Designing OER with Equity: An Example of Situating Equity in a Community College Statistics Course Redesign

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ABSTRACT

This article showcases an example of a large-scale open educational resource (OER) statistics course redesign at Guttman Community College from evaluation, creation, and development. It highlights ways I identified students' needs and responded to them, integrated equity into the OER design by describing how social justice principles were applied, as well as explicit examples of integration of culturally and locally relevant content in the design. This practical illustration of a course redesign is significant due to the lack of literature available on creating culturally and locally relevant and responsive OER. It is the hope that this example will encourage and inform the development of other such relevant and responsive OER projects to promote equity within open education.

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INTRODUCTION

The cost of textbooks poses a notable concern for students, especially at institutions serving underrepresented communities. The analysis of the social justice consequences of textbook cost based on demographic factors such as race, income, and being a first-generation college student has shown that historically underserved college students experienced heightened obstacles due to the increased burden of high textbook expenses (Jenkins et al., 2020). The high textbook costs disproportionately affect equitable access to learning for specific demographic groups. Pell Grant recipients and first-generation college students have experienced a disproportionately adverse effect from the high cost of course materials compared to their peers (Appedu et al., 2021). Latinx students experience a significant negative impact by stress related to textbook expenses in comparison to their white peers (Lo, Jordan, & Surbaugh, 2023). In order to promote a more equitable learning environment for all students, faculty are encouraged to consider how the cost of their required course materials could intensify social and academic barriers in their classrooms (Appedu et al., 2021).

An effective strategy to reduce this barrier to equitable participation in the educational experience is employing open educational resources (OER). In 2002, the OER movement in education started to reduce inequalities of educational opportunity by creating openly licensed content, and by promoting innovative ideas to remove educational barriers (Bliss & Smith, 2017). OER are teaching, learning, and research resources that are available to the public at no cost or have been released under an open license which allows their free use and repurposing by others with no or limited restriction (UNESCO, 2017). Over the years, with increased access and use of technology in education, there has been a notable rise in the acceptance and use of OER in higher education (Seaman & Seaman, 2022).

In recent years, however, there has been a new shift of focus in the movement. Initially, the concept of openness in education primarily centered around the legal aspects. However, more recent perspectives of the concept strive to address a wide range of socio-political inequalities, including understanding openness through the lens of equity and social justice (Bozkurt et al., 2023). When viewed through this lens, it is a progressive movement aimed at fostering a global learning environment characterized by enhanced equity, accessibility, and democratic values (Bozkurt et al., 2023).

Open education through the lens of social justice strives to foster an inclusive society while also advocating for democracy and active engagement (Bozkurt et al., 2023). This shift of focus has been critical for the movement, as it centers on utilizing the potential of OER to enhance educational equity. The emphasis on social justice within the OER movement and the ongoing discussions about integrating equity into OER have been growing (Katz & Allen, 2022). Lambert (2018) initiated this focus by analyzing the OER literature to evaluate the extent to which OER utilized the social justice framework and are aligned with social justice principles of redistributive justice, recognitive justice, and representational justice (Clinton-Lisell et al., 2021). Lambert defines the principle of redistributive justice as the "allocation of materials or human resources towards those who by circumstance have less," recognitive justice as "recognition and respect for cultural and gender difference," and representational justice as "equitable representation and political voice" (Lambert 2018). The findings show that these ideas were present at the beginning of the movement but became lost as it continued. Thus, there was a call to recenter equity and social justice within the movement (Katz & Allen, 2022) and to explore how OER can be utilized to more efficiently break down barriers to learning for diverse student groups (Bozkurt et al., 2023).

In that direction, as the OER movement continues to grow, educators need examples of how to center equity in their practices and how to implement OER with equity in mind (Katz & Allen, 2022). Equity pedagogy can be obtained by culturally relevant teaching and learning practices and by recognizing and responding to inequities experienced by students. As educators create and design teaching and learning practices, they should consider the diverse student body, recognize, and respond to the needs of students when designing educational materials (Clinton-Lisell et al., 2021). As culturally and locally relevant teaching practices are essential to equity, there is a need for practical examples of how to integrate them into the OER design (Katz & Allen, 2022).

This article provides an example of how to integrate equity with OER design. This manuscript describes an OER statistics course redesign at Guttman Community College, City University of New York (CUNY). It highlights the ways I recognized students' needs and responded to them,

the problems faced in the process, and the ways I integrated culturally and locally relevant content in the OER course design.

REASON FOR THE INITIATIVE

CUNY with 24 campuses across New York City is the largest urban university system in the country and serves a diverse student population. Since 54% of CUNY's students receive a Pell grant, nearly 40% come from households with annual incomes of less than $20,000, and 26.7% work over 20 hours per week, for many students at CUNY the cost of textbooks and course materials are often a barrier to academic success (Brandle et al., 2019).

Guttman Community College (Guttman) is one of the community colleges of CUNY serving mainly first-generation, traditionally underrepresented groups of students coming from low-income families. The high cost of required textbooks and access to online homework and software in their mathematics and statistics classes were a barrier to students' performance and success in their classes. At Guttman, all students are required to take the introductory statistics course and had to buy a commercial textbook with access to an online homework which could cost at least $120. This cost was a barrier to college affordability for our students and sometimes, students made the decision to not buy the textbook. Even with financial aid offered from college, students would still face challenges having and accessing course materials as not every student would qualify for the financial aid (such as undocumented students) and even for those who are qualified it often took weeks until they receive the fund. This delayed students' access to the textbook and the online homework in their courses during the crucial first weeks of class. Even a week or two delay in access to the textbook and homework while awaiting financial aid sets students back in their coursework from the start, making it more difficult for them to be successful in the course.

Another challenge in using commercial textbooks and commercial online homework was that the content and language may not necessarily be representable, relatable, or culturally relevant to our student body. As faculty have no control over the content of commercial course materials, it was not possible to adjust, edit, or modify the content to make it suitable for our student body. In striving to create a more equitable environment, in 2019 the author decided to convert the large-scale statistics courses at Guttman to OER courses with equity at the forefront. This enabled students to have access to all the course materials from day one in addition to enabling equitable pedagogy which allowed students' needs to be recognized and responded to. Furthermore, it gave faculty more control over their instructional materials allowing for more individualized adaptations for the most relevant experience for their students.

For this large-scale course conversion, we needed a free textbook, a platform for online assignments with questions for statistics topics, and statistical software. After an initial evaluation of available OER, it turned out there is no OER that is perfectly aligned with the course learning objectives, designed for community college level students, or culturally relevant to our students' population. Therefore, I created a team of faculty to design an OER for the statistics course that aligns with the course learning objectives, fits the needs of community college students, responds to our students' needs, and is relevant to students' lived experiences. To have a collective and inclusive voice in this large-scale course redesign, the team consisted of six faculty with experience teaching the course. The author took the lead in this effort.

EVALUATION

The faculty team worked collaboratively to evaluate OER textbooks, platforms for online assignments, and their database for statistics questions. After evaluating several textbooks, the *OpenStax Introductory Statistics* textbook (Illowsky & Dean, 2013) was chosen as the main reference because of its format and level of textbook which is pretty student friendly. Student-friendliness is what initially attracted us to the textbook, however there were problems with choosing this text. The main issue was the homework problems in the textbook were not designed on a free-to-use platform. To address this issue, we evaluated free platforms for online assignments and their database for statistics questions to design sets of homework assignments to offer alongside the textbook.

After evaluating multiple platforms, we decided to use *MyOpenMath* (www.myopenmath.com), a free-to-use learning management system for online assignments. The platform has rich mathematics content and features that make the design and delivery of online assignments and assessments easy for students and instructors. This platform is based on the fully open-source *IMathAS* software package (www.imathas.com), which allows auto-graded question types. The question-writing capabilities of the platform enabled us to adjust, edit, and create cohesiveness across the OER design.

The team evaluated the MyOpenMath database for statistics topics. While there were questions about the topics of the course, we found issues with the database. Questions in the database are written by various authors, for different levels, and various disciplines. So, there was no cohesiveness in the database, not aligned with the course learning objectives, and not aligned with the textbook. Therefore, we decided to use the database and make modifications and adjustments to create a library of questions in MyOpenMath tailored to our statistics course and our students. The idea was to create a rich, cohesive, and relevant library of statistics questions by selecting questions from the database, editing the selected questions, and writing and adding new questions to the database.

PROBLEMS WITH HOMEWORK QUESTIONS: OPPORTUNITIES TO INTEGRATE RELEVANT CONTENT

In this section, I outline the issues observed in the process of homework design which led to an opportunity for situating equity into the course design. Here are the main issues:

- The context of many questions was either irrelevant to our students or illustrated unethical scenarios that were not aligned with the course learning objectives.

- There were no questions about some of the learning objectives of the course.

- There were many questions with numerical data without any context.

Since questions in the database were written by various authors for various disciplines and levels, the context of many questions was either irrelevant or unfamiliar to our students' population and level. In addition, there were many questions requiring statistical analysis for a given data set without any context or meaning for the data which made it difficult for students to interpret their analysis. The question-writing capabilities of MyOpenMath enabled me to address these issues by editing the existing questions and by writing new questions. By editing the context of questions, I made them relevant to our students' lives and experiences, aligned to the course learning objectives, and created cohesiveness across the OER. By writing new questions from scratch and adding them to the database, I created a rich library for a variety of statistical topics with familiar and relevant context to students' experiences. The question-writing capabilities of the platform enabled me to adjust, edit, and create a cohesive culturally responsive and equitable experience across the OER design.

EDITING IRRELEVANT CONTENT

One of the issues with statistics questions in the database was that many questions either use irrelevant context or unethical studies. For instance, here is a question in MyOpenMath:

> "You would like to investigate whether smokers are more likely than nonsmokers to get lung cancer. You take the students in your class, select half at random and tell them to smoke a pack of cigarettes each day, and you tell the other half not to ever smoke. Fifty years from now, you will analyze whether more smokers than nonsmokers got lung cancer. Is this an experiment or an observational study?" (Question ID: 6942).

The context of the study in this question is not aligned with the ethical lesson of the statistics course. The ethical section of the course teaches students that when a statistical study uses human participants, researchers should be mindful of the safety of their research subjects. So, to change the context of this question to an ethical study that protects participants and ensures the safety of all human subjects, I changed the question to the following which removes the unethical issue in the original version:

"A teacher would like to investigate whether meditation can increase students' grades on final exams. The teacher selects half of the students at random and tells them to meditate before the exam and tells the other half not to meditate. After the exam, the teacher will analyze whether meditation was effective. Is this an experiment or an observational study?" (Question ID: 301417).

In addition, the context of many questions was either unfamiliar or irrelevant to our students' experiences. Many questions ask students to study and analyze the relationship between two variables that are not familiar to students. For example, questions about studying the relationship between age and grip strength of a person is not a familiar experiment to students and they may not know how to measure grip strength. For this case, I changed the context to the study of the relationship between age and height of a person as height and its measurement is a more familiar variable than grip strength. In similar cases, I changed the unfamiliar variable of the study to a more familiar variable of students' experiences so that they can better understand and relate to the context of the study.

CREATING NEW QUESTIONS WITH RELATABLE CONTENT

The absence of questions for some of the concepts and skills of the course in MyOpenMath was another issue that needed to be addressed. The solution was to create questions from scratch for the missing topics however writing questions in MyOpenMath requires knowledge and familiarity with IMathAS question writing. Therefore, I had to learn coding to be able to create new questions. There exists an IMathAS question writing instruction in MyOpenMath that people can use to learn the coding and write questions.

Writing new questions was another opportunity to create relevant content. For instance, because community college students typically work while enrolled, I created questions related to work, such as studying pay rates, working hours, and comparison of those data among genders. I also designed questions related to college experience, such as analyzing grades, GPA, majors, college units taken each semester, age of students, and comparison of those data in different classes, among genders, and across colleges. By recognizing that most of our students transfer to a four-year college at CUNY, I added questions related to CUNY colleges. In generating these questions, I used names and characteristics representative of our student population. Given the college is in New York City (NYC) and most of our students live in NYC, I created locally relevant questions by using local data, such as NYC weather, New Yorker annual income, etc. By considering the students' age group (majority between 18 to 20), I added familiar content tailored to their generation, such as studying percentage of social media users in a population. These are examples of ways I created content close to our students' lived experiences. Table 1 summarizes these approaches and examples.

GIVING CONTEXT AND MEANING TO NUMERICAL DATA

Another issue with statistics questions on MyOpenMath was many of the questions require students to perform data analysis and interpret the results of their analysis for a given data set without any context (data is given as numbers without a meaning behind the set of numbers). Lack of context and meaning for a given data set could make it difficult for students (especially for non-math majors) to understand and interpret the result of the data analysis. I edited these questions and added context to the data set so that students can make connections to the given numbers and make meaningful data analyses. In addition, this posed another space to integrate culturally and locally relevant content into the course design. Based on the data set and the type of analysis, I added relevant context to the data set. Examples of such relevant content can be found in Table 1. This type of question editing on MyOpenMath was easier and less time-consuming than writing questions from scratch because instead of writing the code from scratch, I could just add context to the existing code. As I could modify the question and add content without the need for coding, it did not require much time or effort, which created a great space and opportunity to integrate relevant content into the design.

	RECOGNITION OF STUDENTS' CHARACTERISTICS OR EXPERIENCES	ACTION	EXAMPLES
College Type	Community college	**Relevant content**: writing questions related to community college students' experiences	• Studying variables such as grades, graduation rate, students' stress level, and comparison of data between first year and second-year students • Studying variables related to work such as pay rates, working hours, and comparison of data between part-time and full-time students
Location	Guttman Community College, City University of New York (CUNY)	**Locally relevant content**: writing questions using college data, university data, and city data	• Questions using Guttman and CUNY data such as GPA, grades, college credits earned, graduation rate, majors, age range. • Questions to analyze NYC data such as city temperature, rent, annual income.
Culture	Hispanic-Serving Institution/Minority-Serving Institution	**Culturally relevant content**: writing content including different cultures, races, and ethnicities	• Studying variables such as GPA, credit accumulation, graduation rates through the lens of race. • Using names from multiple cultures in the content creation including Spanish names.
Gender	Inclusive	**Recognition of gender differences**: writing questions to study gender differences in various areas	Studying differences in pay rates, working hours, GPA, credit accumulation and graduation rates through the lens of gender.
Age Range	Young population (18 to 20 years old)	**Recognition of age group**: writing questions with familiar content for students' age range	Studying familiar variables closer to the students' experiences such as studies related to social media

Table 1 Creating Relevant Content by Recognizing Students' Characteristics and Experiences.

DISCUSSION

I recognized the inequity experienced by students due to the high cost of course materials in their statistics courses and responded to it by initiating and leading the design and creation of the zero-cost OER course. Since 2019, we have been offering the OER statistics course at Guttman which saved a total of $221,640 (up to Spring 2023) for students on college costs. In the process of this project, we faced problems that created an opportunity and space to integrate equity within the design by integrating culturally and locally relevant content and by recognizing and responding to students' needs. Table 2 summarizes problems faced in the process, actions taken, and ways I integrated equity in the OER design in those spaces by applying the social justice principles.

One of the products of this project is a library of questions hosted on MyOpenMath for statistics topics, which was designed by selecting questions from the database, writing new questions, and modifying the existing questions. This resource is available to the public and has been used by students and instructors across universities. It is available for everyone globally and can be adapted locally. Users of MyOpenMath with instructor accounts can search through the libraries and find this library under *Guttman_Statistics*. Instructors are allowed to copy and modify questions as they wish. This way they can modify the content and make it culturally or locally relevant to their student population and institution. We also created sets of homework assignments and assessments for introductory statistics on MyOpenMath which can be used and adapted by instructors (course name: Guttman MATH 103, course ID: 90153).

In the design process, I used the writing-question capability of MyOpenMath to make the content relevant and relatable to students. Writing questions in MyOpenMath requires knowledge and familiarity with question writing using IMathAS. However, editing existing

questions in MyOpenMath, to change the content and make it culturally or locally relevant, does not need the knowledge of coding and hence the edition would not be a hard task. One can edit the content of questions using the same code and make the question relevant to their student body, culture, and location.

PROBLEM	ACTION	SITUATING EQUITY
High cost of textbook and course materials	Providing free textbook and course materials, including online homework assignments and assessments	**Redistributive Justice**: Recognizing and responding to students' need
Homework questions with irrelevant content	Editing existing questions	**Recognitive Justice:** Replacing existing content with familiar, culturally, or locally relevant content
Absence of homework questions for some of the concepts/skills	Writing new questions from scratch	**Recognitive Justice:** Writing questions with culturally or locally relevant content
Homework questions with numerical data and statistics without context	Editing existing questions	**Recognitive Justice:** Adding culturally or locally relevant content to existing questions

Table 2 Integrating Equity in the OER Design.

CONCLUSION

This article presents an example of a large-scale OER statistics course redesign, demonstrating how equity can be integrated and culturally and locally relevant practices can be incorporated into OER. At Guttman, the development of this OER benefited students, instructors, and the institution. Between Fall 2019 and Spring 2023, a total of 1874 Guttman students were enrolled in the OER course, resulting in a collective cost savings of $221,640 on college expenses. Beyond reducing financial barriers, the developed OER increased students' access and participation in the learning platform compared to the commercial alternatives. At Guttman, the OER statistics course has been taught by 25 instructors. This OER provided instructors with more flexibility and freedom to tailor their courses based on student's need and their individual teaching approaches. Instructor acquired the ability to modify and customize assignments and assessments using the developed bank of questions in MyOpenMath, a possibility that was previously unavailable in the commercial context. According to instructors' feedback, the developed OER were helpful to enhance student learning and success while also supported their teaching approaches in statistics classes. Furthermore, the creation of this OER motivated additional OER initiatives within the institution. This OER introduced, inspired, and encouraged the development of more OER courses in MyOpenMath at Guttman, such as college algebra and trigonometry, pre-calculus, and calculus. This expansion resulted in a greater cost saving and a more equitable access to education for Guttman students. The implementation of this OER in statistics courses at two year or four-year colleges may yield similar results. This is due to its capacity to provide zero-cost, immediate, and easy access to the course materials from day one, its potential to increase students' engagement with learning platforms and assignments, the potential to impact students' learning and success, and the increase autonomy it grants instructors over their teaching materials.

This article illustrates a case where principles of social justice are emphasized during the design of OER, aiming to address educational inequalities. The developed OER has been perused by a team of Guttman faculty members with expertise in crafting culturally relevant pedagogy. The focus of this article is on the strategies and approaches used to align OER with the principles of social justice. While the presented OER is just one example, it is the hope that this project serves as a model for highlighting methods to prioritize equity in the design of OER. For example, similar practices can be applied in other OER projects as the database on MyOpenMath includes questions from multiple disciplines such as mathematics, statistics, accounting, chemistry, physics, finance, astronomy, etc. Therefore, instructors across various disciplines can use the methods described in this article to create assignments and assessments on MyOpenMath

for their courses and make them culturally and locally relevant. Due to the lack of literature available on practical methods and examples of applying social justice principles to OER, especially within disciplines like mathematics and statistics, further studies are needed to offer additional guidance on situating equity in the OER design. Beyond providing models for social justice aligned OER, these studies should also focus on how such OER can influence access, progress, and success rates.

DATA ACCESSIBILITY STATEMENT

The datasets generated and analyzed during the current study are available in the Guttman_ Statistics library, [www.myopenmath.com].

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS (CRedit)

Conceptualization, S.G.; methodology, S.G.; writing—original draft preparation, S.G.; writing—review and editing, S.G. The author has read and agreed to the published version of the manuscript.

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