

IMPACTS OF A TEACHING STATISTICS MOOC ON EDUCATORS' PERSPECTIVES AND PRACTICE

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In many countries, professional development of teachers' statistical content and pedagogy occurs on a small local scale. To provide learning opportunities for more teachers across geographic boundaries, one effort, the Teaching Statistics Through Data Investigations MOOC, has focused on leveraging the internet to provide a free and open access solution. From 2015-2017, 2525 educators from 50 US states and 84 countries participated in six offerings of the course. We will briefly describe the course design and how educators with diverse characteristics and experiences engaged in course material. We examined forum data, end-of-course surveys, and follow-up surveys and will report on how the course impacted participants' perspectives about statistics and teaching statistics, and their self-reports of how they implemented new ideas in their practice.

INTRODUCTION

In the US and other countries, statistics has gained more prominence in school curricula (Franklin et al., 2007). While the role of statistics within curriculum varies amongst countries, it is typical that statistics is taught within a mathematics curriculum (Zieffler, Garfield, & Fry, 2018). Further, mathematics teachers who teach statistics have often had limited educational experiences in statistics education themselves (Burrill & Biehler, 2011) and are trained in programs that do not support becoming effective statistics teachers (Zieffler et al., 2018). Many agree that statistical thinking is inherently different than mathematical thinking (e.g., delMas, 2004). Thus, an important goal of statistics teacher education is to support teachers in developing their statistical content knowledge, as well as their pedagogical knowledge, so they can design learning environments that support students' development of statistical reasoning. In part, this involves providing opportunities for teachers that may challenge their perspectives about the nature of statistics and teaching statistics. We discuss a way of leveraging the internet to assist in providing an online professional development (OPD) course that is free, open access, and can reach many teachers across geographic boundaries (Kim, 2014). We investigate the following: *How can participation in an online professional development course impact educators' perspectives about the nature of statistics and teaching statistics? How do educators implement new ideas in their practice?*

LITERATURE

Beliefs and perspectives about statistics include an educator's ideas about the nature of statistics, about oneself as a learner of statistics, and about the classroom context and goals for students' learning statistics (Gal, Ginsburg, & Schau, 1997; Pierce & Chick, 2011; Eichler, 2011). Specific beliefs likely result in different approaches to teaching. For example, if a teacher believes that statistics is a way of quantifying data and that procedures for computing measures lead to such quantification, his or her teaching practices may favor statistical procedures and have less emphasis on the context of the data, the process of ensuring good data is collected and available (sampling methods), and making claims about data that are uncertain in nature (Pierce & Chick, 2011). Further, the focus of teachers' intended curriculum in statistics can be considered on a continuum from traditionalists (focused on procedures absent of context), to those wanting students to be prepared to use statistics in everyday life (focused on engaging in an investigative process that is tightly connected to contexts of real data) (Eichler, 2011). Professional development (PD) should move teachers along this continuum towards a focus on investigative processes, which requires impacting teachers' beliefs about the nature of statistics and statistical learning goals for students.

PD that includes accessible, personalized, and self-directed elements can provide increased opportunities for sustained, collaborative and meaningful work among teachers that can affect their knowledge, beliefs and practice (e.g., Vrasidas & Zembylas, 2004). Researchers have found that OPD addressing various needs and abilities of participants can be effective in changing teachers'

instructional practice (e.g., Renninger et al., 2011). Designers of OPD should be especially mindful that activities are meaningful, accessible and relevant so participants can apply their learning to their educational context (Ginsburg, Gray, & Levin, 2004; Vrasidas & Zembylas, 2004).

Just as communities of practice can exist in face-to-face PD, OPD should facilitate development of an online community of practice (CoP). Researchers have highlighted benefits of such communities that are not always afforded in traditional face-to-face PD. For example, Mackey and Evans (2011) argued that online CoPs provide members with “extended access to resources and expertise beyond the immediate school environment” (p. 11), thereby offering ongoing PD and the potential for increased application in their classroom. Designers of OPD should build infrastructure to support such communities across geographic and time zone boundaries. Asynchronous discussion forums, for example, provide opportunities for participants to reflect on practice, exchange ideas, and discuss ways to improve on their own schedules with colleagues with whom they may not otherwise interact (Treacy, Kleiman, & Peterson, 2002).

ONLINE PROFESSIONAL DEVELOPMENT AND CONTEXT

In the *Teaching Statistics Through Data Investigations* (TSDI) course, participants considered the teaching and learning of statistics in ways that likely differed from their own practices and past experiences. TSDI did not focus on specific grade levels or specific statistical content; rather, the course was designed to support teachers in envisioning statistics as an investigative process, promote statistical habits of mind, and view learning statistics from a developmental perspective. It was designed as a free online course that utilized open resources and technology tools in five units over 10-15 weeks. For a detailed discussion of the design of the TSDI course, see Lee, Lovett, and Mojica (2017).

PARTICIPANTS, DATA SOURCES, AND ANALYSIS METHODS

A total of 2525 educators enrolled in six sections of the course from Fall 2015 to Fall 2017. Participants resided in 84 countries, with majority in the US (79%), including all 50 US states. Within the US, most participants resided in the Northeast (41%), while 22% lived in the South, 20% lived in the Midwest, and 17% resided in the West. The majority were female (66%). Twenty-one percent of participants held a 4-year college degree, while most held advanced degrees (54% and 21% had obtained a master’s degree and PhD, respectively). The majority of participants identified themselves as classroom teachers (61%). Participants’ background with respect to number of years of experience was diverse, with a mean of 14 years (20% had 1-5 years, 19% had 6-10 years, 18% had 11-15 years, 16% had 16-20 years, 21% had more than 20 years).

Course activity was tracked through click logs that allowed us to examine trends in participants’ engagement with materials and resources in the course. This data was displayed in a dashboard in Tableau, allowing us to visualize participants’ engagement over time. Three other sources of data were used in this study: 1) discussion forum posts from two forums in Unit 5, 2) open-ended responses to end-of-courses surveys (administered at the end of Unit 5), and 3) a follow-up survey (administered approximately 6 months after course completion). In an earlier study of classroom teachers in the Fall 2015 section, Lee et al. (2017) reported four themes to describe changes in participants’ beliefs and perspectives about statistics and teaching statistics. We extended our analysis in this study to not only include classroom teachers but *all* participants. Each of the 721 posts was coded for one of these themes. In addition, we identified new themes that emerged. Each post from three course offerings was initially coded. Once we were saturated in data and no new themes were emerging, we confirmed codes in the Unit 5 posts from the remaining sections. End-of-course and follow-up surveys were analyzed using open coding.

RESULTS

Engagement

Of the total number of enrollees, only 1737 (69%) participants accessed material/resources in the course. Across the six sections, 1441 of those who registered engaged in the Orientation Unit. Of those that participated in the Orientation Unit, 71% engaged in Unit 1 and only 47% participated in Unit 2. Participation in Units 3 and 4 were very similar, 38% and 33%, respectively,

while only 26% of those who started the course completed Unit 5. Of those who registered, 959 (38%) posted to a discussion forum. There was a total of 2164 discussion forum threads, and 6381 total posts across all six sections, with an average of 6.65 responses per forum participant.

Impact on Perspectives about the Nature of Statistics and Teaching Statistics

Based on coding forum data, eight major themes emerged in relation to changes in participants' beliefs and perspectives about statistics and teaching statistics:

- statistical thinking involves different processes than mathematical thinking;
- engaging in statistics should involve exploring data;
- posing good statistical questions and selecting a context that is interesting/relevant to students is important in engaging students in statistical thinking;
- engaging in statistics is more than computations and procedures and should include investigative cycles and habits of mind;
- engaging in statistics is enhanced by the use of dynamic technology;
- engaging in statistics requires real (and messy) data;
- statistical thinking develops along a continuum; and,
- teachers do not have to know all answers when engaging students in the investigative cycle.

Overall, the majority of participants reported feeling more confident about teaching statistics, and some expressed an increase in content and/or pedagogical knowledge in relation to statistics. Some participants shared that participating in the course with colleagues increased their confidence or knowledge; however, others indicated that they lacked physical brick and mortar support within their local teaching context, which they felt they got within the course. A Spring 2017 participant stated, "I have no opportunity for collaboration other than on forums such as this one but at the same time I have autonomy to try and do what I want in my class. This course has given me so many resources to continue to improve my teaching without the support of others at my school."

Implementation of New Ideas in Practice

On the end-of-course survey, participants reported that they planned on using or had implemented resources from the course. While most participants mentioned resources in general, many specified particular resources or activities (e.g., Census at School, Gapminder). Others cited dynamic software/technology in general, some identifying specific tools, like StatCrunch or Tuva.

Based on the follow-up survey, 84% of participants indicated they acquired knowledge and skills based through their participation in the TSDI course. Of those that indicated that their knowledge/skills increased, 63% signified that they had applied this in their practice while only 45% reported that newly acquired knowledge/skills had an impact on student learning. For example, a Fall 2016 participant indicated he had done "more interactive data explorations in class (having gained the confidence to try them instead of lecturing material as students)". Another Fall 2016 participant said that she was "trying to use more data that the students can relate to and is more real-world applications and not just problems from a book". Participants also reported that they used specific tasks, websites, technology tools, and other resources in their practice. For example, a Spring 2016 participant indicated he had changed his practice with an "integration of technology definitely. I was exposed to some really good tools". A participant from Summer 2016 explained that she now "used the resources and framework for choosing and developing tasks" in planning her lessons.

DISCUSSION

There is evidence that participating in OPD has the potential to challenge educators' beliefs and perspectives about statistics and teaching statistics, and these experiences can lead to implementing these ideas in practice. In accordance with Treacy et al. (2002), we found that for some, experiences interacting with other educators in asynchronous discussions provide necessary support for those whom may not have opportunities to interact with other educators about statistics teaching. Engagement in such courses can be a powerful experience in supporting teachers' professional learning, allowing statistics teacher educators to influence many teachers across geographic boundaries (Kim, 2014). The themes we identified from participants' comments at the

end of the course (forums and survey) and the self-reported changes in their practices suggest that the TSDI course, and perhaps other similar OPD about teaching statistics, can be successful in shifting teachers' perspectives about the nature of statistics and their use of real world contexts and investigations in their teaching that align with Pierce and Chick (2011) and Eichler (2011).

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