Reflections on the Current and Potential K-12 Impact of the *Journal of Statistics and Data Science Education*

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**ABSTRACT**

The *Journal of Statistics and Data Science Education (JSDSE)* has a history of initiatives to expand its readership and impact. In this article, we reflect on JSDSE’s relevance to K-12 education and how it might increase its influence in this area. We characterize JSDSE’s K-12 impact partially in terms of its ability to foster statistical knowledge for teaching (SKT). We also introduce a new construct, statistical knowledge for the transformation of teaching (SKT\textsuperscript{2}), to more fully capture the K-12 contributions JSDSE can make. Our analysis draws upon the perspectives of an experienced high school teacher (the first author) and a statistics education researcher (the second author). The first author of the article surveyed recent JSDSE issues to identify and reflect upon articles with implications for his teaching practice. The second author framed the first author’s article reflections in terms of their connections to SKT and SKT\textsuperscript{2}. Drawing upon our collaborative analysis, we propose strategies to help JSDSE more fully realize its potential to contribute to SKT and SKT\textsuperscript{2}. We explain how acting on the proposed strategies may help JSDSE readers, authors, and editors bridge the persistent historical gap between formal scholarship and practice in K-12 education.

**KEYWORDS**

Assessment; Curriculum; Education; Pedagogical content knowledge; Professional development; Statistical knowledge for teaching

1. Introduction

The *Journal of Statistics and Data Science Education (JSDSE)* has a long history of making scholarly work accessible to a wide audience. As the journal was founded, Arnold (1993) stated that it was “intended to be international in scope, dedicated to improving all postsecondary statistics education, and crossing both disciplinary and national borders” (n. p.). The intended audience encompassed those teaching “pure” statistics as well as those teaching statistics in various disciplines such as psychology, economics, and biology.

As the journal grew, efforts to expand its reach grew as well. For example, in 2007, a new department, “From Research to Practice,” was established to encourage conversations about using research to inform teaching. The journal's readers were invited to craft submissions by “finding a research article of interest, reading and reflecting on it, implementing ideas from the paper in their classes, assessing the results, writing up their findings, and submitting it” (Miller 2007, n. p.). Another new department, “Research on K-12 Statistics Education,” was later established to encourage study of precollege teaching and learning of statistics (Jacobbe 2013). Although the journal’s original intended audience was those teaching college-level statistics, it has expanded to include K-12 issues. The journal’s efforts to expand its K-12 content and connect research to practice, along with the fact that it is freely available online, make it a potentially powerful catalyst to help improve K-12 teaching and learning.

2. Purpose

In this article, we aim to support JSDSE’s goal of improving K-12 statistics education by reflecting on the journal’s current and potential impact in this area. Our reflections draw upon our backgrounds in K-12 education and statistics education research. The first author of this article is a high school teacher. When the article was written, he had 7 years of teaching experience at a rural high school of approximately 500–600 students and had taught AP Statistics each year to classes ranging between 10 and 25 students in size. He also had served as an official AP Statistics exam scorer. The second author is a university faculty member and researcher in the field of statistics education. He has investigated the nature and importance of statistical knowledge for teaching and has published such work in JSDSE and in other venues. Collectively, our reflections highlight directions JSDSE has taken, and may be able to take in the future, to publish content addressing the needs of K-12 statistics teachers. We offer these reflections as food for thought for JSDSE readers, contributors, and editors.

3. Method

A reading response journal (Lee 2008) constructed during a 5-week independent study course provided the initial collaboration space for the reflections reported in this article. The second author, who served as course instructor, elicited the first
author’s initial impressions of JSDSE by asking him to browse recent volumes of the journal and select articles with relevance to his teaching practice. Each week, the first author selected three articles from a volume of JSDSE published within the past five years, initially attending to articles with value for teaching AP Statistics. As the first author carried out this task, he wrote reflections on how each selected article could inform his practice and uploaded the reflections to an online course management system. The second author then wrote detailed feedback on the first author’s journal entries to prompt additional reflection on implications for statistics education. Providing such feedback on written journal entries can be a powerful technique to foster and deepen reflection (Pieper et al. 2021). At the end of each week of the course, the two authors met to discuss the reflections and feedback. These discussions helped identify additional possible implications for teaching AP Statistics and K-12 education in general. A subjectively chosen sample of 15 articles was discussed using this process.

We note that our overall goal was not to conduct an exhaustive review of journal content, but rather to identify some articles that may be most salient to a teacher encountering the journal for the first time and to reflect on the professional development value of those articles. We believed that focusing on articles that initially stood out the most to a practicing teacher would be valuable because the internet contains an overwhelming amount of both high-quality and low-quality material competing for teachers’ attention. To make an impact, high-quality online material like that offered in JSDSE must capture readers’ attention. Individuals tend to skim and scan webpages for information relevant to specific tasks and questions they have, and they quickly move on if they do not find content of interest and relevance (Redish 2007). First impressions are hence important objects of study when assessing the impact of online material.

As we discussed the first author’s initial impressions of JSDSE content, the second author recognized some aspects of JSDSE’s potential to enhance readers’ statistical knowledge for teaching (SKT). SKT is not common disciplinary knowledge of statistics alone; it also includes pedagogical content knowledge, which helps one make subject matter comprehensible to students (Shulman 1987; Groth 2013). Along with SKT connections, some of the selected articles also had the potential to enhance readers’ knowledge of ways to diagnose and improve large-scale infrastructure needed to support the teaching of statistics. We characterize such knowledge by introducing the construct of statistical knowledge for the transformation of teaching (SKT2). Whereas SKT can have a profound impact on student learning in a single classroom, SKT2 has an impact across multiple classrooms to improve the overall education system.

### 4. Characterizing JSDSE’s Potential Impact on SKT

Pedagogical content knowledge components of SKT include knowledge of content and students, knowledge of content and teaching, and knowledge of curriculum (Hill, Ball, and Schilling 2008; Groth 2021). Knowledge of content and students involves knowing how students commonly understand, and misunderstand, statistics content. Knowledge of content and teaching allows teachers to select pedagogical strategies that leverage existing student understandings and address common misunderstandings. Knowledge of curriculum involves understanding frameworks and learning progressions that can be used to support the teaching of statistics. Connections between these three components of pedagogical content knowledge and the JSDSE articles selected during the first author’s survey of the journal are summarized in Table 1 and discussed in this section.

### 4.1. Knowledge of Content and Students

JSDSE contains a variety of articles to help develop the knowledge of content and students component of teachers’ pedagogical content knowledge. Tunstall’s (2018) article, “Investigating College Students’ Reasoning With Messages of Risk and Causation,” stood out to us in this regard. Tunstall found that the majority of college students entering a quantitative literacy course agreed with a newspaper article containing flawed statistical claims. Especially concerning was that students tended to accept the claims even when acknowledging that they lacked supporting evidence. Most of the students in Tunstall’s study were taking the quantitative literacy course to satisfy a university mathematics requirement, so the relevant knowledge they brought to bear was largely developed during their K-12 experiences. For the first author of this article, Tunstall’s findings underscored the importance of having high school students evaluate media reports with a critical eye toward claims

| Knowledge component | Description (Groth 2021) | Relevant JSDSE articles |
|----------------------|--------------------------|-------------------------|
| Knowledge of content and students | Knowing how students commonly understand, and misunderstand, statistics content | Specific activities to use as the basis for a lesson on a given statistical idea: Burke, Goukasian, and Shearer (2020), Campbell and Hanley (2017), and Ross (2017) General strategies to use in a variety of statistics lessons: Arnold and Franklin (2021) |
| Knowledge of content and teaching | Allows for the selection of pedagogical strategies that leverage existing student understandings and address their common misunderstandings | Comparisons of statistics curriculum structures: Brisbin and do Nascimento (2019), Hahs-Vaughn et al. (2017), and Latif and Miles (2020) |
| Knowledge of curriculum | Provides understanding of the broad frameworks and learning progressions that generally undergird the teaching of statistics | |
of correlation and causation. Moreover, the development of a critical eye should begin before high school; research tells us that "students need to begin at an early age to become data-savvy" (Bargagliotti et al. 2020, p. 7). Being able to anticipate and subsequently address prevalent student reasoning patterns as they learn to question statistical claims is one of the cornerstones of effective teaching (Stein et al. 2008), and articles like Tunstall's can help teachers do so.

In addition to developing knowledge of content and students through articles like Tunstall's, teachers can also do so by carefully probing their own students' thinking. Several articles with guidance for conducting authentic, comprehensive assessments of students' statistical reasoning stood out to the first author in his initial review of JSDSE. For example, in the article "Preservice Secondary Mathematics Teachers’ Statistical Knowledge: A Snapshot of Strengths and Weaknesses," Lovett and Lee (2018) modeled the use of an assessment framework that requires carefully examining knowledge of all phases of statistical investigation, including formulating questions, collecting data, analyzing data, and interpreting results. Drawing teachers' attention to assessing thinking related to all phases of statistical investigation is particularly important given that many K-8 and high school curricula students experience fail to emphasize the critical phases of formulating questions and collecting data (Shaughnessy 2007). AP Statistics prioritizes the study of all phases of investigation, but the study of all phases can and should begin in the early grades (Bargagliotti et al. 2020).

It can be challenging to assess students' reading, writing, and communicating when their work pertaining to all phases of an investigation is assessed, but the JSDSE article “Statistical Literacy: Misuse of Statistics and Its Consequences” (Johannssen et al. 2021) provides some helpful strategies to consider. Assessment ideas from the article that can be applied broadly include having students do peer reviews of one another's work and having them do oral presentations of their finished products. The first author of this article was also intrigued by Hudiburgh and Garbinsky (2020) ideas for making assessment even more authentic by evaluating projects conducted over an entire semester in "Data Visualization: Bringing Data to Life in an Introductory Statistics Course." Such articles provide a vision for authentic assessment practices that are alternatives to more procedural and fragmented approaches. Students can conduct and report on their own statistical investigations at both the K-8 (English 2014) and high school (Groth and Powell 2004) levels.

4.2. Knowledge of Content and Teaching

Knowledge of content and teaching can be developed through teachers' interactions with JSDSE content as well. JSDSE contains an extensive collection of articles about lessons that support active learning of statistics. Several of these articles caught the first author's attention as he surveyed the journal for the first time. For example, Burke, Goukasian, and Shearer (2020) presented an intriguing activity to challenge common student misconceptions about independence in “Teaching the Complexity of Dependence With the Triplet Game.” Campbell and Hanley (2017) described how to teach with a dataset widely used in research in their article, “Twin Data That Made a Big Difference, and that Deserve to be Better-Known and Used in Teaching.” Ross (2017) explained how to engage students in reasoning about the "hot hand" phenomenon in basketball in the article “Classroom Investigations of Recent Research Concerning the Hot Hand Phenomenon.” Although the first author did not adopt the Ross (2017) approach in its entirety for his own students, the article did inspire him to approach the hot-hand fallacy from a simulation perspective for the first time.

Some JSDSE articles, such as Arnold and Franklin's (2021) "What Makes a Good Statistical Question," provide teaching strategies flexible enough to use in virtually all K-12 classrooms. The first author found Arnold and Franklin's emphasis on interrogative questions particularly helpful. It made him more aware of the benefits of asking such questions to help move students' thinking forward as they conduct statistical investigations. Some such questions that stood out were, "Where did the data come from?", "What is the background context?", and "What questions were asked to get the data?" Questions of this nature can be powerful catalysts to spark student reflection, and they are relevant to statistical investigations in both AP courses and earlier coursework. Having students become accustomed to asking and answering such questions during their earliest years in school can help them become more critical consumers of statistics (Bargagliotti et al. 2020) and subsequently avoid some of the earlier-discussed reasoning difficulties documented by Tunstall (2018).

4.3. Knowledge of Curriculum

A broad view of curricular issues can be developed with the help of JSDSE content as well. The Johannssen et al. (2021) article, for example, showed how to organize an entire course around the theme of statistical errors in media reports about scientific studies. This curricular theme helped students learn by leading to extended explorations of contexts of direct relevance to daily life, such as the COVID-19 pandemic. Students reported that this approach aroused their curiosity and interest, while also making them more likely to be critical of claims they encountered in daily life. The Johannssen et al. article exemplifies how JSDSE can provide a broad vision of the progression of learning over an entire sequence of lessons dedicated to statistical investigation. Although the Johannssen et al. work was not done in a high school setting, the first author of this article found their curricular structure to be useful in informing the structure of one of his own units leading up to an investigative project his students completed after taking the AP Statistics exam.

Some JSDSE articles can add to teachers' curriculum knowledge by comparing statistics curriculum structures to one another. Hahs-Vaughn et al. (2017) compared online and hybrid curriculum formats in their article, "Statistical Literacy as a Function of Online Versus Hybrid Course Delivery Format for an Introductory Graduate Statistics Course." This study was particularly attention-grabbing because COVID-19 had forced experimentation with online formats during our survey of JSDSE. Hahs-Vaughn et al. found no significant difference in students' statistical literacy outcomes between the two formats they investigated. These findings led the first author of this article to consider incorporating more of the online resources the AP Statistics program had developed during COVID-19 to support students' learning.
Brisbin and do Nascimento (2019) also presented findings that helped the first author compare different curricular approaches in their article, “Reading Versus Doing: Methods of Teaching Problem-Solving in Introductory Statistics.” They compared teaching by having students solve practice problems against having them read worked examples. The finding that students who read worked examples had more success was counter-intuitive to the first author, prompting us to consider how the practice problem and worked example techniques described in the article compared to his own teaching strategies. Similar reflection and discussion was sparked by the Latif and Miles (2020) article, “The Impact of Assignments and Quizzes on Exam Grades: A Difference-in-Difference Approach.” Their finding that courses emphasizing homework had a stronger impact on exam grades than those emphasizing quizzes prompted reflection about the effectiveness of different assessment practices to prepare students for the AP Statistics exam. Such articles emphasized that curricular norms for teaching and assessment that cut across multiple lessons can influence student learning outcomes.

5. Characterizing JSDSE’s Potential Impact on SKT²

As we discussed selected JSDSE articles, we noticed that some had potential to support statistics instruction on a large scale. Hence, we introduced the notion of SKT² to characterize knowledge that can have an impact beyond the bounds of a single classroom. Earlier, we noted that such knowledge contributes to the construction of broad educational infrastructure. One can safely argue that teachers are the most vital human component of this infrastructure. So, we see knowledge of teachers’ statistical knowledge as a vital component of SKT². Given documented gaps in teachers’ statistical knowledge, we argue that knowledge of structures to support teachers’ development of SKT is another important component of SKT². It is also powerful to know of connections and disjunctions between school curricula and disciplinary and professional practices, so knowledge of curricular relevance can be considered a third component of SKT². Articles from the first author’s survey of JSDSE that connect to each component of SKT² are shown in Table 2.

### Table 2. Connections between selected JSDSE articles and components of SKT².

| Knowledge component                                    | Description                                                                 | Relevant JSDSE articles                        |
|--------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------|
| Knowledge of teachers’ statistical knowledge           | Knowing how teachers commonly understand, and misunderstand, statistics content | Lovett and Lee (2018)                         |
| Knowledge of structures to support teacher learning    | Knowing structures that support the development of statistical knowledge for teaching (SKT) | Green et al. (2018) and Schwab-McCoy (2019)   |
| Knowledge of curricular adequacy and relevance          | Knowing connections and disjunctions between the curriculum and disciplinary and professional practices | Ashley et al. (2019), Horton and Hardin (2021), Hudiburgh and Garbinsky (2020), and Schwab-McCoy (2019) |

5.1. Knowledge of Teachers’ Statistical Knowledge

Knowing what teachers understand of statistics is essential to designing professional development for them. Teachers’ content knowledge influences implementation of curricula. A high-quality curriculum may not meet its full potential to support students’ learning if teachers lack deep understanding of its content (Remillard and Kim 2017). The Lovett and Lee (2018) JSDSE article provided a helpful snapshot of preservice teachers’ statistical content knowledge that can be used to anticipate the types of professional development teachers might need. Participants in their large-scale study at times had difficulty analyzing and interpreting data in ways students are expected to do in many K-12 curricula. Lovett and Lee’s findings were jarring, but not entirely surprising, to the first author of the present article, who has worked with many colleagues who have had just one course in statistics and no further preparation in the area. It is difficult to teach AP Statistics, or K-12 curricula leading up to the AP level, without more robust learning experiences. This underscored the point that statistical learning experiences for teachers must be improved if enhanced student learning of statistics is to occur. Understanding teachers’ statistics content knowledge and developing it as needed is essential to systematic, widespread curriculum improvement efforts that have impact across multiple grade levels (Franklin et al. 2015).

5.2. Knowledge of Structures to Support Teachers’ Learning

Some JSDSE articles describe professional development structures that can support the development of teachers’ SKT. A recurrent theme in such articles is that collaborative structures are extremely valuable (Green et al. 2018; Schwab-McCoy 2019). For example, Green et al. (2018) described the implementation of a “course communities” model among statistics instructors in the article, “Implementing Active Learning Department Wide: A Course Community for a Culture Change.” The article described how instructors met regularly to discuss their efforts to implement active learning in the statistics classroom. During their meetings, questions about statistics content arose frequently, giving participants opportunities to deepen their own content knowledge along with pedagogical knowledge. Instructors’ participation in this professional development experience was associated with higher levels of student achievement. These findings helped motivate the first author of this article to join a peer learning community in his own school, which allowed him to observe, firsthand, resultant improvements in his own learning at that of his students.

5.3. Knowledge of Curricular Adequacy and Relevance

As the first author examined his classroom practices in light of JSDSE articles, reflections on larger-scale issues related to the AP Statistics program naturally followed. The JSDSE articles providing strategies for assessing extended projects (e.g., Hudiburgh and Garbinsky 2020) raised questions about the adequacy of a single end-of-year AP examination as a sound summative assessment strategy. There is already precedent for AP courses to go beyond such limited means of assessment.
AP Art and Design offers a portfolio-style assessment which AP Statistics could consider and adapt. In the AP Art and Design Portfolio structure, student work should “reflect ongoing practice, experimentation, and revision” (College Board 2020, p. 38). Each section of the portfolio requires students to explain their work. AP Statistics could potentially merge elements of Hudiburgh and Garbinsky’s data visualization project (and assessment practices from other extended investigative projects described in JSDSE) with portfolio ideas from AP Art and Design to create guidelines for student statistical investigation portfolios. Yearlong investigative projects that prompt students to ask questions, collect data, analyze data, and interpret the results may be more meaningful, authentic, and educational than single end-of-semester exam scores.

Schwab-McCoy’s (2019) article, “The State of Statistics Education Research in Client Disciplines: Themes and Trends Across the University,” prompted the first author to think about technology required for AP Statistics and its relevance to students’ lives after graduation. Schwab-McCoy discussed literature about acquainting students with statistical software frequently used in their intended professions. One particular study that was cited (Spinelli 2001) investigated alternatives to graphing calculators in the context of teaching business statistics. Although the AP Statistics course was not specifically mentioned in the article, it raised the question of the extent to which it is appropriate for the AP course to rely heavily upon graphing calculators. Excessive reliance on graphing calculators could limit students’ opportunities to become acquainted with technological tools more commonly used in practice. Shifting the emphasis of the AP course toward more relevant and powerful technological tools would require large-scale changes such as modifications to the technology to be used during the AP exam.

JSDSE’s recent special issue on computing in the statistics curriculum further suggested a need to attend to and re-envision the role of technology in teaching AP Statistics. Horton and Hardin’s (2021) introduction to the special issue underscored the idea that continuous improvement and change to statistics curricula are essential to ensuring their adequacy and relevance. Introductory statistics experiences, including the AP course, run the risk of becoming irrelevant if their curriculum does not acknowledge and respond to recent disciplinary and professional advances in technology and computing. Attaining such large-scale improvements is challenging, but JSDSE articles like the Ashley et al. (2019) tribute to Tom Short illustrate that there is a cohesive and dedicated group of statistics educators to draw upon to spur and support large-scale improvements to the AP program.

6. Steps Toward More Fully Realizing JSDSE’s Potential Impacts on SKT and SKT2

As we have illustrated, JSDSE has a great deal of content relevant to K–12 education, even in articles not dealing exclusively with precollege statistics. We begin this section by offering some strategies JSDSE readers might use to draw teachers’ attention to relevant content from the journal. We then reflect on how JSDSE contributors and editors might continue to work toward expanding the journal’s K–12 impact.

6.1. Suggestions for JSDSE Readers

JSDSE readers who have contact with K-12 teachers are in optimal positions to invite teachers to engage with the journal. The independent study course model we described earlier in this manuscript is one way to do so. The initial activity for the course was to search recent JSDSE issues with an eye toward finding ideas relevant to K–12 education. The next step was to write reflections on how each selected article might improve practice and receive written feedback from the instructor. We then discussed the written reflections and expanded upon them as we spoke. As we did so, we found a variety of ways the articles could help expand K–12 teachers’ STK and SKT2. This is one, but not the only, strategy that can be used to help teachers engage with JSDSE content.

JSDSE readers who do not currently have contact with K-12 teachers can build such relationships in multiple ways. Readers who teach in statistics departments may be able to do so by contacting colleagues in schools of education to inquire about current professional development initiatives involving university faculty members in local schools. Reaching out to former students who have become teachers in another possibility. Offering graduate-level courses, programs, or certificates that build STK and SKT2 during hours that teachers are available to take them can also help, because teachers often need and seek graduate-level credit after completing their undergraduate degrees and receiving their teaching licenses. Once a few initial relationships are established, opportunities to participate in further professional development initiatives often follow. For example, mathematicians and statisticians have served as subject matter experts for teams of teachers collaborating to design and improve lessons for their students (Seino and Foster 2021). Working with a team of teachers in this manner can have a snowball effect; that is, professional relationships with one or two teachers in the group grants access the team, and each team member, in turn, has professional connections to other teachers outside the immediate group. Becoming a trusted member of a team provides a natural opportunity to direct teachers’ attention toward JSDSE content useful for classroom instruction.

Establishing working relationships with K-12 teachers paves the way for sustained productive sharing of JSDSE material. JSDSE content can be readily shared via Twitter, Facebook, and email by using the appropriate icons at the top right corner of the HTML version of each article. The STK and SKT2 categories we described earlier can be used as starting points to focus K–12 teachers’ attention on portions of articles particularly relevant to them. Tweets, emails, and social media posts can be crafted to highlight important takeaways related to the nature of students’ statistical knowledge, assessment, curricular issues, teachers’ knowledge, and promising professional development structures. Concise messages to focus teachers’ attention on such issues can be particularly helpful for drawing attention to articles teachers might otherwise overlook.

For an example of what concise electronic sharing of JSDSE content with K-12 teachers might look like, consider the Tunstall (2018) article we discussed earlier. Tunstall had students in a quantitative literacy course read an article from popular media. A series of prompts was used to assess students’ reasoning about the media article’s messages relating to causation and risk. In a tweet, email, or social media post, a JSDSE reader...
could highlight the media article Tunstall had students read and the prompts used to assess their interpretation of it. Teachers could be encouraged to have their own students respond to the prompts after reading the media article. They could then compare their own students’ responses to those documented by Tunstall. Such a comparison could provide K-12 teachers a sense of how well-prepared their own students are to enter an introductory level college quantitative literacy course like the one described by Tunstall. Similar messaging could be done to invite teachers to try additional assessments and activities described in other relevant JSDSE articles. As with the Tunstall example, at times this messaging could include articles relevant to K-12 even though they were written about college statistics courses.

6.2. Suggestions for JSDSE Contributors

Contributing to JSDSE’s “Research on K-12 Statistics Education” department is one way, but not the only way, for authors to have a positive impact on K-12 SKT and SKT2. As noted in several of our examples, articles primarily pertinent to college teaching can still provide food for K-12 teachers’ thought. JSDSE authors working in college classrooms might consider including article sections that explicitly identify key takeaways for K-12 teachers when possible. Such sections might encourage teachers to try a specific assessment task (e.g., Tunstall 2018) or an accessible part of a classroom activity (e.g., Burke, Goukasian, and Shearer 2020; Ross 2017) with their own students and observe the results. As teachers carry out such activities, they can develop SKT regarding assessment techniques, students’ thinking, and possible teaching strategies. In the process, SKT2 can also be developed by alerting teachers to needed large-scale curriculum changes and teacher professional development. Ultimately, college instructors benefit from this as well, as such efforts have potential to improve students’ preparation to do post-secondary work.

Perhaps an even more powerful way for JSDSE authors to draw K-12 teachers into the journal is to coauthor articles with them. Coauthorship can take many forms. The coauthorship model we presented in this article could be extended to involve elementary and middle school teachers. Working alongside K-12 teachers to design, test, implement, and assess instructional practices is another possibility. JSDSE articles contain examples of structures that can support such work. For example, Roback et al. (2006) described how Japanese Lesson Study can foster practice-based collaboration that results in iterative improvement of a lesson over time. Groth (2019) described collaborations devoted to co-designing and field-testing entire sequences of lessons with teachers. Such collaborations may eventually produce larger-scale studies devoted to comparing the effectiveness of different curricula (American Statistical Association 2007). Again, such work has multiple benefits; K-12 students and teachers benefit from continuous improvement of instructional practices, and researchers gain firsthand knowledge of K-12 students and settings.

JSDSE authors may also wish to address the task of researching teachers’ consumption of online content. JSDSE added “data science” to its title in recognition of the growing impact of computational science on data analysis. In a similar vein, it may be possible to take advantage of computational techniques for analyzing big data to help understand teachers’ use of online material. For example, it may be informative to analyze the data K-12 teachers generate as they search for online resources about teaching statistics. Knowing key words and phrases used during such searches and the types of links clicked may help JSDSE structure its content in a manner that would make it more likely to be found and accessed by teachers as they use common search engines.

Although gathering and analyzing teachers’ internet browsing data could be a promising approach to understanding their consumption habits, it does present some ethical hurdles. Many institutional review boards overseeing human subjects research may not have protocols for evaluating proposals that incorporate big data analyses in educational studies. So, scholarship concerning the appropriate nature of such protocols is important. Despite this logistical hurdle, constructing appropriate ethics protocols for such research is still worthy of the time and effort it would entail. Such protocols may ultimately also have an impact beyond the field of education, as various other fields of endeavor struggle with ethical issues related to big data analysis (Herschel and Miori 2017). Norms established by educational researchers might ultimately provide starting points for data scientists in other fields to navigate such ethical quandaries.

6.3. Suggestions for JSDSE Editors

JSDSE editors might consider encouraging submission of additional types of digital enhancements to help develop readers’ SKT and SKT2. Supplementary electronic files commonly contain datasets to use in the classroom, instructions for using technology to analyze data, and other ready-to-use materials to implement ideas from the article. JSDSE’s online format allows for expansion beyond these types of common digital enhancements. For example, videos and interactive applets could be embedded more frequently in articles. Videos could show key excerpts from classroom instruction, technology being used with students, or authors talking about key implications of their articles. Embedded interactive applets could allow readers to have some of the types of learning experiences described in JSDSE articles and experiment with technology in the context of reading about students’ use of it. Digital enhancements of this nature are becoming more common in journals for K-12 teachers (Edwards and Robichaux-Davis 2020); as an established online journal, JSDSE is uniquely positioned to contribute to ongoing conversations about how to structure these materials in ways that produce maximum impact on teaching practice.

It may also be worthwhile to consider designing other new, supplemental types of content to increase JSDSE’s K-12 impact. Executive summaries or condensed articles (e.g., Silver and Kenney 2015) can make journal content more accessible to a wide audience. Research briefs that summarize findings across several articles that are pertinent to K-12 can also capture teachers’ attention. The National Council of Teachers of Mathematics, for instance, created a collection of briefs, some of which address teaching and learning statistics (e.g., Shaughnessy 2008). Their collection of briefs also explores cross-cutting themes such as fostering classroom discussions, conducting formative assessment, and learning from professional
development. In the present article, we have given examples of similar cross-cutting themes in *JSDSE* that are relevant to K-12 teachers, such as student assessment and teacher professional development strategies. So, content currently published in *JSDSE* could provide foundational material for freely accessible online research/scholarship briefs written with K-12 audiences in mind.

### 7. Conclusion

The gap between formal scholarship and practice in education has historically been difficult to bridge (Silver and Kenney 2015). However, *JSDSE* is uniquely positioned to help close the gap with its open-access, online platform and spirit of innovation. Existing *JSDSE* content has the potential to help develop readers’ SKT and SKT2. These types of knowledge can help readers become more effective statistics teachers and transform the overall statistics education system. Continuing to study and foster teachers’ interactions with the journal can maximize *JSDSE*’s readership and positive impact on K-12 education.

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