36.6%

To what extent do you agree with the following statements? This online professional development... - promoted critical-thinking and/or problem-solving through discussions and activities.

Strongly Disagree	0.0%	0.0%	0.0%	0.6%	2.1%	0.6%
Disagree	2.2%	0.0%	0.0%	0.6%	0.0%	0.6%
Somewhat Disagree	0.0%	8.5%	0.0%	0.0%	4.3%	1.7%
Neither Agree nor Disagree	6.5%	0.0%	1.9%	3.9%	4.3%	3.4%
Somewhat Agree	10.9%	8.5%	11.1%	14.1%	4.3%	11.1%
Agree	47.8%	42.6%	40.7%	46.2%	51.1%	45.7%
Strongly Agree	32.6%	40.4%	46.3%	34.6%	34.0%	36.9%

To what extent do you agree with the following statements? This online professional development... - provided supports for small-group work or collaborations around shared goals.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	0.3%
Disagree	0.0%	2.1%	0.0%	1.3%	0.0%	0.9%
Somewhat Disagree	2.2%	4.3%	5.6%	1.9%	6.4%	3.4%
Neither Agree nor Disagree	24.4%	17.0%	5.6%	11.5%	10.6%	12.9%
Somewhat Agree	22.2%	10.6%	22.2%	13.5%	25.5%	17.2%
Agree	31.1%	44.7%	42.6%	45.5%	31.9%	41.3%
Strongly Agree	20.0%	21.3%	24.1%	26.3%	23.4%	24.1%

To what extent do you agree with the following statements? This online professional development... - enabled me to personalize my learning through differentiated resources and activities.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	2.2%	0.0%	0.0%	0.6%	0.0%	0.6%
Somewhat Disagree	2.2%	2.1%	1.9%	1.3%	0.0%	1.4%

Neither Agree nor Disagree	6.5%	6.4%	3.7%	6.4%	6.4%	6.0%
Somewhat Agree	19.6%	8.5%	7.4%	11.5%	21.3%	12.9%
Agree	39.1%	48.9%	51.9%	44.2%	38.3%	44.6%
Strongly Agree	30.4%	34.0%	35.2%	35.9%	34.0%	34.6%

To what extent do you agree with the following statements? This online professional development... - provided opportunities to investigate self-identified problems or areas of interests.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	2.2%	0.3%
Disagree	2.2%	0.0%	0.0%	1.3%	0.0%	0.9%
Somewhat Disagree	0.0%	4.3%	1.9%	0.6%	0.0%	1.2%
Neither Agree nor Disagree	6.5%	4.3%	5.6%	8.3%	2.2%	6.3%
Somewhat Agree	17.4%	10.6%	14.8%	7.1%	19.6%	11.8%
Agree	45.7%	42.6%	48.2%	48.7%	45.7%	47.0%
Strongly Agree	28.3%	38.3%	29.6%	34.0%	30.4%	32.7%

To what extent do you agree with the following statements? This online professional development... - provided flexibility in the ways in which I could demonstrate my learning.

Strongly Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.3%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	1.3%	0.0%	0.6%
Neither Agree nor Disagree	8.9%	4.3%	1.9%	5.8%	8.5%	5.8%
Somewhat Agree	8.9%	8.5%	16.7%	10.3%	19.2%	12.1%
Agree	48.9%	48.9%	51.9%	48.4%	36.2%	47.4%
Strongly Agree	33.3%	38.3%	29.6%	33.6%	36.2%	33.9%

To what extent do you agree with the following statements? This online professional development... - provided activities and/or resources to help me gauge my learning (e.g. self-assessments, peer assessment or feedback)

Strongly Disagree	2.2%	0.0%	0.0%	0.6%	0.0%	0.6%
Disagree	0.0%	0.0%	0.0%	1.3%	0.0%	0.6%
Somewhat Disagree	4.4%	2.2%	0.0%	1.9%	2.1%	2.0%
Neither Agree nor Disagree	8.7%	4.4%	1.9%	3.2%	8.5%	4.6%
Somewhat Agree	23.9%	17.4%	14.8%	10.9%	10.6%	14.0%
Agree	37.0%	43.5%	46.3%	48.1%	40.4%	44.7%
Strongly Agree	23.9%	32.6%	37.0%	34.0%	38.3%	33.5%

To what extent do you agree with the following statements? This online professional development... - clearly communicated the purpose, goals, and expectations of this course.

Strongly Disagree	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Disagree	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%

Somewhat Disagree	2.2%	0.0%	0.0%	1.3%	2.1%	1.2%
Neither Agree nor Disagree	8.7%	2.2%	1.9%	5.8%	6.4%	5.2%
Somewhat Agree	6.5%	2.2%	7.4%	11.5%	14.9%	9.5%
Agree	41.3%	57.8%	44.4%	39.1%	29.8%	41.4%
Strongly Agree	41.3%	37.8%	46.3%	39.7%	46.8%	41.7%

**Were you able to complete all of the activities that you wanted to complete in this course?**

Yes	82.6%	86.7%	83.3%	91.5%	57.5%	83.8%
No. Please explain.	17.4%	13.3%	16.7%	8.5%	42.6%	16.2%

**This unit deepened my understanding of the topic(s) addressed. (Actual Number of Respondents: Total=2,386)**

1-2 hours per unit	19.6%	12.8%	11.1%	15.6%	14.9%	14.9%
3-4 hours per unit	45.7%	59.6%	35.2%	40.9%	44.7%	43.7%
5-6 hours per unit	28.3%	17.0%	42.6%	27.3%	27.7%	28.5%
7-8 hours per unit	4.4%	4.3%	11.1%	7.8%	10.6%	7.8%
more than 8 hours per unit	2.2%	6.4%	0.0%	8.4%	2.1%	5.2%

**Have you discussed or shared what you learned in this MOOC-Ed with any of the following? Please...**

Strongly Disagree	44.2%	29.6%	49.0%	64.4%	34.8%	50.8%
Disagree	55.8%	70.5%	76.5%	65.8%	71.7%	67.6%
Somewhat Disagree	27.9%	36.4%	39.2%	20.8%	41.3%	29.4%
Neither Agree nor Disagree	4.7%	11.4%	3.9%	6.7%	10.9%	7.2%

**This unit deepened my understanding of the topic(s) addressed. (Actual Number of Respondents: Total=2,386)**

School or district-based professional learning team	32.6%	17.4%	24.1%	30.7%	17.0%	26.3%
Online professional learning network (e.g. Twitter, Facebook group)	4.4%	2.2%	3.7%	2.6%	0.0%	2.6%
Informal group of colleagues	26.1%	28.3%	40.7%	34.6%	44.7%	35.0%
Other (please describe)	4.4%	0.0%	0.0%	2.0%	4.3%	2.0%
I did not participate and/or collaborate with anyone outside of the MOOC-Ed	32.6%	52.2%	31.5%	30.1%	34.0%	34.1%

Table C.2 End of Course Percentages Only

	DLL1	DLL2	FF 1	FF 2	TSDI 1	<b>TOTAL</b>
<b>The Online Module/ Webinar...</b>	n=20-354	n=0-48	n=0-54	n=0-159	n=0-48	n=20-354

**As a whole, how effective was this MOOC-Ed in supporting your personal and/or professional learning**

Very Ineffective	0.0%	2.1%	0.0%	0.6%	0.0%	0.0%
Ineffective	0.0%	0.0%	1.9%	0.6%	0.0%	0.0%
Somewhat Ineffective	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neutral	6.4%	2.1%	0.0%	2.5%	0.0%	6.4%
Somewhat Effective	12.8%	12.8%	14.8%	14.5%	14.9%	12.8%
Effective	51.1%	48.9%	42.6%	47.8%	42.6%	51.1%
Very Effective	29.8%	34.0%	40.7%	34.0%	42.6%	29.8%

**How effective were the following components of this MOOC-Ed in supporting your professional learning - Course Videos**

Very Ineffective	4.2%	1.9%	2.5%	0.0%	0.0%	0.0%
Ineffective	0.0%	0.0%	0.0%	0.0%	2.1%	0.3%
Somewhat Ineffective	0.0%	0.0%	0.0%	2.5%	0.0%	1.1%
Neutral	6.5%	0.0%	0.0%	1.9%	0.0%	1.7%
Somewhat Effective	8.7%	14.6%	13.0%	6.9%	12.8%	9.9%
Effective	30.4%	41.7%	24.1%	29.6%	29.8%	30.5%
Very Effective	54.3%	39.6%	61.1%	56.6%	55.3%	54.5%

**How effective were the following components of this MOOC-Ed in supporting your professional learning - Course Readings**

Very Ineffective	0.0%	4.2%	1.9%	1.3%	0.0%	1.4%
Ineffective	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Somewhat Ineffective	2.2%	4.2%	0.0%	1.3%	2.1%	1.7%
Neutral	6.5%	2.1%	1.9%	5.7%	2.1%	4.2%
Somewhat Effective	17.4%	6.3%	16.7%	17.1%	8.3%	14.4%
Effective	28.3%	56.3%	33.3%	48.1%	39.6%	43.2%
Very Effective	45.7%	27.1%	46.3%	25.9%	47.9%	34.7%

**How effective were the following components of this MOOC-Ed in supporting your professional learn... - Discussion Forums and/or Online Chats (e.g. Twitter)**

Very Ineffective	0.0%	4.3%	1.9%	1.3%	4.4%	2.0%
Ineffective	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%
Somewhat Ineffective	2.2%	4.3%	0.0%	1.3%	4.4%	2.0%
Neutral	10.9%	0.0%	7.5%	6.4%	6.7%	6.3%
Somewhat Effective	23.9%	21.7%	26.4%	20.4%	22.2%	22.2%
Effective	37.0%	41.3%	32.1%	37.6%	46.7%	38.3%
Very Effective	26.1%	28.3%	32.1%	31.2%	15.6%	28.2%

**How effective were the following components of this MOOC-Ed in supporting your professional learn... - Practitioner Tools (e.g. rubrics, apps, websites, classroom aids, planning templates, etc.)**

Very Ineffective	0.0%	4.2%	3.8%	1.9%	0.0%	2.0%
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Ineffective	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Somewhat Ineffective	0.0%	0.0%	1.9%	0.6%	0.0%	0.6%
Neutral	11.1%	2.1%	3.8%	4.5%	2.2%	4.6%
Somewhat Effective	15.6%	4.2%	7.5%	11.5%	6.5%	9.7%
Effective	35.6%	50.0%	30.2%	38.9%	37.0%	38.4%
Very Effective	37.8%	39.6%	52.8%	42.0%	54.3%	44.4%

**How effective were the following components of this MOOC-Ed in supporting your professional learn... - Self-Assessment and/or Peer-Assessment Activities**

Very Ineffective	0.0%	4.4%	1.9%	1.3%	2.1%	1.7%
Ineffective	0.0%	0.0%	0.0%	1.3%	2.1%	0.9%
Somewhat Ineffective	2.2%	2.2%	0.0%	1.9%	4.2%	2.0%
Neutral	11.1%	4.4%	7.4%	2.5%	2.1%	4.6%
Somewhat Effective	24.4%	13.3%	16.7%	22.2%	14.6%	19.4%
Effective	44.4%	57.8%	33.3%	41.8%	47.9%	43.7%
Very Effective	17.8%	17.8%	40.7%	29.1%	27.1%	27.7%

**How effective were the following components of this MOOC-Ed in supporting your professional learn... - Course Project**

Very Ineffective	0.0%	6.8%	2.0%	2.0%	2.2%	2.4%
Ineffective	0.0%	0.0%	0.0%	0.7%	0.0%	0.3%
Somewhat Ineffective	2.3%	0.0%	0.0%	2.0%	0.0%	1.2%
Neutral	6.8%	0.0%	2.0%	3.9%	4.3%	3.6%
Somewhat Effective	9.1%	6.8%	9.8%	8.5%	17.4%	9.8%
Effective	34.1%	36.4%	39.2%	42.5%	39.1%	39.6%
Very Effective	47.7%	50.0%	47.1%	40.5%	37.0%	43.2%

**To what extent do you agree with the following statements? As a result of my participation... - Strengthen my understanding of how to engage students in a statistical investigation process.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	18.8%	18.8%
Agree	0.0%	0.0%	0.0%	0.0%	41.7%	41.7%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	37.5%	37.5%

**To what extent do you agree with the following statements? As a result of my participation... - Deepen my understanding of how students reason with data to make evidence-based claims.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	20.8%	20.8%
Agree	0.0%	0.0%	0.0%	0.0%	45.8%	45.8%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	29.2%	29.2%

**To what extent do you agree with the following statements? As a result of my participation... - Improve my ability to use a framework to guide my planning and teaching of statistical investigations to promote deeper data explorations for my students.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	16.7%	16.7%
Agree	0.0%	0.0%	0.0%	0.0%	43.8%	43.8%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	33.3%	33.3%

**To what extent do you agree with the following statements? As a result of my participation... - Improve my ability to use rich data sources to support investigations of questions that are of interest to me and my students.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	12.5%	12.5%
Agree	0.0%	0.0%	0.0%	0.0%	41.7%	41.7%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	41.7%	41.7%

**To what extent do you agree with the following statements? As a result of my participation... - Improve my ability to use dynamic tools to visualize and analyze data.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.0%	4.2%	4.2%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	2.1%
Somewhat Agree	0.0%	0.0%	0.0%	0.0%	18.8%	18.8%
Agree	0.0%	0.0%	0.0%	0.0%	35.4%	35.4%
Strongly Agree	0.0%	0.0%	0.0%	0.0%	37.5%	37.5%

**To what extent do you agree with the following statements? As a result of my participation... - fraction content standards.**

Strongly Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Disagree	0.0%	0.0%	1.9%	1.4%	0.0%	1.5%
Somewhat Disagree	0.0%	0.0%	0.0%	1.4%	0.0%	1.0%

Neither Agree nor Disagree	0.0%	0.0%	5.7%	7.0%	0.0%	6.7%
Somewhat Agree	0.0%	0.0%	15.1%	22.5%	0.0%	20.5%
Agree	0.0%	0.0%	56.6%	47.2%	0.0%	49.7%
Strongly Agree	0.0%	0.0%	20.8%	19.7%	0.0%	20.0%

**To what extent do you agree with the following statements? As a result of my participation... - common student difficulties and misconceptions about fractions.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	0.7%	0.0%	1.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Somewhat Agree	0.0%	0.0%	5.6%	14.8%	0.0%	12.2%
Agree	0.0%	0.0%	50.0%	47.2%	0.0%	48.0%
Strongly Agree	0.0%	0.0%	42.6%	35.9%	0.0%	37.8%

**To what extent do you agree with the following statements? As a result of my participation... - analysis of student thinking about fractions to inform instruction.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	0.7%	0.0%	1.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	1.4%	0.0%	1.0%
Somewhat Agree	0.0%	0.0%	9.3%	16.2%	0.0%	14.3%
Agree	0.0%	0.0%	50.0%	50.0%	0.0%	50.0%
Strongly Agree	0.0%	0.0%	38.9%	31.0%	0.0%	33.2%

**To what extent do you agree with the following statements? As a result of my participation... - effective use of fair-sharing activities to help students understand key fraction concepts.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	1.9%	1.4%	0.0%	1.5%
Somewhat Agree	0.0%	0.0%	7.4%	10.6%	0.0%	9.7%
Agree	0.0%	0.0%	48.1%	44.4%	0.0%	45.4%
Strongly Agree	0.0%	0.0%	42.6%	42.3%	0.0%	42.3%

**To what extent do you agree with the following statements? As a result of my participation... - effective use of measurement and number line activities to help children understand key fraction concepts.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	1.9%	3.5%	0.0%	3.1%
Somewhat Agree	0.0%	0.0%	7.4%	13.4%	0.0%	11.7%

Agree	0.0%	0.0%	46.3%	43.7%	0.0%	44.4%
Strongly Agree	0.0%	0.0%	44.4%	38.0%	0.0%	39.8%

**To what extent do you agree with the following statements? As a result of my participation... - effective use of fair-sharing and measurement activities to help students understand computations with fractions.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	1.4%	0.0%	1.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	1.9%	2.1%	0.0%	2.0%
Somewhat Agree	0.0%	0.0%	11.1%	16.9%	0.0%	15.3%
Agree	0.0%	0.0%	53.7%	45.8%	0.0%	48.0%
Strongly Agree	0.0%	0.0%	33.3%	33.1%	0.0%	33.2%

**To what extent do you agree with the following statements? As a result of my participation... - addressing student learning differences when teaching fraction content and skills.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	1.4%	0.0%	1.5%
Somewhat Disagree	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%
Neither Agree nor Disagree	0.0%	0.0%	0.0%	2.1%	0.0%	1.5%
Somewhat Agree	0.0%	0.0%	13.2%	23.2%	0.0%	20.5%
Agree	0.0%	0.0%	54.7%	48.6%	0.0%	50.3%
Strongly Agree	0.0%	0.0%	30.2%	23.9%	0.0%	25.6%

**To what extent do you agree with the following statements? As a result of my participation... - disciplinary literacy practices (e.g., close reading, constructing and supporting claims).**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	6.5%	0.0%	0.0%	0.0%	0.0%	3.3%
Somewhat Agree	15.2%	10.9%	0.0%	0.0%	0.0%	13.0%
Agree	37.0%	52.2%	0.0%	0.0%	0.0%	44.6%
Strongly Agree	41.3%	34.8%	0.0%	0.0%	0.0%	38.0%

**To what extent do you agree with the following statements? As a result of my participation... - the Model for Inquiry-Based Disciplinary Literacy and how it can promote deeper learning for your students.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	2.2%	0.0%	0.0%	0.0%	0.0%	1.1%
Somewhat Agree	21.7%	13.0%	0.0%	0.0%	0.0%	17.4%
Agree	37.0%	50.0%	0.0%	0.0%	0.0%	43.5%
Strongly Agree	39.1%	34.8%	0.0%	0.0%	0.0%	37.0%

**To what extent do you agree with the following statements? As a result of my participation... - use of technology to support disciplinary literacies.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Neither Agree nor Disagree	6.5%	2.2%	0.0%	0.0%	0.0%	4.3%
Somewhat Agree	21.7%	23.9%	0.0%	0.0%	0.0%	22.8%
Agree	47.8%	47.8%	0.0%	0.0%	0.0%	47.8%
Strongly Agree	23.9%	23.9%	0.0%	0.0%	0.0%	23.9%

**To what extent do you agree with the following statements? As a result of my participation... - assessment practices for disciplinary literacy.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	2.2%	4.3%	0.0%	0.0%	0.0%	3.3%
Neither Agree nor Disagree	2.2%	8.7%	0.0%	0.0%	0.0%	5.4%
Somewhat Agree	34.8%	17.4%	0.0%	0.0%	0.0%	26.1%
Agree	39.1%	50.0%	0.0%	0.0%	0.0%	44.6%
Strongly Agree	21.7%	17.4%	0.0%	0.0%	0.0%	19.6%

**To what extent do you agree with the following statements? As a result of my participation... - how to design, critically evaluate, and share Inquiry-Based Disciplinary Literacy lessons.**

Strongly Disagree	0.0%	2.2%	0.0%	0.0%	0.0%	1.1%
Disagree	2.2%	0.0%	0.0%	0.0%	0.0%	1.1%
Somewhat Disagree	0.0%	4.3%	0.0%	0.0%	0.0%	2.2%
Neither Agree nor Disagree	0.0%	6.5%	0.0%	0.0%	0.0%	3.3%
Somewhat Agree	19.6%	15.2%	0.0%	0.0%	0.0%	17.4%
Agree	45.7%	41.3%	0.0%	0.0%	0.0%	43.5%
Strongly Agree	32.6%	30.4%	0.0%	0.0%	0.0%	31.5%

**Overall, how effective do you feel this MOOC-Ed was in preparing you to make positive changes in...**

Very Ineffective	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ineffective	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Somewhat Ineffective	0.0%	0.0%	1.9%	1.9%	0.0%	1.1%
Neutral	4.3%	0.0%	1.9%	1.9%	2.1%	2.0%
Somewhat Effective	28.3%	19.1%	14.8%	15.2%	14.9%	17.3%
Effective	39.1%	57.4%	48.1%	44.9%	42.6%	46.0%
Very Effective	28.3%	23.4%	33.3%	35.4%	40.4%	33.2%

**Have you attempted to make any changes in your professional practice as a result of your participation...**

Yes	92.7%	90.2%	100.0%	95.9%	100.0%	95.9%
No	7.3%	9.8%	0.0%	4.1%	0.0%	4.1%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Mathematics curriculum content**

No Change	0.0%	0.0%	13.0%	0.0%	0.0%	13.0%
Minor Change	0.0%	0.0%	8.7%	0.0%	0.0%	8.7%
Moderate Change	0.0%	0.0%	56.5%	0.0%	0.0%	56.5%
Significant Change	0.0%	0.0%	21.7%	0.0%	0.0%	21.7%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Mathematical language I use**

No Change	0.0%	0.0%	2.1%	0.0%	0.0%	2.1%
Minor Change	0.0%	0.0%	14.9%	0.0%	0.0%	14.9%
Moderate Change	0.0%	0.0%	51.1%	0.0%	0.0%	51.1%
Significant Change	0.0%	0.0%	31.9%	0.0%	0.0%	31.9%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Collaboration on instructional planning**

No Change	0.0%	0.0%	6.4%	0.0%	0.0%	6.4%
Minor Change	0.0%	0.0%	19.1%	0.0%	0.0%	19.1%
Moderate Change	0.0%	0.0%	34.0%	0.0%	0.0%	34.0%
Significant Change	0.0%	0.0%	40.4%	0.0%	0.0%	40.4%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Approaches to assessing students' mathematical proficiency**

No Change	0.0%	0.0%	2.1%	0.0%	0.0%	2.1%
Minor Change	0.0%	0.0%	12.8%	0.0%	0.0%	12.8%
Moderate Change	0.0%	0.0%	34.0%	0.0%	0.0%	34.0%
Significant Change	0.0%	0.0%	51.1%	0.0%	0.0%	51.1%

**To what extent have you attempted to make changes in each of the following areas of practice as... - Approaches to address the diversity of student mathematical proficiency**

No Change	0.0%	0.0%	2.1%	0.0%	0.0%	2.1%
Minor Change	0.0%	0.0%	8.5%	0.0%	0.0%	8.5%
Moderate Change	0.0%	0.0%	44.7%	0.0%	0.0%	44.7%
Significant Change	0.0%	0.0%	44.7%	0.0%	0.0%	44.7%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Insufficient planning time**

Not at All	0.0%	0.0%	12.2%	0.0%	0.0%	12.2%
Small Extent	0.0%	0.0%	18.4%	0.0%	0.0%	18.4%
Moderate Extent	0.0%	0.0%	36.7%	0.0%	0.0%	36.7%
Fairly Great Extent	0.0%	0.0%	22.4%	0.0%	0.0%	22.4%
Great Extent	0.0%	0.0%	10.2%	0.0%	0.0%	10.2%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Resistance from other teachers**

Not at All	0.0%	0.0%	42.9%	0.0%	0.0%	42.9%
Small Extent	0.0%	0.0%	24.5%	0.0%	0.0%	24.5%
Moderate Extent	0.0%	0.0%	22.4%	0.0%	0.0%	22.4%
Fairly Great Extent	0.0%	0.0%	8.2%	0.0%	0.0%	8.2%
Great Extent	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Resistance from administrators**

Not at All	0.0%	0.0%	67.3%	0.0%	0.0%	67.3%
Small Extent	0.0%	0.0%	16.3%	0.0%	0.0%	16.3%
Moderate Extent	0.0%	0.0%	12.2%	0.0%	0.0%	12.2%
Fairly Great Extent	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%
Great Extent	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Curricular or pacing guide constraints**

Not at All	0.0%	0.0%	8.2%	0.0%	0.0%	8.2%
Small Extent	0.0%	0.0%	32.7%	0.0%	0.0%	32.7%
Moderate Extent	0.0%	0.0%	30.6%	0.0%	0.0%	30.6%
Fairly Great Extent	0.0%	0.0%	12.2%	0.0%	0.0%	12.2%
Great Extent	0.0%	0.0%	16.3%	0.0%	0.0%	16.3%

**When introducing changes in your practice based on your experience in the MOOC-Ed, to what extent... - Other (please describe)**

Not at All	0.0%	0.0%	80.0%	0.0%	0.0%	80.0%
Small Extent	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Moderate Extent	0.0%	0.0%	5.0%	0.0%	0.0%	5.0%
Fairly Great Extent	0.0%	0.0%	5.0%	0.0%	0.0%	5.0%
Great Extent	0.0%	0.0%	10.0%	0.0%	0.0%	10.0%

**To what extent do you agree with the following statements? This online professional development... - was enhanced by the expertise of practitioners and/or leaders in the field.**

Strongly Disagree	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%
Disagree	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%
Somewhat Disagree	2.2%	2.1%	1.9%	1.3%	0.0%	1.4%
Neither Agree nor Disagree	0.0%	2.1%	0.0%	6.4%	2.2%	3.4%
Somewhat Agree	28.3%	19.1%	16.7%	17.3%	8.7%	17.8%
Agree	37.0%	40.4%	44.4%	51.3%	54.3%	47.3%
Strongly Agree	32.6%	36.2%	37.0%	19.9%	34.8%	28.4%

**To what extent do you agree with the following statements? This online professional development... - provided models of effective practice (e.g. demonstrations, tools, resources) to support the application of course content.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	1.9%	1.3%	0.0%	0.9%
Somewhat Disagree	2.2%	2.1%	0.0%	0.0%	0.0%	0.6%
Neither Agree nor Disagree	4.3%	2.1%	0.0%	2.6%	2.1%	2.3%
Somewhat Agree	15.2%	12.8%	9.3%	9.6%	8.5%	10.6%
Agree	45.7%	48.9%	40.7%	51.9%	53.2%	49.1%
Strongly Agree	32.6%	34.0%	48.1%	34.6%	36.2%	36.6%

**To what extent do you agree with the following statements? This online professional development... - provided projects or activities that can be embedded in my professional practice.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	0.0%	2.1%	1.9%	1.3%	0.0%	1.1%
Somewhat Disagree	2.2%	0.0%	0.0%	0.0%	0.0%	0.3%
Neither Agree nor Disagree	8.7%	0.0%	5.6%	4.5%	2.1%	4.3%
Somewhat Agree	19.6%	10.6%	5.6%	9.6%	8.5%	10.3%
Agree	37.0%	42.6%	46.3%	47.4%	51.1%	45.7%
Strongly Agree	32.6%	44.7%	40.7%	37.2%	38.3%	38.3%

**To what extent do you agree with the following statements? This online professional development... - provided meaningful opportunities to share ideas, resources, and experiences.**

Strongly Disagree	0.0%	0.0%	0.0%	0.6%	2.1%	0.6%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	2.2%	4.3%	0.0%	0.0%	2.1%	1.1%
Neither Agree nor Disagree	8.7%	0.0%	3.7%	5.1%	6.4%	4.9%
Somewhat Agree	15.2%	19.1%	14.8%	12.8%	10.6%	14.0%
Agree	39.1%	36.2%	42.6%	46.2%	42.6%	42.9%
Strongly Agree	34.8%	40.4%	38.9%	35.3%	36.2%	36.6%

**To what extent do you agree with the following statements? This online professional development... - promoted critical-thinking and/or problem-solving through discussions and activities.**

Strongly Disagree	0.0%	0.0%	0.0%	0.6%	2.1%	0.6%
Disagree	2.2%	0.0%	0.0%	0.6%	0.0%	0.6%
Somewhat Disagree	0.0%	8.5%	0.0%	0.0%	4.3%	1.7%
Neither Agree nor Disagree	6.5%	0.0%	1.9%	3.8%	4.3%	3.4%
Somewhat Agree	10.9%	8.5%	11.1%	14.1%	4.3%	11.1%
Agree	47.8%	42.6%	40.7%	46.2%	51.1%	45.7%
Strongly Agree	32.6%	40.4%	46.3%	34.6%	34.0%	36.9%

**To what extent do you agree with the following statements? This online professional development... - provided supports for small-group work or collaborations around shared goals.**

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	2.1%	0.3%
Disagree	0.0%	2.1%	0.0%	1.3%	0.0%	0.9%
Somewhat Disagree	2.2%	4.3%	5.6%	1.9%	6.4%	3.4%
Neither Agree nor Disagree	24.4%	17.0%	5.6%	11.5%	10.6%	12.9%
Somewhat Agree	22.2%	10.6%	22.2%	13.5%	25.5%	17.2%

Agree	31.1%	44.7%	42.6%	45.5%	31.9%	41.3%
Strongly Agree	20.0%	21.3%	24.1%	26.3%	23.4%	24.1%

To what extent do you agree with the following statements? This online professional development... - enabled me to personalize my learning through differentiated resources and activities.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Disagree	2.2%	0.0%	0.0%	0.6%	0.0%	0.6%
Somewhat Disagree	2.2%	2.1%	1.9%	1.3%	0.0%	1.4%
Neither Agree nor Disagree	6.5%	6.4%	3.7%	6.4%	6.4%	6.0%
Somewhat Agree	19.6%	8.5%	7.4%	11.5%	21.3%	12.9%
Agree	39.1%	48.9%	51.9%	44.2%	38.3%	44.6%
Strongly Agree	30.4%	34.0%	35.2%	35.9%	34.0%	34.6%

To what extent do you agree with the following statements? This online professional development... - provided opportunities to investigate self-identified problems or areas of interests.

Strongly Disagree	0.0%	0.0%	0.0%	0.0%	2.2%	0.3%
Disagree	2.2%	0.0%	0.0%	1.3%	0.0%	0.9%
Somewhat Disagree	0.0%	4.3%	1.9%	0.6%	0.0%	1.1%
Neither Agree nor Disagree	6.5%	4.3%	5.6%	8.3%	2.2%	6.3%
Somewhat Agree	17.4%	10.6%	14.8%	7.1%	19.6%	11.7%
Agree	45.7%	42.6%	48.1%	48.7%	45.7%	47.0%
Strongly Agree	28.3%	38.3%	29.6%	34.0%	30.4%	32.7%

To what extent do you agree with the following statements? This online professional development... - provided flexibility in the ways in which I could demonstrate my learning.

Strongly Disagree	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Somewhat Disagree	0.0%	0.0%	0.0%	1.3%	0.0%	0.6%
Neither Agree nor Disagree	8.9%	4.3%	1.9%	5.8%	8.5%	5.7%
Somewhat Agree	8.9%	8.5%	16.7%	10.3%	19.1%	12.1%
Agree	48.9%	48.9%	51.9%	48.4%	36.2%	47.4%
Strongly Agree	33.3%	38.3%	29.6%	33.5%	36.2%	33.9%

To what extent do you agree with the following statements? This online professional development... - provided activities and/or resources to help me gauge my learning (e.g. self-assessments, peer assessment or feedback)

Strongly Disagree	2.2%	0.0%	0.0%	0.6%	0.0%	0.6%
Disagree	0.0%	0.0%	0.0%	1.3%	0.0%	0.6%
Somewhat Disagree	4.3%	2.2%	0.0%	1.9%	2.1%	2.0%
Neither Agree nor Disagree	8.7%	4.3%	1.9%	3.2%	8.5%	4.6%
Somewhat Agree	23.9%	17.4%	14.8%	10.9%	10.6%	14.0%
Agree	37.0%	43.5%	46.3%	48.1%	40.4%	44.7%
Strongly Agree	23.9%	32.6%	37.0%	34.0%	38.3%	33.5%

To what extent do you agree with the following statements? This online professional development... -

**clearly communicated the purpose, goals, and expectations of this course.**

Strongly Disagree	0.0%	0.0%	0.0%	0.6%	0.0%	0.3%
Disagree	0.0%	0.0%	0.0%	1.9%	0.0%	0.9%
Somewhat Disagree	2.2%	0.0%	0.0%	1.3%	2.1%	1.1%
Neither Agree nor Disagree	8.7%	2.2%	1.9%	5.8%	6.4%	5.2%
Somewhat Agree	6.5%	2.2%	7.4%	11.5%	14.9%	9.5%
Agree	41.3%	57.8%	44.4%	39.1%	29.8%	41.4%
Strongly Agree	41.3%	37.8%	46.3%	39.7%	46.8%	41.7%

**Were you able to complete all of the activities that you wanted to complete in this course?**

Yes	82.6%	86.7%	83.3%	91.5%	57.4%	83.8%
No. Please explain.	17.4%	13.3%	16.7%	8.5%	42.6%	16.2%

**This unit deepened my understanding of the topic(s) addressed. (Actual Number of Respondents: Total=2,386)**

1-2 hours per unit	19.6%	12.8%	11.1%	15.6%	14.9%	14.9%
3-4 hours per unit	45.7%	59.6%	35.2%	40.9%	44.7%	43.7%
5-6 hours per unit	28.3%	17.0%	42.6%	27.3%	27.7%	28.4%
7-8 hours per unit	4.3%	4.3%	11.1%	7.8%	10.6%	7.8%
more than 8 hours per unit	2.2%	6.4%	0.0%	8.4%	2.1%	5.2%

**Have you discussed or shared what you learned in this MOOC-Ed with any of the following? Please...**

Strongly Disagree	44.2%	29.5%	49.0%	64.4%	34.8%	50.8%
Disagree	55.8%	70.5%	76.5%	65.8%	71.7%	67.6%
Somewhat Disagree	27.9%	36.4%	39.2%	20.8%	41.3%	29.4%
Neither Agree nor Disagree	4.7%	11.4%	3.9%	6.7%	10.9%	7.2%

**This unit deepened my understanding of the topic(s) addressed. (Actual Number of Respondents: Total=2,386)**

School or district-based professional learning team	32.6%	17.4%	24.1%	30.7%	17.0%	26.3%
Online professional learning network (e.g. Twitter, Facebook group)	4.3%	2.2%	3.7%	2.6%	0.0%	2.6%
Informal group of colleagues	26.1%	28.3%	40.7%	34.6%	44.7%	35.0%
Other (please describe)	4.3%	0.0%	0.0%	2.0%	4.3%	2.0%
I did not participate and/or collaborate with anyone outside of the MOOC-Ed	32.6%	52.2%	31.5%	30.1%	34.0%	34.1%

## APPENDIX D: DESIGN PRINCIPLES ILLUSTRATIVE QUOTES

*Design Principle 1: Practice-Based.* Discussion to support educators applying course strategies, projects, and content in their professional practice.

*Table D.1 Evidence of Alignment to Practice Based Design Principle/ Value Add – Illustrative Quotes*

<b>Practice Based Principle</b>	<b>Illustrative Examples</b>
<p>(a) <i>Purpose, goals, and learning outcomes are clearly communicated, with support provided to help educators understand how they address educational standards or priorities in their local, regional, and/or national context.</i></p>	<ul style="list-style-type: none"> <li>• “I found looking at the sequence of fraction instruction in the CCSS beneficial. As a 5th and 6th grade educator, I have looked at deeply at my standards. I have looked briefly at the 4th grade standards to see what skills my students should be coming in with and I have also glanced at 7th grade standards to see where my students are going with the standards. Really understanding how the conceptual understanding grows from one grade level to the next is very helpful when knowing what students should have been exposed to”</li> <li>• “I lead secondary mathematics teachers and as our standards have called for a greater demand of teaching through application, I have used examples from the class such as the "what would you do next" scenarios with my team to guide their work as they coach teachers and in our professional development sessions. (Fractions)”</li> <li>• “By showing specific examples of what is meant by each standard was very helpful. I need to become more familiar and comfortable in the models demonstrated so that I can share with my students”</li> <li>• “I also appreciated the discussion on the Common Core Standards and the Emphasis overall on Fractions. It is interesting to collaborate across the nation and get ideas from other places.</li> </ul>
<p>(b) <i>Models of effective practice (e.g. strategies, tools, processes, etc.) are frequently provided to support the application of new learning into educators' professional settings.</i></p>	<ul style="list-style-type: none"> <li>• “I found that using the videos and the course readings was most helpful with my personal and professional learning goals. I was able to take a lot of this information back and use it in my classroom and pass it to my team members. It was very helpful with my growth as a teacher. (DLDL)”</li> <li>• “The most valuable part was the "What Would You Do Next" videos. I think we need to see the "look for(s)" in students' misconceptions. So often teachers put a check or X on an answer and that is as far as it goes. For students to understand teachers must become comfortable seeing misconceptions and addressing the understanding. (Fractions)”</li> </ul>

	<ul style="list-style-type: none"> <li>“Looking at the videos and then going through with, “What Would We Do Next” was really interesting. It’s always good to watch kids work, and I like being able to watch a video of that instead of having to do it. I like it in my own classroom too, but it’s hard. So it’s cool to be able to watch a video of a kid doing math and trying to think about what would I do as a teacher? And then reading what other people would do. (Fractions)”</li> </ul>
(c) <i>Course content is enhanced by the expertise of practitioners and leaders in the field (e.g. expert panels, case-studies, guest Q&amp;A, etc.).</i>	<ul style="list-style-type: none"> <li>“HollyLynne and the way she interacted with us were crucial for our learning. She was paying attention to all the forums and whenever there were any comments, and you ask her opinion, she was there responding. Because of her experience, it was very useful. (Stats)”</li> <li>“The most valuable aspect of the course for me was the expert panel videos. Because of where we are in Montana, we just don’t hear people, leading, cutting edge people, or leaders in mathematics education up here really ever, so to be able to hear the expert panel was really good.”</li> <li>“I really, really, REALLY enjoyed the expert panel interviews because there was just a wealth of knowledge from many perspectives.”</li> <li>“I appreciate the expert panel because they both explain and represent the spectrum of instruction. They readily tell of their experiences in the classroom and connect that to the research in which they are currently involved which makes for a shorter journey for us.”</li> </ul>
(d) <i>Authentic project-based activities result in a product or process directly connected to participants’ professional practice.</i>	<ul style="list-style-type: none"> <li>“The most valuable aspect of the course was developing my IDL, which I’ll be able to bring back to my PLC and share with my colleagues, who will hopefully tweak it and make it a really great and applicable project! (DLIDL)”</li> <li>“My recommendation is to provide specific tools and strategies for our daily lesson plans. Sometimes it is hard to select the right article between that many.(Disciplinary Literacy)”</li> <li>“The end product! [was the most valuable aspect of the course] I’m excited to be walking away from this course with something tangible that I can immediately apply to my teaching and share with my colleagues. (DLIDL)”</li> <li>“I think that this whole project has helped me gain a deeper understanding of the importance of building on student’s knowledge for fraction instruction. I feel that having the classroom project is a great way to use real world application to the objectives that were outlined in this course. (Fractions)”</li> <li>“I think the course project is really important. It’s hard to do, and it’s not something that I necessarily love, but I think it’s really important because</li> </ul>

	<p>one, our curriculum doesn't really align very well, so the project is a way that I know that they're going to be understanding fractions at a deeper level, which is really important. I also think that having to come up with the course project, and having to think about how you would apply your learning, it definitely makes it a deeper learning experience for me. (Fractions)"</p>
(e) <i>Data-informed activities enable participants to collect new data and/or use existing data to inform their work during and beyond the MOOC-Ed.</i>	<ul style="list-style-type: none"> <li>“Defining disciplinary literacy. The videos and readings made this explicit and were helpful. I look forward to learning how to apply all this in my classroom.(Disciplinary Literacy)”</li> <li>“I really enjoyed the videos with the math experts and also watching the math teacher use the multiple strategies approach. I learned a lot about avoiding mistakes in my teaching of fractions, especially when using manipulatives, that ultimately cause confusion with my struggling students. I have walked away from this unit with a renewed awareness of the need to focus on the unit of one whole.(Fractions)”</li> <li>“I thought Moje's (2012) article on disciplinary literacy for ELA instruction insightful for its views on how best to help students navigate the many disciplines they encounter in a school day.(Disciplinary Literacy)”</li> </ul>
(f) <i>Supports are provided to facilitate the integration of MOOC-Eds within local PD initiatives that provide face-to-face and hands-on activities, coaching, PLCs, or other professional learning experiences.</i>	<ul style="list-style-type: none"> <li>“The PLC questions for discussion were great too - they really sparked some nice discussion within my cohort. (DLDL.)”</li> <li>“I appreciate the information on the upcoming Classroom Activity so that I can prepare ahead of time. I also appreciated the discussion on the Common Core Standards and the Emphasis overall on Fractions. It is interesting to collaborate across the nation and get ideas from other places.(Fractions)”</li> </ul>

*Design Principle 2: Peer-Supported.* Educators cited opportunities for peer collaboration and discussion that supported their learning.

*Table D.2 Evidence of Alignment to Peer-Supported Design Principle/Value Add – Illustrative Quotes*

Peer-Supported Principle	Illustrative Examples
<p>(a) <i>Discussion/Reflection questions scaffold critical-thinking and group problem-solving.</i></p>	<ul style="list-style-type: none"> <li>• “Each unit began with a video and a question that asked what we would have done next with the student in that video. Reading postings from other educators was both a boost to my own self-confidence that I had reached the same or similar conclusions, or the other postings provided insight on different approaches for teaching the same concepts. (Fractions)”</li> <li>• “Input from the other participants was valuable”.</li> <li>• “Reading classmates posts. I learned a lot of new things that I can use in my classroom and share with my colleagues. Reading other teacher’s responses about frustrations, wins and losses with their own classes. That we are all on the same playing field, swinging for the fence, even if we feel like we are still in the dugout”.</li> </ul>
<p>(b) <i>Crowdsourcing activities promote the sharing and curation of resources, tools, and effective practices.</i></p>	<ul style="list-style-type: none"> <li>• “I thoroughly enjoyed reading all of the posts in this feedback. They provided some additional help and resources (along with the resources that were provided) to help better teach the concept of fair sharing.”</li> <li>• “I enjoyed learning about how everyone else was using digital literacy in their classrooms across the subject areas.”</li> <li>• “I enjoyed the discussions and I probably read more than I participated so I think that was still a valuable part. As I observed the exchange that was going on, I could see that teachers were truly learning from each other. (Fractions)”</li> </ul>
<p>(c) <i>Strategies are used to facilitate constructive peer feedback and/or coaching at various levels of support (e.g. forum replies and ratings, project peer review).</i></p>	<ul style="list-style-type: none"> <li>• “Getting feedback from peers regarding our proposals and specific activities to try with our students.”</li> <li>• “The most valuable aspect of the unit is the manner in which the information was organized and delivered. It was a good idea to have people get into groups by state...”</li> </ul>
<p>(d) <i>Educators are provided varied and ongoing opportunities to exchange opinions, experience, and information (e.g. discussions, twitter chats, polls, etc.).</i></p>	<ul style="list-style-type: none"> <li>• “The most valuable aspect of the course was the network of people. It is awesome to have access to others that are in your field with whom you can bounce ideas around. (Stats)”</li> </ul>

	<ul style="list-style-type: none"> <li>“The collaboration opportunities I think are the most helpful. I look forward to the discussion threads. It gives great insight as to what is going on in other states. (Fractions)”</li> </ul>
	<ul style="list-style-type: none"> <li>“For our project, another participant and I collaborated to create three lessons for our class. She teaches pre-service high school teachers and I teach high school kids. … The last two summers we have worked together in other online classes and kind of clicked. So I had signed up for this MOOC and she had signed up for it too. Then we said ‘hey let’s do our projects together.’ We’ve collaborated on some other stuff so we’re pretty good at emailing, calling, texting.”</li> </ul>
<p>(e) Learning activities provide opportunities for small-group work and/or collaboration on shared outcomes or goals.</p>	<ul style="list-style-type: none"> <li>“The most valuable part was the online collaboration happening with teachers around the world. I know a lot of teachers don’t have time to collaborate any more, and especially with statistics since very few math teachers ever teach statistics. It was nice to be able to communicate about statistics in a safe forum.”</li> <li>“This was my first MOOC and it was very interesting in terms of meeting other people. For instance, there was another teacher from Australia, and wow, her excitement was incredible. Also getting in touch with her was invaluable. There was no way we could do it unless we had something like this. For me it was a very interesting and rewarding experience. (Stats)” [University level participant from Honduras]</li> </ul>
<p>(f) Social supports (e.g. netiquette guidelines, ice breakers, overall tone) cultivate a general sense of collegiality and trust among participants.</p>	<ul style="list-style-type: none"> <li>“Hearing that I’m not alone in my desire to improve the way I approach the teaching of fractions &amp; that others have difficulties similar to mine.”</li> <li>“I think people are either going to communicate or not and you all did a good job in removing any barriers and making it a safe environment but it’s hesitation on people to say what they don’t know in the discussion group. (Fractions)”</li> <li>“I have taken some online courses before but, I think this course made the experience very personable…everything that you all included made it seem like we were really in a class and we were all there together. I love the two that were at the beginning of each unit and kind of summed up what we talked about so far and this what to expect and the guiding questions, so for me, this was a different experience from any online course I’ve ever participated in. (Fractions)”</li> </ul>

*Design Principle 3: Self-Directed.* Educators reported MOOC-Eds are helping them self-direct their learning.

*Table D.3 Evidence of Alignment to Self-Directed Design Principle/Value Add – Illustrative Quotes*

<b>Self-Directed Principle</b>	<b>Illustrative Examples</b>
<p><i>(a) Differentiated learning experiences are provided to address varied educator experience, role, competency and commitment.</i></p>	<ul style="list-style-type: none"> <li>• “I valued the different videos and articles regarding disciplinary literacy and the option to pick and choose those most applicable.”</li> <li>• “I knew this was geared towards the core subjects, but I don't think I realized how heavily it was designed that way. I wish there had been more information provided for other areas (CTE, Fine Arts, Healthful Living/PE, World Languages.)”</li> </ul>
<p><i>(b) A wide range of tools, strategies, and/or resources are available to support application of content in a variety of educational contexts appropriate to the intended audience.</i></p>	<ul style="list-style-type: none"> <li>• “Seeing discipline-specific examples of close reading was very helpful.”</li> <li>• “The most valuable aspect of this unit was a lot of real classroom situations that help me as a trigger to develop and adapt them to my subject.”</li> </ul>
<p><i>(c) Course clearly provides learners logical and varied pathways to help navigate the course based on their personal and professional learning goals.</i></p>	<ul style="list-style-type: none"> <li>• “I felt like there was flexibility as far as choosing topics that I wanted to respond to” [re: discussion forum]</li> <li>• “I am not a ms or hs teacher, but a faculty member who teaches content area reading - with a wish to move more towards a disciplinary literacy course. I do not particularly feel like I belong, but I believe there is much for me to learn here. (Disciplinary Literacy)”</li> </ul>
<p><i>(d) Educators are provided opportunities to investigate self-identified problems, areas of interest, or special topics related to their professional learning needs.</i></p>	<ul style="list-style-type: none"> <li>• “I found looking at the sequence of fraction instruction in the CCSS beneficial. As a 5th and 6th grade educator, I have looked at deeply at my standards. I have looked briefly at the 4th grade standards to see what skills my students should be coming in with and I have also glanced at 7th grade standards to see where my students are going with the standards. Really understanding how the conceptual understanding grows from one grade level to the next is very helpful when knowing what students should have been exposed to.”</li> <li>• “The selection of readings and video case reports was generally good. The articles provided some grounding in the research and there were descriptions of projects and videos of teachers modeling some of the methods.”</li> <li>• “The ability to bookmark the videos for referencing/sharing with my new</li> </ul>

	<p>teachers (I'm an instructional practices coach) is a great thing! :)"</p> <ul style="list-style-type: none"> <li>• "The pre-assessment help me reflect my own understanding of fraction. Video tapes are very helpful to monitor students' understanding and misunderstanding of fraction concepts."</li> </ul>
(e) <i>Educators are provided flexibility in demonstrating new knowledge and skills with ongoing opportunities for feedback.</i>	<ul style="list-style-type: none"> <li>• "The most valuable aspect of this unit was the access to the body of work of leading researchers in disciplinary literacy through video and text."</li> <li>• "The most valuable aspect of the unit is the manner in which the information was organized and delivered. It was a good idea to have people get into groups by state..."</li> <li>• "The ability to bookmark the videos for referencing/sharing with my new teachers (I'm an instructional practices coach) is a great thing! :)"</li> <li>• "Being able to communicate with my peers about literacy.(DLDL)"</li> </ul>
(f) <i>Educators are provided a variety of self-assessment strategies and tools to help monitor progress towards course outcomes and personal goals.</i>	<ul style="list-style-type: none"> <li>• "For me it was the self-assessment questions. Before taking this course, I was unaware of students' misconceptions regarding fractions. I did not understand how they saw fractions, but after taking this course I am more aware of their lack of understanding. Taking the self-assessment helped me better understand what they are thinking and why they think the way they do. It is interesting to see how much more clear fractions are for me, too. I thought that the pre-assessment questions were excellent!"</li> <li>• "Most valuable - self-assessment - it shows me that there are still a lot more that I can learn about fractions.(Fractions)"</li> <li>• "The pre-assessment help me reflect my own understanding of fraction."</li> <li>• "The self-assessment/ reflection questions and the answer of each question, explains the misconceptions of students on concrete questions, this Analysis of the different answers helped me a lot."</li> <li>• "I really liked the self-assessment and reflection. It helped me to really check my understanding and struggle with the concepts to see if I was correct in my understanding. The explanations were helpful as well."</li> </ul>

## APPENDIX E: PRODUCTIVE DISCUSSION ILLUSTRATIVE EXAMPLES

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The discussion forums are a primary means for participants to demonstrate their compression of unit concepts, and for course designers and facilitators to gauge participant understanding.

To help determine the extent to which forum participation resulted in these outcomes, the evaluation team examined a random sample (approximately 30%) of discussion threads from each course. The team used the Productive Online Discussion Model (Gao, Zhang, & Franklin, 2013) as a framework for the analysis. This framework highlights four learner dispositions that encompass a variety of cognitive and social activities: comprehension, critique, knowledge construction, and community.

Two evaluation team members, following analysis guidelines proposed by Lombard, Snyder-Duch, and Bracken (2002) to help ensure accuracy and consistency, reviewed and coded each posting in the sampled discussions. Instances of learner actions described in the framework were coded with a “1” if present and a “0” if absent and then postings assigned to each learner action and dimension were then reviewed to look for common themes. The tables presented below illustrate the range of cognitive and social activities encompassed by the discussions.

*Disposition 1: Discussion to Comprehend.* Learners actively engage in such cognitive processes as interpretation, elaboration, making connections to prior knowledge.

*Table E.1 Disposition 1. Discussion to Comprehend*

Learner Actions	Illustrative Examples
(a) <i>Interpreting or elaborating the ideas by making connection to the learning materials</i>	<ul style="list-style-type: none"><li>“The one problem many approaches correlated with what was said in the What Teachers Need to Know About Teaching Fractions video. Both emphasized teachers and students being able to represent fractions with multiple representations. I believe that the Build it Draw It Write About It method that was discussed helps aid in students seeing fractions in multiple ways.” [A-Fractions2]</li><li>“I thought the video was absolutely amazing. I was captivated. I would love to see my children engaged in that type of learning. I am no longer in the classroom but considering where I come from I’m not sure if what I in the video is possible.” [A-Disciplinary Literacy for Deeper Learning]</li><li>“The expert panel mentioned designing tasks that target concepts. Do small tasks that move your agenda of technology. Some of the simulation tools from Unit 2 would be useful.” [A-Teacher Statistics Through Data Investigations]</li></ul>

*(b) Interpreting or elaborating the ideas by making connection to personal experience*

- “I asked my second grade students what they thought was most difficult about fractions. Only a few wanted to comment. Most of them gave me a blank stare. However, one of my more advanced students summed it up with ‘the whole thing’. I hope by taking this class I can gain a better understanding of ‘the whole thing’ about fractions for my student as well as for myself.” [B-**Fractions2**]
- “I have used inquiry in the classroom through and I-Search project where students chose topics they were interested in and created questions they would like answered about that topic. Students used visual resources texts and were required to interview one person they considered to be an expert on the topic.” [B-**Disciplinary Literacy for Deeper Learning**]
- “These activities were full of various levels from the SASI framework. Students were posing relevant questions checking the simulations to see what changed and then posing more questions. I love how they spent so little time on the actual calculations and so much time posing and seeking answers to relevant questions. Students were engaged and not frustrated with tedious calculations.” [B-**Teacher Statistics Through Data Investigations**]

*(c) Interpreting or elaborating the ideas by making connection to other ideas, sources or references*

- “I agree with you Allison. I too think we are too quick to teach fractions with symbols and numbers. We are using a program in my school called ‘STMath’ to help students with math. I too see students thinking that the numerator and denominator are whole numbers. This misconception is more evident when they have to show fractions on a number line. Loved reading all the articles” [C-**Fractions2**]
- “I did a close reading of the webpage [http://www.pballewe.net/old\\_mutl.htm](http://www.pballewe.net/old_mutl.htm) I am a reader who definitely has to read things multiple times in order to make sense of them. I tend to skim over and get the main point on an article first and then go back and tackle the vocabulary and other parts.” [C-**Disciplinary Literacy for Deeper Learning**]
- “Hi Christian Yes the 6th grade team has to teach the math standards over and over using a variety of activities to reach the different middle school learners. The learners really enjoyed using the technology and data that TuvaLabs shares and they learned how to associate several attributes while they analyzed the data. :)” [C-**Teacher Statistics Through Data Investigations**]

*Disposition 2: Discuss to Critique.* Learners carefully examine other people's views, and are sensitive and analytical to conflicting views.

*Table E.2 Disposition 2. Discussion to Critique.*

Learner Actions	Illustrative Examples
<p>(a) Building upon others' posts by adding new insights or ideas</p>	<ul style="list-style-type: none"> <li data-bbox="660 612 1395 770">• “I have been to really good SDE conferences that discussed the importance of teaching students in order. Start with a hands on manipulative once they master that then move onto a pictorial representation and only after mastering pictorial are they ready to move to abstract symbols.” [A-<b>Fractions2</b>]</li> <li data-bbox="660 802 1395 1045">• “Cool! I can see your compelling question coming together with the text. I think this will really challenge your AG student. It is important to show your students the process you go through in reading math texts. They will begin to realize it is okay if they don’t fully understand the first time but the strategies you mentioned can help them interpret and make sense of the text after they read it multiple times. That will also help with perseverance!” [A-<b>Disciplinary Literacy for Deeper Learning</b>]</li> <li data-bbox="660 1056 1395 1298">• “This is a great way to try to end the age old debate: Pepsi or Coke. By having students undergo this statistical investigation it will be interesting to see what questions arise. I was thinking you could even add more flavors another time by having kids vote on the different Fanta flavors instead or have the students interview the student population by having them take a blind taste test and compile all of the data together of the choices made by students.” [A-<b>Teacher Statistics Through Data Investigations</b>]</li> </ul>
<p>(b) Challenging the ideas in the learning materials</p>	<ul style="list-style-type: none"> <li data-bbox="660 1341 1395 1510">• “One concern I have about what I have learned is how can reach pre-service and teachers already in service give these ideas and skills? New things are always being launched in the education field and so school districts try new things and implement new tools/strategies frequently and it is hard to keep up with the ever changing education field.” [B-<b>Fractions2</b>]</li> <li data-bbox="660 1541 1395 1869">• “One of the main challenges I see with this lesson is the educator’s comfort with the technology. Teacher comfortability with subject matter approach or implementation impacts the types of experiences that students have within schools. Another challenge could be access to technology; some students may not have a device capable of what is required or have access to high-speed internet. Finally I wonder how this lesson was differentiated to meet the needs of all learners. As mentioned earlier the prerequisite skills needed must be identified and addressed to some extent so that the playground is level and all are included equally in the collaboration” [B-<b>Disciplinary Literacy for Deeper Learning</b>]</li> </ul>

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| <p><i>(c) Challenging the ideas in others' posts</i></p> | <ul style="list-style-type: none"> <li>• “I completed the 1.5 concept assessment and got no feedback. My assumption was that this was a type of formative assessment and not summative assessment and it now seems to be. I also found the 30 questions quite tedious and repetitive. After the first 10 I started filling in random responses. Am very interested in finding out how others felt about this” [B-<b>Teacher Statistics Through Data Investigations</b>]</li> <li>• “I teach tier III math and while I love the use of manipulatives I struggle using them with this clientele. This may sound silly but I feel like it is a little counterproductive giving my students manipulatives then taking the one thing that affords them the opportunity to be successful away from them. I guess anymore my preferred method of instruction with tier III is a more basic pencil and paper method which students can always use no questions asked on state tests and anything else tossed their way.” [C-<b>Fractions2</b>]</li> <li>• “As much as I agree with you two about time to complete projects I have also seen a problem with teacher readiness to lead these projects. I semi-retired just as my school was supposed to launch into project-based learning and most teachers were ill-prepared for that. Basically the kids made a lot of posters and dioramas. There wasn’t any student-led work and some kids had no idea what the context or content was. So we can’t expect teachers to implement this approach without adequate training.” [C-<b>Disciplinary Literacy for Deeper Learning</b>]</li> <li>• “Do students really need the skill of creating charts and graphs as much as they do interpreting them? Maybe we should teach it the other way around and then when we run out of time they have done the important stuff.” [C-<b>Teacher Statistics Through Data Investigations</b>]</li> </ul> |
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*Disposition 3: Discuss to construct knowledge.* Actively negotiate meanings, and be ready to reconsider, refine and sometimes revise their thinking.

*Table E.3 Disposition 3. Discuss to construct knowledge.*

Learner Actions	Illustrative Examples
<p>(a) Comparing and contrasting views from the texts or others' posts</p>	<ul style="list-style-type: none"> <li>• “The One Problem Many Approaches correlated with what was said in the What Teachers Need to Know About Teaching Fractions video. Both emphasized teachers and students being able to represent fractions with multiple representations. I believe that the Build It Draw It Write About it method that was discussed helps aid in students seeing fractions in multiple ways.” [A-Fractions2]</li> <li>• “Great to meet you. I agree with your ideas around grammar instruction. I think that the best guide to grammar is through reading and writing. Reading comprehension is critical for students as they move through all levels of education., It is our number one priority as English teachers. In another post I read by Dala he mentioned the artistry of language and the effect it has meaning. I think this is really critical when looking at literacy devices...” [A-Disciplinary Literacy for Deeper Learning]</li> <li>• “When I read Hollylynne’s question my first thought was... we can’t teach everything as “procedure based.” ONE of the things that I love about the Connected Math Project (from Michigan State) is that lessons don’t begin with formulas. Students are encouraged to find answers via different avenues and there can be several different ways to get to an answer. Often the problem is viewed from a numerical standpoint looked at visually and the deriving of an abstract formula with variables is the last piece of the puzzle. Different learning styles and individuality are encouraged.” [A-Teacher Statistics Through Data Investigations]</li> </ul>
<p>(b) Facilitating thinking and discussions by raising questions</p>	<ul style="list-style-type: none"> <li>• “After getting caught up on the other posts I just had an idea. Do you think having her work with volume type examples would be good? Say measuring cups with sand or water or rice etc. That would give her the real life meaningful attachment/practicality of the question perhaps? Or would that be too confusing?” [B-Fractions2]</li> <li>• “Yes Jacqueline I see the problem of students trying to complete projects without reading objectives and skipping steps. They end up wasting time but that is their choice to make right? They do realize after some time that they need to go back and read something they’ve either missed or intentionally skipped.” [B-Disciplinary Literacy for Deeper Learning]</li> </ul>

*(c) Refining and revising one's own view based on the texts or others' posts*

- “If as math teachers we feel uncomfortable teaching statistics how do you think elementary teachers feel? They are expected to know how to teach concepts they may never have had as students.” [B-**Teacher Statistics Through Data Investigations**]
- “This was an interesting video. The student wasn’t aware that if the numerators are one that the fraction with the biggest denominator is actually the smallest fraction. I also have to be honest I have never heard of the butterfly method not as a student parent or teacher and so I am glad that I never learned it I think it would be confusing to students.” [C-**Fractions2**]
- “Kaitlin I just finished a PD course on ESL/ELL. My eyes were open to the many strategies one has to consider when teaching ESL/ELL students/learners. The most important fact from the course is to do what works best for each student.” [C-**Disciplinary Literacy for Deeper Learning**]
- “I have never used this data in my classroom but I could imagine having the students interact with this data could turn into very rich mathematical discussions. After a scaffolded introduction on how to navigate the website and maybe use Tuva Labs I think students would enjoy coming up with their own questions to see if there were any trends or relationships between question responses. Students would pose their own question do the research create a graphical display analyze the results and then present their findings to the rest of the class. I think I might do this!” [C-**Teacher Statistics Through Data Investigations**]

*Disposition 4: Discuss to share.* Actively encourage and support each other's thinking and share improved understanding based on previous discussions.

Table E.4 Disposition 4. *Discuss to share.*

Learner Actions	Illustrative Examples
<p>(a) Comparing and contrasting views from the texts or others' posts</p>	<ul style="list-style-type: none"> <li data-bbox="654 608 1405 699">• “Wow thanks so much for that insight from your students. Again it proves there is more than one way to solve a problem and we should listen more and let students talk more.” [A-Fractions2]</li> <li data-bbox="654 734 1405 946">• “Kami I like your inquiry projects. It would be cool to Skype with a classroom who did a similar project and shared their results. Love all that technology and I appreciate your comment Kathy that we can add some of those components even if we don’t have the same technology. I’m thinking about how to make lessons more engaging as well.” [A-Disciplinary Literacy for Deeper Learning]</li> <li data-bbox="654 982 1405 1100">• “I really like your idea of turning the Jane video into a project. I am in my first year of teaching and looking for great ways to engage students in meaningful tasks.” [A-Teacher Statistics Through Data Investigations]</li> </ul>
<p>(b) Facilitating thinking and discussions by raising questions</p>	<ul style="list-style-type: none"> <li data-bbox="654 1151 1405 1262">• “I agree with using manipulatives to show the ‘parts’ of the fraction. Using a transparent form would allow her to visualize that each half of the rectangle can be divided into several fractions” [B-Fractions2]</li> <li data-bbox="654 1298 1405 1564">• “I also am intrigued by the idea of using Fahrenheit 451. This also made me think about H.G. Wells’ The Time Machine in which the society of the future does not know how to read or use books. I wonder though if this is getting away from my original idea of books as escape. It seems to be separating the idea of books into a binary where there are ‘good’ societies that respect books and ‘bad’ societies that don’t. I guess I was thinking more along the lines of books as a way to remove oneself from a terrible situation.” [B-Disciplinary Literacy for Deeper Learning]</li> <li data-bbox="654 1600 1405 1812">• “Renard that’s an interesting idea about having students create a small computer program. I wonder whether the average statistics class would introduce programming concepts. If the class had a lab then students could get a chance to practice using technology. I think that showing them code without teaching them the basics of programming could be confusing though.” [B-Teacher Statistics Through Data Investigations]</li> </ul>

*(c) Refining and revising one's own view based on the texts or others' posts*

- “I like the idea of having her cut out the rectangles but when they are placed on the opposite square they won't align directly with the triangles halves. How would you explain this?” [C-Fractions2]
- “Luann and India I really like the combined question as well. Have you considered which texts will support this inquiry? It's probably a bit overly ambitious but one question that came to mind from your question is whether the picture of the American Dream changes over time - like do writers in the 20's hold a different view than writers in 2000's? That may be difficult to do unless your students read different American Dream themed texts from different periods. Great Start. Eric.” [C-Disciplinary Literacy for Deeper Learning]
- “Actually one of my main concerns is the relationship between stats and research methodology. Of course such course might go on a completely different direction if we deal with qualitative research but I do find they are closely related (methods and stats). That's why the statistical investigation cycle has been such an eye opener for me. Has anybody tried combining the two disciplines into one course? context-variability-uncertainty: a powerful tri.” [C-Teacher Statistics Through Data Investigations]

Table E.5 Total instances of learner actions described in the framework as coded with a “1” if present.

Disposition Title	Aggregate	Literacy1	Fractions1	Literacy2	Fractions2	Statistics
<b>Disposition 1: Discussion to Comprehend</b>						
Elaborate on learning materials	673	131	69	39	292	142
Elaborate on personal experiences	1724	311	183	209	826	195
Elaborate on sources	535	143	49	95	178	70
<b>Disposition 2: Discuss to Critique</b>						
Building on others' post	1369	302	190	139	591	147
Challenge ideas of MOOC materials	132	48	12	17	34	21
Challenge others' post	137	38	18	25	46	10
<b>Disposition 3: Discuss to construct Knowledge</b>						
Compare and contrast from others	59	23	5	1	25	5
Facilitate thinking by raising questions	510	104	45	75	197	89
Refining and revising one's own view based on others	366	47	70	19	188	42
<b>Disposition 4: Discuss to Share</b>						
Showing support and appreciation	591	13	9	61	431	77
Synthesizing discussion contents	63	17	5	2	36	3
Coming up with ideas or questions that invite further discussion	130	21	0	16	77	16
Totals	3357	1198	655	698	2921	817

## APPENDIX F: MOOC-ED EVALUATION PARTICIPANT INTERVIEW PROTOCOL

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Following a mid-course email solicitation, a representative sample of participants were selected based on their educational role and extent of engagement. A semi-structured phone interview (30-60 min) was designed to gather feedback regarding motivations, perceived value, recommendations, and application to practice. Audio recordings were transcribed and open-coded by one Team member using Atlas.ti software who then consolidated quotes by themes.

### ***Statistics MOOC-Ed Evaluation Participant Interview Protocol***

1. Please tell me about your **current role**.
2. **Motivation.** What initially motivated you to enroll in the **Teaching Statistics Through Data Investigations** MOOC-Ed course? Was your goal realized?
3. **Value.** What have been the most valuable aspects of the course?
4. **Application to practice (teacher):** To what extent, if any, have you used what you learned through participation in the course to change your practices in teaching statistics? Can you provide a specific example? Were there any resources from the course that you used (or plan to use) with your students? How do you think those resources will be helpful in supporting your students learning of statistics?
5. **Application to practice (non-teacher).** In what ways, if any, are you applying or do you plan to apply what you learned in the MOOC-Ed to your professional practice? Can you provide a specific example?
6. **Impact on student learning (teacher).** In what ways, if any, do you feel that the activities you've engaged in with your students as a result of your participation in this MOOC-Ed have impacted their learning? Can you provide a specific example?
7. **Discussion Forums.** To what extent, if any, did you engage with your peers in the discussion forums. Please tell me about the nature of those interactions. In what ways might MOOC developers further foster and support those interactions?
8. **Course Project.** Did you complete a project for the course? Please describe your project.

- a. To what extent, if any, did the project directly support or contribute to your learning and/or professional practice? (Or .... Was the project a worthwhile use of your time?) Please explain.
  - b. To what extent did you receive feedback on your project from fellow participants?
  - c. Did you collaborate with any fellow MOOC participants on the project? If so, can you tell me about that experience?
    - i. In what ways, if any, did the collaboration contribute the value of the project experience?
    - ii. What challenges, if any, did you face in collaborating with other participants?
    - iii. What additional support or scaffolding might the MOOC developers provide for participants who wish to collaborate?
    - iv. If you did not collaborate on the course project, were there particular reasons or barriers to collaboration that impacted your choice?
    - v. In what ways, if any, do you intend to use your project in the future?
9. **Blended learning model.** Often our MOOC-Ed participants use the MOOC as part of a blended learning model in their local settings. Did you participate in the MOOC-Ed as part of a blended learning model (formal or informal)? Please tell me more about how that worked.
  - a. Would you recommend this to future participants? Specific suggestions?
10. **Additional topics.** If our team developed additional MOOCs on teaching statistics, are there specific topics, resources, or approaches that you think would be useful to include?
11. **Follow-up/impact on practice.** In addition to talking with MOOC participants at the end of the MOOC course, we are also interested in following up with a few participants 3-6 months down the road to glean further insight to the ways and extent to which you are applying what you learned. Would you be willing to engage in a short follow-up conversation with me by phone in a few months?

12. Those are all of the questions I have for you today. Is there anything else you would like to share with me about your experience in the **Teaching Statistics Through Data Investigations** MOOC-Ed? Suggestions for improvement?

***Fractions MOOC-Ed Evaluation Participant Interview Protocol***

1. Please tell me about your **current role**.
2. **Motivation.** What initially motivated you to enroll in the Fraction Foundations MOOC-Ed course? Was your goal realized?
3. **Value.** What have been the most valuable aspects of the course?
4. **Application to practice (teacher):** To what extent, if any, have you used what you learned through participation in the course to analyze your own students thinking about fractions? Can you provide a specific example? (fair sharing activities?; measurement/numberline activities?; activities to help students understand why procedures for computations with fractions make sense?)

**Application to practice (non-teacher).** In what ways, if any, are you applying or do you plan to apply what you learned in the MOOC-Ed to your professional practice? Can you provide a specific example?

5. **Knowledge capital (teacher).** What did you learn (from this experience) as a teacher?
6. **Impact on student learning (teacher).** In what ways, if any, do you feel that the activities you've engaged in with students as a result of your participation in this MOOC-Ed have impacted their learning? Can you provide a specific example?
7. **Discussion Forums.** To what extent, if any, did you engage with your peers in the discussion forums (e.g. "What would you do next?"). Please tell me about the nature of those interactions. In what ways might MOOC developers further foster and support those interactions?
8. **Course Project.** Did you complete a project for the course? Please describe your project.
  - a. To what extent, if any, did the project directly support or contribute to your learning and/or professional practice? (Or .... Was the project a worthwhile use of your time?) Please explain.

- b. To what extent did you receive feedback on your project from fellow participants?
  - c. Did you collaborate with any fellow MOOC participants on the project? If so, can you tell me about that experience?
    - i. In what ways, if any, did the collaboration contribute the value of the project experience?
    - ii. What challenges, if any, did you face in collaborating with other participants?
    - iii. What additional support or scaffolding might the MOOC developers provide for participants who wish to collaborate?
    - iv. If you did not collaborate on the course project, were there particular reasons or barriers to collaboration that impacted your choice?
    - v. In what ways, if any, do you intend to use your project in the future?
9. **Blended learning model.** Often our MOOC-Ed participants use the MOOC as part of a blended learning model in their local settings. Did you participate in the MOOC-Ed as part of a blended learning model (formal or informal)? Please tell me more about how that worked.
  - a. Would you recommend this to future participants? Specific suggestions?
10. **Follow-up/impact on practice.** In addition to talking with MOOC participants at the end of the MOOC course, we are also interested in following up with a few participants 3-6 months down the road to glean further insight to the ways and extent to which you are applying what you learned. Would you be willing to engage in a short follow-up conversation with me by phone in a few months?
11. Those are all of the questions I have for you today. Is there anything else you would like to share with me about your experience in the Fraction Foundations MOOC-Ed? Suggestions for improvement?

***Disciplinary Literacy for Deeper Learning MOOC-Ed Evaluation Participant Interview Protocol***

The Disciplinary Literacy for Deeper Learning MOOC-Ed is designed for educators in K-12 and postsecondary levels who are interested in learning more about disciplinary literacy for deeper learning.

### **Motivation and Value**

1. \*Please tell me about your current role.
2. What initially motivated you to enroll in the Disciplinary Literacy for Deeper Learning MOOC-Ed course? Was your goal realized?
3. What were the most valuable aspects of the course?
4. To what extent did you gain a better understanding of what it takes to engage students in deeper learning through disciplinary literacy practices Please explain.
5. What new mindsets or “habits of mind” have you cultivated as a result of your participation in this course?

### **Collaboration**

6. To what extent, if any, did you engage with fellow MOOC-ed participants in the discussion forums? Please tell me about the nature of those interactions. In what ways might MOOC developers further foster and support those interactions?
7. Did you participate in the MOOC-Ed with one or more peers (e.g. as a PLC within your school or district)? Please tell me more about how that worked.
  - a. Would you recommend this to future participants? Specific suggestions?

### **Course Design**

8. As you navigated through the units of the course, what aspects tended to draw you in the most? Which elements of the course did you skip? Why?
9. The DLDL design team will be revising the course for a second run this spring. They are interested in feedback from participants on the course resources. Do any resources stand out in your mind as being particularly useful and/or relevant to your practice? Were there any types of resources that you tended to skip? Please explain.

### **Application to Practice**

10. To what extent, if any, have you applied what you learned through participation in the course to make changes in your professional practice? Can you provide a specific example? Additional prompts ...
  - a. Engaging students in disciplinary practices (e.g. close reading, digital learning, constructing and supporting claims)?

- b. Applying tools introduced in the MOOC-Ed in working with your own students?
- c. Designing inquiry-based disciplinary literacy lessons?
- d. Taking action to become a teacher leader by engaging others in disciplinary literacy practices.

### **Impact**

11. In what ways, if any, do you feel that the activities you've engaged in with students as a result of your participation in this MOOC-Ed have impacted their learning? Can you provide a specific example?

### **Additional**

Those are all of the questions I have for you today. Is there anything else you would like to share with me about your experience in the Learning Differences MOOC-Ed? Suggestions for improvement?