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Keeping It Real: Information Literacy, Numeracy, and Economic Data

Diego Mendez-Carbajo
Illinois Wesleyan University, diego.mendez-carbajo@stls.frb.org
Charissa O. Jefferson
California State University-Northridge, charissa.jefferson@csun.edu
Katrina L. Stierholz
Federal Reserve Bank of St. Louis, katrina.l.stierholz@stls.frb.org

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Keeping It Real: Information Literacy, Numeracy, and Economic Data

Abstract

We describe a pedagogical strategy aimed at developing both quantitative and information literacy skills through a social justice lens. This lesson plan is suitable for a variety of high school and introductory college courses. The student learning goals associated with this pedagogical strategy span three intellectual domains: *social justice*, through a critical exploration of either the purchasing power of minimum wages across states or the earnings gap between men and women employed full time; *numeracy*, through the computation of ratios between variables with different rates of growth over time; and *information literacy*, through a series of activities and discussion questions aimed at evaluating sources of data on wages, earnings, and price levels for authority and content. This strategy was developed for a hybrid teaching and learning environment and has two elements: an interactive online module that students complete ahead of class and a hands-on lesson plan guiding face-to-face instruction. The two resources are part of the economics and personal finance education resources produced by the Federal Reserve Bank of St. Louis and are free to access and use through econlowdown.org and www.stlouisfed.org/education/keeping-it-real, respectively. This pedagogical strategy makes use of up-to-date data available through the FRED® (Federal Reserve Economic Database) website (https://fred.stlouisfed.org) of the Federal Reserve Bank of St. Louis.

Keywords

numeracy, social justice, information literacy, data literacy

Cover Page Footnote

Diego Mendez-Carbajo is a Professor of Economics at Illinois Wesleyan University; Charissa O. Jefferson is a Senior Business and Data Librarian at the Oviatt Library, California State University - Northridge; and Katrina L. Stierholz is a Vice President and Director of Library and Research Information Services at the Federal Reserve Bank of St. Louis. Separately, each of us engages with different aspects of data literacy on a daily basis. Together, we collaborate to make the interplay between economic analysis, numeracy, and information literacy more powerful than the sum of its parts. The views expressed in this article are those of the authors and don't necessarily reflect the position of the Federal Reserve Bank of St. Louis or the Federal Reserve System.

Introduction

Although multiple voices in the literature convincingly argue for linking numeracy and social justice, it is not always clear which is leading which. Should mathematics instructors employ social justice constructs and examples to teach required material because doing so "improves student learning and understanding" (Voss and Rickards 2016, 40), or should a humanist advocate for social justice seize the tools of mathematics "to challenge, in words and in actions, oppressive structures and acts" (Gutstein 2006, 4)?

Far from trying to force a choice between these two tasks, we want to draw attention to a key element in the literature devoted to documenting actual practices of teaching mathematics for social justice: the role of data literacy in developing informed and effective students/citizens. Although the literature on numeracy and quantitative literacy spans the whole educational spectrum, our references are directly applicable to the elementary-through-first-year-of-college or "K-13" range. Frequently overlooked by practicing educators, this element of the "politics of mathematical knowledge" described by Frankenstein (2013) refers to the ability of adult learners to "understand how raw data are collected and transformed into numerical descriptions of the world" (Frankenstein 2013, 35). Because pedagogical strategies bridging social justice and mathematics build on real data, a critical examination of data sources and methods is a prerequisite to data analysis and interpretation.

In fact, this particular aspect of information literacy is explicitly highlighted by Wiest et al. (2007) in their description of quantitative literacy. Defined as "operating only in real-world applications" and being "naturally interdisciplinary," it includes "asking questions such as how data are collected, analyzed and used" (Wiest et al. 2007, 49). Moreover, due to the overlap among quantitative literacy and economic access, civic participation, and decisions for personal life, Jordan and Haines (2003) call for cross-disciplinary collaboration to teach quantitative literacy. The library science profession has answered that call, and Hogenboom et al. (2011) report on a survey documenting the multiple shapes of collaborative instructional practices focused on data. Our own scholarly work has strived to foster precisely that collaboration. Working independently, we have provided an overview of "strategies that libraries can use ... to educate library users on finding, understanding, and using data to create effective visualizations" (Jefferson 2016, 173) as well as described a pedagogical strategy where an academic librarian works alongside an economics instructor to discuss "the means of access, the forms, and

the formats of quantitative information relevant to [a particular] course" (Mendez-Carbajo 2016, 311).

Because "an understanding of the social sciences is derived from the interpretation of data—much of it numerical" (Lake 2002, 5), we argue for the development of the habits of mind and knowledge dispositions required for the critical examination of data's trustworthiness and reliability. We believe that without establishing those qualities, quantitative reasoning exercises are susceptible to yielding incorrect conclusions or, worse, misguided courses of social action. Promoting the broad integration of information literacy in student learning outcomes, the Association of College & Research Libraries (ACRL) states that its Framework for Information Literacy for Higher Education "opens the way for librarians, faculty, and other institutional partners to redesign instruction sessions, assignments, courses, and even curricula" (ACRL, adopted in 2016). Moreover, it expects responsibility to be shared among all educational agents. Jefferson (2017) provides an exemplar of how to fulfill that shared responsibility. Most recently, Oberlies and Mattson (2018) have edited a six-volume collection of lesson plans for teaching information literacy, yet only one of the 52 chapters they compile references data. By developing a hybrid lesson plan for a library instructional session suitable for a variety of high school and introductory college courses, we are answering the ACRL's call for pedagogical strategies highlighting information literacy as it relates to data. Although our teaching experience is limited to college-level economics, the instructional design and content of the lesson plan makes it suitable for Advanced Placement courses in economics as well as high school-level course units in personal finance.

Also, by making use of the FRED (Federal Reserve Economic Database) website (https://fred.stlouisfed.org) of the Federal Reserve Bank of St. Louis, we are streamlining the data-related component of the pedagogical strategy. The use of FRED as a resource for developing data-related proficiencies has been previously documented in the economic education literature by the authors. FRED is the largest aggregator of US statistics, with free access to 527,000 US and international time series from 87 sources (as of October 9, 2018), and "reduces data searching costs in terms of time and energy" (Mendez-Carbajo 2015, 421). Moreover, FRED "offers free and easy online access to each and every one of those series through a streamlined and user-friendly site" (Mendez-Carbajo 2019, 2). All data series on FRED can be plotted and algebraically manipulated through its website, which sidesteps the need to download data files and master a spreadsheet software package and makes the type of numeracy instruction described by Kingan (2013) easier to deploy.

Finally, by making the online component of the lesson available through econlowdown.org (the free economic education portal of the Federal Reserve Bank of St. Louis) and the lesson plan available through stlouisfed.org/education (the easily searchable repository of videos, podcasts, and lesson plans of the Federal Reserve Bank of St. Louis), we are able to capitalize on the institutional reputation of this high-quality educational partner for high school and college instructors. Most recently, the educational materials available through econlowdown.org have been recognized with the 2018 Excellence in Financial Literacy Education Award from the Institute for Financial Literacy and the 2017 Gold Curriculum Awards of Excellence from the National Association of Economic Educators.

Pedagogical Goals

We build on the work of Gutstein (2006) by adding an information literacy pedagogical goal to the two related sets of pedagogical goals he identifies for teaching mathematics for social justice. Gustein's social justice pedagogical goals, summarized by Stinson et al. (2012), include using mathematics "to understand resource inequities." The mathematics pedagogical goals include recognizing mathematics as "a powerful analytical tool for understanding real-world phenomena" (Stinson et al. 2012, 79-80). Our pedagogical goals span three intellectual domains.

Social justice pedagogical goals. We offer instructors a choice between two data-focused activities: plotting nominal (unadjusted for inflation) and real (adjusted for inflation) wages across individual states and plotting the nominal and real earnings gap between men and women employed full time.

The critical exploration of minimum wages is a frequent topic in the literature discussing the teaching of mathematics for social justice. Powell (2012) uses nominal federal minimum wages for nonfarm employment between 1938 and 1997 as a prompt to task students with "making solid arguments for what they thought the minimum wage should be, using mathematics to back up their arguments" (Powell 2012, 191). Dean (2013) references the federal minimum wage when discussing living wages and describes how, in the state of Washington in 1998, social advocacy groups "joined forces to lobby to have the minimum wage indexed to inflation" so that "future increases would come annually, without expensive and time-consuming lobbying efforts" (Dean 2013, 70). In that particular pedagogical strategy, hourly wages in a variety of service sector jobs are prompts for discussing linear relationships in the context of an eight-hour workday.

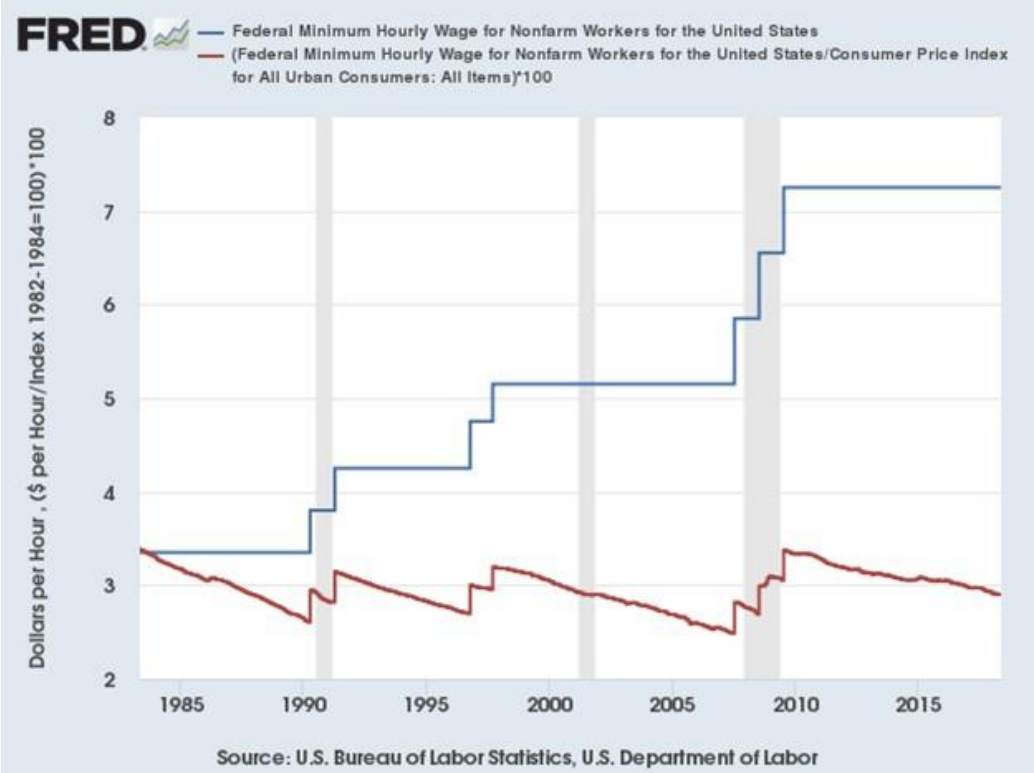

Figure 1. Nominal federal minimum hourly wage for nonfarm workers for the United States (blue line) and real (adjusted for inflation) federal minimum hourly wage for nonfarm workers for the United States (red line). Note that the base period for the CPI used to compute the real wage is 1982-1984=100.

In our pedagogical strategy, we draw comparisons between nominal and real federal and state minimum wages in order to highlight how the lack of a regular adjustment of nominal wages to a constantly rising cost of living erodes the purchasing power of wages. The real purchasing power of the minimum wage, indicated by the red line in Figure 1, increases when the nominal minimum wage, the blue line, is raised, but it generally decreases otherwise due to the effects of inflation. Through FRED, students can plot the minimum wages set by any of the 50 US states and notice their differences in magnitude. A simple algebraic manipulation, computing a ratio between the federal nominal minimum wage and the Consumer Price Index (CPI) illustrates the fact that the real purchasing power of the federal minimum wage has not increased over the past 30 years. The recent drive, in some states, toward a $15/hour minimum wage addresses this situation. The exploration of this topic can be deepened through an optional in-class instructional activity asking students to compare and contrast the evolution of the

purchasing power of the minimum wage depending on a range of alternative price indices.

Noting the dearth of peer-reviewed teaching materials on the topic of gender, we must agree with Gutstein's claim that "even social justice classes rarely confront [sexism]" (Gutstein 2012, 67). In that light, as an alternative topic of instruction, we also investigate the earnings gap between men and women employed full time, comparing the earnings of both men and women before and after adjusting their wages for changes in the overall cost of living. The inclusion of gender inequality as an element of social justice echoes the work of Denny (2013), which asks students to compute the percent changes in the number of women elected to the House and to the Senate between 1979 and 1999 and between 1999 and 2009.

In our pedagogical strategy, we first direct students to plot the median weekly earnings for men and women employed full time, drawing attention to the fact that men's earnings have been higher than women's earnings for the whole data sample, which begins in 1979. (See Fig. 2.) Next, students compute the gap between both data series and reflect on the fact that it has increased in nominal terms. Lastly, students compute the real earnings gap between men and women by performing the algebraic manipulation described above. Now students can see that the real earnings gap between genders decreased—at a progressively smaller rate— between 1979 and 2005 and has remained effectively constant since. The exploration of this topic can be deepened through optional short writing assignments asking students to compare (i) the number of men and women holding multiple part-time jobs, (ii) the nominal and real median weekly earnings across age, sex, and race groups, or (iii) the types of employment and average levels of education of men and women.

Mathematical pedagogical goals. Students learn that the size of numbers does not dictate the relationship between those numbers, and that as numbers change, even though their sizes may change in the same direction, the relationship between them can change in different ways. In more formal terms: when computing a ratio between two magnitudes over time, differences in the rates of growth across variables can yield unexpected conclusions:

- Normalize $x/y = 1$ at $t = 0$, the base period for the CPI. If $\Delta x/\Delta t = 0$ and $\Delta y/\Delta t > 0$, then $x/y < 1$ for all $t > 0$. This is the case of the minimum wage set by the US Congress and by the majority of state constituencies. Each minimum wage is set in nominal terms (x) and left unchanged ($\Delta x/\Delta t = 0$) between legislative drives to revise it. When expressed in real terms—i.e., adjusted for the generally rising cost of living ($\Delta y/\Delta t > 0$), minimum wage purchasing power declines ($x/y < 1$ for all periods after the nominal wage was set).

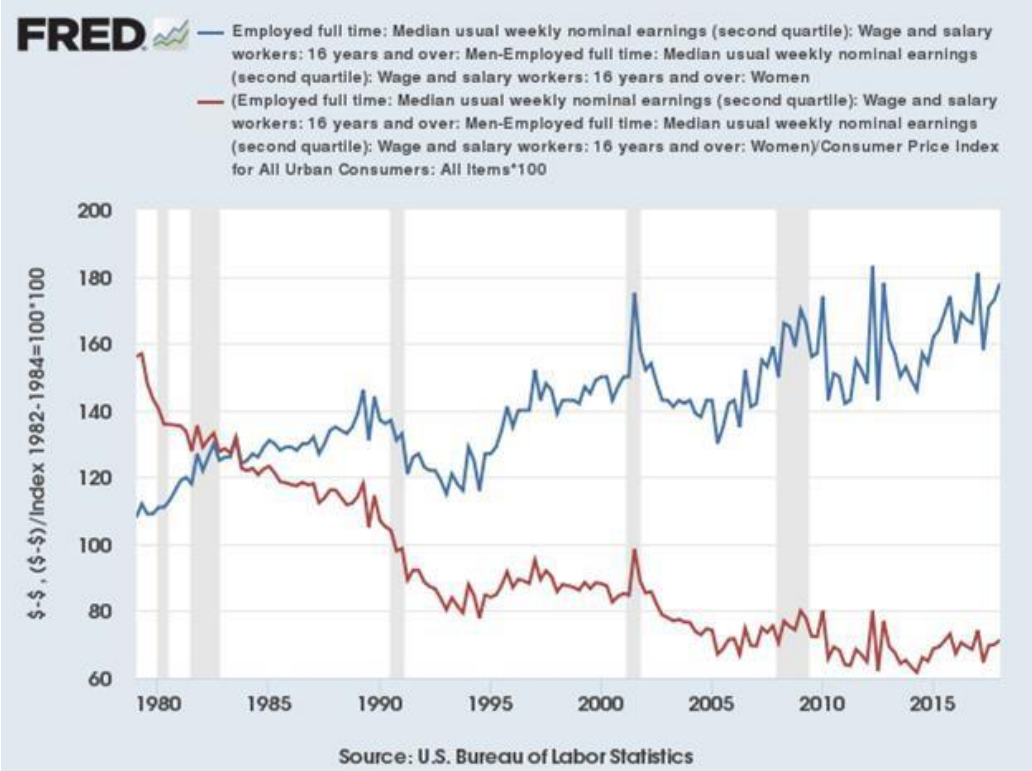

Figure 2. Nominal earnings gap between men and women employed full time (blue line) and real (adjusted for inflation) earnings gap between men and women employed full time (red line). Note that the base period for the CPI used to compute the real wage is 1982-1984=100.

- Normalize $x/y = 1$ at $t = 0$, the base period for the CPI. If $\Delta y/\Delta t > \Delta x/\Delta t > 0$, then $x/y < 1$ for all $t > 0$; if $\Delta x/\Delta t > \Delta y/\Delta t > 0$, then $x/y > 1$ for all $t > 0$; and if $\Delta x/\Delta t = \Delta y/\Delta t$, then $x/y = 1$ for all t. This is the case of the median weekly earnings gap between men and women employed full time. When adjusting the gap's nominal value (x) by the cost of living (y), the real magnitude of the earnings gap decreased ($x/y < 1$) between 1979 and 2005 and has remained effectively constant since.

This mathematical pedagogical goal aligns with and complements the focus placed by Dean (2013) on graphing a functional relationship and by Powell (2012) on modeling and predicting the evolution of a data series over time. Also, as a practical exploration of ratios, it is likely to prove less intimidating to social science instructors and students than the discussion of an exponential decay model presented by Kingan (2013). Finally, for instructors in economics and personal finance, our pedagogical strategy presents an opportunity to discuss the concept of a price index and its applicability in a practical context.

Information literacy goals. We offer instructors an opportunity to incorporate information literacy goals into the practice of teaching mathematics for social

justice. Students develop habits of mind and knowledge dispositions associated with several of the ACRL Information Literacy Frames (ACRL, n.d.) adopted in 2016, namely "Research as Inquiry," "Information Creation as a Process," and "Authority Is Constructed and Contextual." These three Frames are articulated in the proposed pedagogical strategy through a series of activities and discussion questions. To being with, we ask students to evaluate the data sources for authority and content. In doing so, they develop the knowledge practice of determining the credibility of the data they are going to use to build an argument, recognizing that an argument built on poorly understood data may lead to biased conclusions. In parallel, students acknowledge the capabilities and constraints derived from employing particular data sets, becoming aware that the choices they make when creating information impact the information product they create and the message it conveys. Finally, by carrying forward questions for further research and drawing conclusions from the analysis and interpretation of the data, they learn to make their own contributions to a community of knowledge.

As discussed above, explicit information literacy pedagogical goals are not regularly identified in the literature by teachers of mathematics for social justice. Nonetheless, the historical review of critical pedagogy provided by Stinson et al. (2012) highlights the growing body of literature that "positions the discipline of mathematics within critical pedagogy" (Stinson et al. 2012, 79). Among critical mathematics scholars, the references made by Frankenstein (2012, 58) to the "non-neutrality of all knowledge" directly refer to data literacy goals. Frankenstein (2013, 37) asserts that

> There are political struggles/choices involved in: which data are collected; which numbers represent the most accurate data; which definitions should guide how the data are counted; which methods should guide how the data are collected; which ways should the data be disaggregated; and which are the most truthful ways to describe the data to the public.

Pedagogical Strategy

In its most basic definition, a hybrid—or blended—pedagogical strategy integrates online instruction with face-to-face instruction. In the "flipped classroom" format that we propose here, we combine an interactive online module that students complete ahead of class with an in-class lesson plan with hands-on activities. The online instruction component introduces students to the concepts and resources key to the topic, and the face-to-face instruction builds on the acquired individual knowledge to add learning value through small-group activities and guided discussions. Both the online module and the face-to-face instruction incorporate summative assessment activities so that the instructor can gauge student

achievement. We next describe the elements of the proposed pedagogical strategy in the order the students engage with them. Based on our scholarly experience in the field of economic education, we use the term "pedagogical strategy" to simultaneously refer to the proposed hybrid learning instructional approach and to its application in the form of the lesson plan at hand.

The module begins with pre-class, online work. The instructor assigns the FRED Interactive online module "Information Literacy" for students to complete ahead of class. This instructional resource is available, at no cost to either the instructor or student, through econlowdown.org. Step-by-step instructions to create a classroom in the online platform and to enroll students in the module are available in Appendix A.

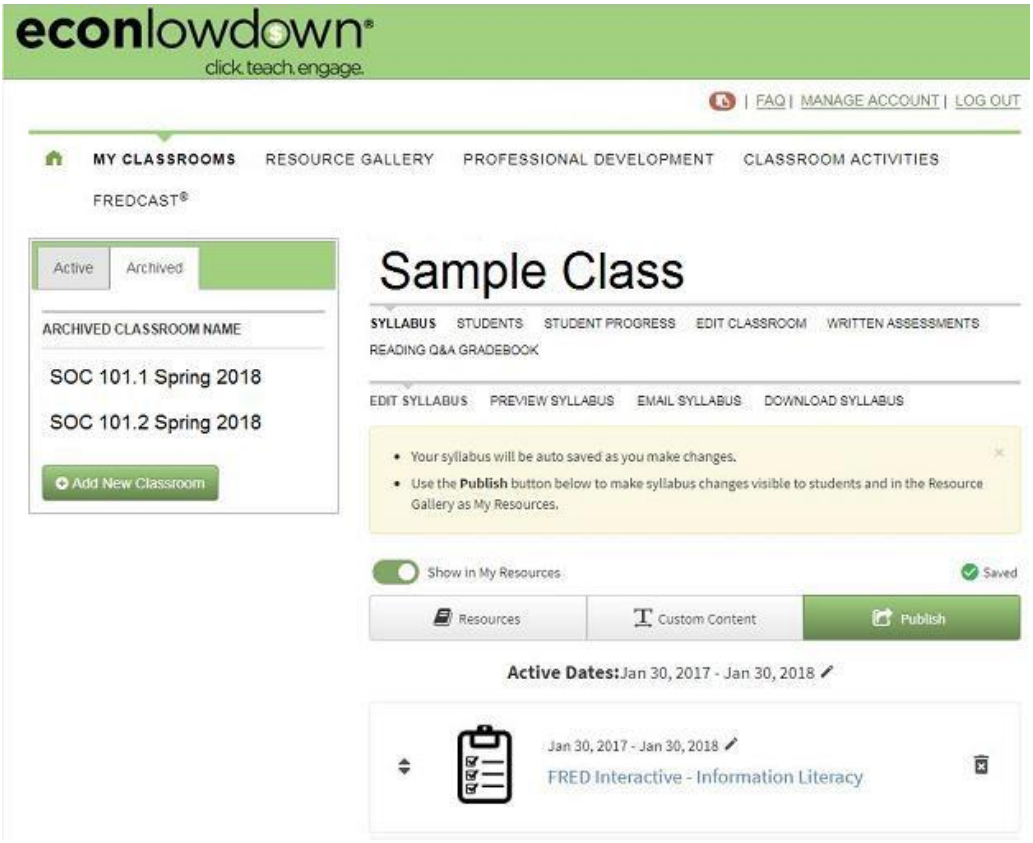

Figure 3. Screen capture of the econlowdown.org portal with a sample classroom displaying the FRED Interactive "Information Literacy" module.

When students log into the econlowdown.org platform, they are presented with the classroom syllabus and the option of "Launching" the module. Once they do so, they will navigate and complete the following units within the module:

- *Welcome and student learning goals page*. The information literacy learning goals are listed and defined on this page. Additionally, this unit contains links to tutorials for working with a FRED graph and for reading a graph. Students wanting additional exposure to these topics may choose to access the tutorials.
- *Brief video.* The video describes the features of a FRED Interactive module and how to navigate it. This video labels the visual elements of the module, identifying the navigation page and the areas where task objectives and instructions are displayed. Additionally, the video describes the function of the following icons incorporated in the work area: receive a hint to complete a task (when available), resize the work areas, reset the graph, select a level of confidence in the work completed, submit work for evaluation, and receive feedback (when available). After completing every task in the FRED Interactive module—and before submitting the work for evaluation—the student must select a level of confidence in her/his work: "Very Confident," "Pretty Confident," "Unsure," or "Don't Know." By incorporating this element of metacognition, the module aims to foster student self-reflection and build confidence as tasks are successfully completed.
- *Pre-test.* This test includes eight multiple-choice questions designed to establish the existing (baseline) level of student knowledge of basic notions of information literacy. For example, the student is asked to identify the source and units of the data series used to build a particular graph. Students receive no feedback on their answers, but the instructor does have access to a report on each student's pre-test scores.
- *Short video.* This video introduces the concept of real wages, i.e., wages adjusted for changes in the cost of living. The video also defines the concepts of inflation, consumer prices, minimum wages, nominal wages, and real wages. In addition, it also explains that when nominal wages are constant, increases in the cost of living reduce their purchasing power, making real wages decrease in value. These basic concepts underpin the economic education component of the module.
- *"Build It" interactive activity.* In this unit, students complete the following series of FRED graph-related tasks: search for data, format the data (e.g., select a data range, change the units, or change the frequency), and format the graph (e.g., change the type or modify the axes). Nominal minimum wages are transformed into real minimum wages by applying the formula $(a/b)*100$ where a is the nominal wage series and b is the consumer price index.

Students have access to hints associated with each task that they are asked to complete (e.g., "Try searching for the data series by its ID [instead of its name]"), and they receive feedback when they complete a task and submit it for evaluation (e.g., "Ooops…Remember to enter the formula $(a/b)*100$," or "Good job!").

- *"Read It" activity.* Made up of nine multiple-choice questions, this unit aims to develop several knowledge dispositions associated with critical data information literacy. For example, the student is asked to differentiate the roles of data creator (i.e., source) and data aggregator (i.e., point of access), as well as to identify those roles when citing statistical information in support of an argument. Attention is also focused on quantitative literacy matters of data creation and reporting methodologies. The questions are directly related to the numeracy skills deployed while building a graph of nominal and real minimum wages. Students have access to hints associated with each question and receive feedback when they answer them.
- *Post-test.* These eight multiple-choice questions, identical to the pre-test questions but based on different data and graphs, are designed to establish the amount of learning on basic notions of information literacy added by the instructional video, graph-building tasks, and graph-reading questions. Students do receive feedback on their answers, and the instructor has access to a report on each student's post-test scores.

For novice FRED users, the econlowdown.org online module is expected to require between 20 and 30 minutes to complete. Students familiar with FRED, from previous exposure in Advanced Placement or introductory economics courses, likely require even less time.

After completing the assignment, students receive in-class, face-to-face instruction. The instructor uses the lesson plan "Keeping It Real: Teach ACRL Information Literacy Frames with FRED Data" to guide a traditional, face-to-face instructional session. The lesson plan is organized in the following sequence:

- *Lesson description.* This section provides an outline and brief description of each of the following parts in the lesson plan: review of the online module content, graph-building tasks and graph-reading discussion prompts, learning assessment instruments, and links to resources for further exploring the topics of the lesson.
- *Summary of student learning goals.* The goals are mapped to the ACRL Information Literacy Frames & Knowledge practices.
- *Essential Question:* How can you determine the purchasing power of wages and earnings over time?
- *Procedure.* The procedure provides a numbered sequence of steps that guide the instructional session. It contains directions for displaying information on a video projector, questions (and answers) for recalling definitions, and discussion prompts along with likely replies and strategies to probe student attitudes and aptitudes. There are two parts to the procedure:
    - *Part A: Reviewing "FRED Interactive - Information Literacy" Online Course Content.* This part aims to ensure a reliable degree of familiarity among students with the concepts and resources key to the lesson plan. By first recalling the foundational work done in the online module, the instructor can use the majority of the in-class instruction time to add learning value through tasks ideally suited to face-to-face interactions.
    - *Part B: ACRL Information Literacy Frames as FRED-Integrated Abilities.* This part allows instructors to choose between two sets of activities highlighting the differences between nominal and real wages:
        - *Option A: Plotting Nominal and Real Wages Across Individual States.* First, students are assigned a state-level minimum wage by the instructor. This can be the state where the school is located or a state that might have been in the news recently regarding employment or labor conditions. After plotting that particular data series in a FRED graph, students transform the nominal wage values into real wage values using the formula they learned about in the online module. Next, students add a second state-level minimum wage to the FRED graph, choosing among the remaining 49 states—perhaps a state they would like to move to after graduation. After transforming it into real wage values, students can compare living standards across states of workers receiving minimum wages for their labor.
        - *Option B: Plotting the Nominal and Real Earnings Gaps between Men and Women.* Popular media frequently refers to the difference between earnings for men and women as a "gap." To show this gap, students first plot on a FRED graph the median weekly earnings for men employed full time and the median weekly earnings for women employed full time. The vertical distance between both graph lines is the nominal earnings gap. Next, students are directed to create a new FRED graph displaying the spread between the aforementioned data series as a difference. Students are given instructions for

performing that algebraic manipulation on the FRED graph. Lastly, students compute the ratio between the spread (i.e., the nominal earnings gap) and the CPI, thus plotting the real earnings gap between men and women. Note that, alternatively, the relative magnitudes of the median weekly earnings for men and women employed full time can be expressed as a ratio. Because both sets of earnings are exposed to the same changes in the cost of living, measured through the CPI, the evolution of this nominal figure closely tracks the real earnings gap.

- *Part C: Assessment.* Instructors can choose between a series of low-stakes or high-stakes summative assignments to determine the amount of learning accrued from the instructional session of the course unit. These instruments include options for in-class assignments, such as a verbal gallery walk or a minute paper, and out-of-class assignments, specifically, options for writing assignments of varying complexity.
- *Part D: Resources.* This list of educational resources and news articles provides additional information on topics relevant to the lesson, allowing the instructor to acquire in-depth background knowledge on data literacy and economics.
- *Handout 1: Step-by Step Instructions for Option A*
- *Handout 2: Step-by-Step Instructions for Option B*
- *Appendix.* This appendix provides an optional activity on sources of consumer prices. In this activity, real wages are expressed as a ratio between nominal values and the CPI. The CPI is the most common measure of the cost of living in the United States used by economists and policymakers. Instructors may want to use the activity to draw attention to some basic facts about the CPI, for example, how it is constructed, what its source and frequency are, and who holds the intellectual property rights for it. Moreover, instructors may choose to have students explore alternative measures of the cost of living. Some, such as the "Big Mac Index" (noted in the activity), are proprietary, and some, such as the "Billion Prices Project" (also noted in the activity), are the result of scholarly enterprise incorporating a social activism component. Instructors can easily point out that the choice of price index impacts the computation of real wages or earning gaps and so the ensuing interpretation of the data.

Discussion and Conclusions

Although the library and information science discipline, represented by the Association of College & Research Libraries (ACRL), has a natural strong hold on the domain of information literacy, other groups have a stake in its promotion. For example, the Association of American Colleges and Universities has developed a set of 10 VALUE (Valid Assessment of Learning in Undergraduate Education) rubrics spanning a series of student learning outcomes. Universities across the United States use these rubrics as guidelines for their regional accreditation efforts. However, although the VALUE rubrics include quantitative literacy and information literacy, they do not integrate, or even cross-reference, these intellectual domains.

Through our proposed pedagogical strategy, instructors are able to highlight the close functional relationship connecting numeracy, information literacy, and

social justice. We draw attention to the fact that the accurate quantitative assessment of social justice issues (e.g., the erosion in the purchasing power of minimum wages when not adjusted for changes in the cost of living and the initial [1979-2005] decrease and subsequent stagnation in the real earnings gap between men and women) must be built on a foundation of solid data literacy skills. Our lesson plan provides a practical framework for developing those skills and an accessible discussion of the issues. Additionally, it provides a venue for instructors to teach economics and personal finance while simultaneously highlighting matters of social justice, quantitative literacy, and information literacy. This allows instructors to avoid choosing between teaching content, teaching issues, and teaching skills.

In testing the pre-class interactive online module, we have received very positive feedback, suggesting minor adjustments to the timing of the instructional videos. Over the last 12 months, 54 students of economics at a small liberal arts institution in the Midwest have completed the FRED Interactive module "Information Literacy." Because the module was assigned in a variety of courses in the major and no demographic information was collected at the time, it is not possible to confidently extrapolate from the information gathered. Nonetheless, the available data paints an encouraging picture: of the 54 students who completed the online module, 5 scored 100% on both the pre-test and the post- test; another 25 students scored higher in the post-test than in the pre-test, thus demonstrating some measure of "positive learning"; 14 additional students did not raise their scores from pre-test to post-test and thus achieved "zero learning"; finally, only 10 students scored lower in the post-test than in the pre-test, effectively achieving some measure of "negative learning." When comparing the pre- and post-test student performance at the item level we observe that the largest gains in student proficiency (12%) were achieved in identifying data sources, followed by proficiency gains in identifying data transformations (7%) and in recognizing the role of data aggregators in facilitating access to data sources (7%). The smallest gains in student proficiency (5%) were associated with identifying the units of economic statistics such as dollars per week, dollars per hour, or index numbers.

A pilot of the two-part pedagogical strategy—i.e., the online module and lesson plan combined—has also been successful. Students were able to complete data and mathematical tasks and then address the discussion questions designed to elicit specific elements of information and data literacy. In addition, one of the pilot instructors successfully incorporated into two separate classes the optional activity (in Appendix A) focused on exploring alternative measures of inflation.

In both instances, by organizing the students into small groups and using the online collaborative platform Padlet (https://padlet.com/), the instructor was able to facilitate an in-depth discussion on the connections among data literacy, numeracy, and social justice. Overall, the hybrid pedagogical format holds great promise in a flipped classroom. It allows students to establish baseline comfort with the data tool (FRED), freeing up class time to focus on data literacy and mathematical instruction.

What is next for data literacy and FRED? As the wealth of statistical information available online continues to grow, users' ability to search for it efficiently and confidently needs to be strengthened. The development of effective online data search strategies is a high-priority task when engaging in the process of information creation. Creating more online modules and face-to-face lessons for learning about data and its construction, sources, uses, and re-uses will benefit educators and students.

Acknowledgements

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Appendix A

Creating a Classroom in Econlowdown.org

If the instructor has not done so already, she/he needs to register on the site. This process involves providing some basic information (e.g., instructor name, contact email, and school name). This information is protected by the strict privacy rules of the Federal Reserve System. After registering on the site and logging in, the instructor creates a classroom and adds the online module as follows: Click on "+Add New Classroom" and add a "Begin Date" and an "End Date." To add the online module to the classroom, click "Resource Gallery" (at the top) and then click "Resource Types" (on the left-hand side), the "Interactive Lessons" box, and the resource "FRED Interactive - Information Literacy." In the "My selected resources" box that appears, click "Add to Classroom" and then "Add" next to the appropriate classroom in the pop-up box. Next, click the "Go to classroom to publish changes" link. The last step is to click "Publish" on the classroom page, which adds the resource to the class syllabus and makes it accessible to enrolled students.

Enrolling Students in Econlowdown.org

Next, the instructor signs students up to the platform as follows: From the classroom page, click the "Students" tab (under the class name) and then click "Add New Student." Either enter individual names and contact information manually or import a spreadsheet with the required information. We recommend, for ease of use and to save time, formatting the student information from a class roster into a spreadsheet and importing that file onto the online platform by clicking the "import student list" link. Lastly, email students the "Student Code" and "Password" required to log into the econlowdown.org platform as follows: On the "Students" tab on the classroom page, click "Email Log In Information." This feature provides the option of adding a message to the email sent to students. We suggest including a reminder about completion deadlines and a note about any extra credit associated with the timely and thoughtful completion of this module.