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Impact of OER in Teacher Education

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Abstract

The purpose of this research study, which employed a quantitative research design, was to determine if there was a difference in the grades achieved by students who were enrolled in an entry-level Foundations of Education course using Open Educational Resources (OER) versus the grades achieved by students who used textbooks in other course sections. The goal was to find out whether OER was of the same or higher quality as textbooks in our minority-serving higher education institution. The outcomes revealed that there was no significant difference in grades for course sections that used OER when compared to course sections that used textbooks. Thus, it can be concluded that OER were as good as the textbook usage. The study was conducted at Hostos Community College (HCC), a two-year college of City University of New York (CUNY). CUNY is comprised of 25 campuses across the five boroughs in New York City, USA.

Keywords: Open education, open educational resources, distance education, teacher education, early child-hood education, technology in the classroom

When reflecting upon how academic content is dispensed to adults, Open Education is a relatively new marvel. At the time of this research study, the arena of Open Educational Resources (OER) reflected in the literature, benefits including cost effectiveness, accessibility of academic content, enhancement of andragogy, student engagement via a flipped classroom, and advancement of student learning. The author's goal was to help students reduce their expenses in purchasing textbooks and the idea that OER could achieve this goal was intriguing. However, when the author's Early-Childhood Education Department at an urban community college was part of a consortium of three institutions awarded a shared $300,000 *Achieving the Dream* (AtD) grant and financed in the Spring of 2016 (DiSanto et al., 2019), the author was skeptical of OER curriculum development. One of the author's major aims was to ensure that the OER chosen for courses was robust and cutting edge. With the financial resources to develop OER for all courses, the Education Department plunged into the challenge of converting the usage of Teacher Education textbooks in all courses to OER.

The Foundations of Education textbook used in the study traditionally was reviewed from samples provided by textbook publishers like Pearson, Cengage, etc. and selected by the faculty based upon criteria such as relevant topics related to the course, clarity in text, usage of visuals, robustness, and user-friendliness. The OER materials utilized in the course were selected by faculty from the public Open Education domain based upon similar criteria for selection of a hard copy textbook. A distinguishing feature of the OER is its digitized format resulting in improved accessibility in all teaching modalities. Moreover, the usage of the OER is at no cost to the student.

> As a college community striving to reach a 50% graduation rate by 2021-2022, it was hoped that the proliferation of OER would help students reduce their costs, thereby mitigating one of the factors that often delays graduation–a lack of funds. It was also anticipated that OER would level the academic playing field because all students would have access to academic content on the first day of class–no more waiting for the secondhand book to come from another state or students using earlier editions that may be worn, damaged, or incomplete (DiSanto et al., 2019, p. 229).

This research study evolved from the premise that OER usage might not be as good as textbook usage, although it was accessible to all students on the first day of class. The author believed that the findings of the study were important to uncover, as it was believed that the findings at the author's higher education institution would provide the empirical evidence to support OER usage versus textbook usage or oppose OER usage.

Review of the Literature

OER is defined as "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others" (William and Flora Hewlett Foundation, 2013 n.p.). OER include full courses, course materials, modules, textbooks, streaming videos, tests, software, and other tools, materials, or techniques used to support access to knowledge (Fischer et al., 2015; William and Flora Hewlett Foundation, 2013). David Wiley expounded on the notion of the consent allowed to an educational resource through an open license:

The term 'open content' describes any copyrightable work (traditionally excluding software, which is described by other terms like 'open source') that is licensed in a manner that provides users with free and perpetual permission to engage in the 5R activities:

1. Retain – the right to make, own, and control copies of the content (e.g., download, duplicate, store, and manage)
2. Reuse – the right to use the content in a wide range of ways (e.g., in a class, in a study group, on a website, in a video)
3. Revise – the right to adapt, adjust, modify, or alter the content itself (e.g., translate the content into another language)
4. Remix – the right to combine the original or revised content with other open content to create something new (e.g., incorporate the content into a mashup)
5. Redistribute – the right to share copies of the original content, your revisions, or your remixes with others (e.g., give a copy of the content to a friend) (Bliss & Smith, 2017).

Faculty and higher education institutions must determine whether OER usage is a worthy alternative to textbook usage in the 21st century. It has been a practice for colleges and universities to use textbooks in courses as academic content (Fischer et al., 2015). Professors usually assign the textbook as the major instructional material for a class (Fischer et al., 2015). "Students are obligated to purchase this book and use it to study the material in preparation for each class period" (Fischer et al., 2015, p. 160). Obviously, the textbook has a cost associated with its purpose. However, when OER is used, there is zero cost associated with its usage.

Textbook Cost & The Shift to OER

From a conventional perspective in the United States, textbooks have been a vital feature of the post-secondary learning encounters of most students (Fischer et al., 2015). However, the cost of textbooks has spiraled beyond the reach of many students from lower socioeconomic backgrounds, producing inequities in access to learning materials (Fischer et al., 2015). College textbook prices increased about 6% annually since Academic Year 1987-1988 (Silver et al., 2012). "The rising cost of textbooks may disproportionately harm students in community colleges, where tuition is generally lower and students may face greater financial difficulties" (Hilton et al., 2014, p. 68).

This was concerning to the author as the author's higher education institution is a community college located in one of the poorest counties in the nation. The findings of a longitudinal study focused on high school graduating seniors indicated that persons of lower socioeconomic statuses were more apt to postpone college enrollment (Provasnik & Planty, 2008). The study also conveyed that the graduating seniors who enrolled in college were more inclined to choose a community college than their peers who might be wealthy (Provasnik & Planty, 2008). Another research study's findings indicated that 55% of community college students were from the two last quartiles for income contrasted with 38% of public four-year students (Bailey et al., 2005).

The cost of textbooks has been a topic discussed frequently by the faculty in the Teacher Education unit. The faculty recognized that textbooks were of excessive cost and taxing for students of limited means. Textbook costs were rising at two times the inflation rate (Lyons & Hendrix, 2014). To help with textbook cost in a Field Experience course, immediately before conducting this research study, the author developed a comprehensive customized textbook to provide materials for students at a lower cost. Students seemed to be pleased with the textbook that was less than $90 for purchase and the reduced cost.

> … data from countless surveys show that students will go to lengths in order to avoid the sticker shock associated with buying new textbooks in print: buying used books, renting semester-long access; sharing textbooks with classmates; pirating them online; and, with increasing frequency, going without access to textbooks (Lyons & Hendrix, 2014, pp. 262-263).

The faculty recognized that there was an increase in the volume of students who were not prepared for class assignments into the third and fourth weeks of class because they could not afford the textbook. Although a challenge initially, the decision to pilot OER in the Early-Childhood Education courses to level the playing ground for students became a primary aim.

> Faculty cannot teach successfully in classroom environments, whether face to face or online, with increasing numbers of students who do not have access to required readings and other learning materials. There is a gap between the business models employed by textbook publishers and student expectations for access (Buczynski, 2007, p. 174).

The faculty determined that the usage of OER was a way to connect the gap. "Utilized in the classroom, OER can provide powerful tools for teaching and learning" (Hilton et al., 2014, p. 69). Furthermore, employing all-encompassing OER usage results in zero cost for each student (Hilton et al., 2014). "Students benefit from having course content available with zero costs and a wealth of resources available to them" (DiSanto, et al., 2019, p. 229).

Non-Financial Benefits of OER

Accessibility of Academic Content

One of the primary non-financial benefits of OER is making the academic content accessible from the first day of classes in a semester. In the Education Department, where the usage of the first OER was being piloted, the OER was uploaded in digital format in the course shells via the college's Blackboard system. Thus, on the first day of classes, learners were able to access academic content and faculty could demonstrate to learners how to access the OER from the Blackboard system.

Accessibility was evident in a case study conducted to "understand how open licensed approaches are used within the Colleges of the University of London that contribute to the University of London International Programmes and explore any policies that are being applied" (Hatzipanagos & Gregson, 2015, p.96). A major advantage of OER revealed in the findings was the promotion of "digital resource access, availability and usage" (Hatzipanagos & Gregson, 2015, p. 102).

This advantage of providing learning materials to students free of charge on the first day of courses served as a major reason for the Education Department determining that converting to OER usage fully was worth pursuing. Using OER enabled faculty to create an environment that engaged students in the learning process immediately. Moreover, it took away an excuse that previously had been used—in the case of a learner who did not purchase a textbook due to unaffordability—that they were unable to read learning materials and/or do assignments because the materials were unavailable.

Enhancement of Andragogy

Another benefit of OER discovered is that it enhances andragogy. The term *andragogy* is described as the art of instruction of adults (Ross-Gordon, 2003). Malcolm Knowles, who is recognized for his work on andragogy, describes it as the art and science of helping adults learn (Knowles, 1984). Andragogy was first introduced in 1833 by Alexander Kapp, a German educator, to categorize learning approaches that focus on adults (Knowles, 1975).

A recommendation for classroom practice for adult learners in higher education is to foster relationships between academic learning and learning in the larger world (Ross-Gordon, 2003). Thus, an approach that faculty can use to facilitate adult learning is to create "opportunities within the classroom for students to make linkages between course content and knowledge gained in the contexts of work, family, and community living" (Ross-Gordon, 2003, p. 50). Adult learner access to OER provides the content to help adult learners build these connections. In practice, the author determined that these connections also could be created in Hybrid and online modalities.

Student Engagement via a Flipped Classroom

Another benefit of the OER featured as an advantage was its usage as a tool in a flipped classroom using team-based learning instructional strategies (Jakobsen & Knetemann, 2017). An example of this in this author's experience is from Language Arts for Young Children, a course designated as Service-Learning by the college. Students were given access to OER materials on the first day of the course. Some of the OER academic content featured such topics as literacy, the tutoring process, and instructions on how to conduct a running record whereby learners could identify the reading level of a young child. Meanwhile, some class sessions were used to teach specific strategies to tutor a child that included direct instruction and time to practice the developing skill. In addition to the provision of additional academic content, learners gained experience tutoring young children in neighboring elementary schools with a resulting class assignment that assessed their volunteer tutoring service. Periodically, learners were asked focused questions regarding the OER. Exams were given to assess the outcomes of student learning and written assignments, focused on the tutoring experience, were given to document and assess reflective learning outcomes.

In the flipped classroom, students engage in the course material (i.e., OER) outside of the classroom permitting them to study the OER data at their personal speed (Jakobsen & Knetemann, 2017). "Rather than spending class time laying down the foundation, students are able to delve into a deeper understanding of the material" (Jakobsen & Knetemann, 2017, p. 177).

Advancement of Student Learning

Finally, a major benefit of OER featured as an advantage of its usage is that it advances student learning. In a study of the impact of OER use on teaching and learning, one conclusion drawn from a project was that "implementation of OER can improve student performance, but often indirectly through increased confidence, satisfaction and enthusiasm for the subject" (Farrow et al., 2015, p. 972). Other research on encounters with OER referenced the identification of improved learning as a potential benefit of OER (Hatzipanagos & Gregson, 2015).

Moreover, to strengthen the argument further regarding OER's impact on student learning, the outcomes of some research studies indicating student success using OER were discovered. These studies focused on analyzing student learning outcomes when OER are substituted for traditional textbooks.

The studies, as noted in table 1, were cited in an article that provided a review of the literature of OER research by John Hilton, III (2016), a well-respected researcher of OER.

Table 1: Research Studies of Student Learning Outcomes Using OER

College/Year	Study	Findings
Lovett et al. (2008) Online OER Component of Carnegie Mellon University	Measured the result of implementing an online OER component (2005-2006)	No statistically significant differences were noted.
Lovett et al.	Follow-up study (2007)	No statistically significant differences between traditional and online groups were noted.
Bowen et al. (2012) Six different undergraduate institutions	Extension of study just mentioned *Note: largest of OER efficacy using randomization and comparisons of multiple learning outcomes*	Students who used OER performed slightly better in terms of passing the course; differences were marginal and not statistically significant.
Hilton & Laman (2012) Houston Community College	Study conducted in 2011	Students had a high GPA in the course, a lower withdrawal rate, and higher scores on the final exam; no analysis was performed to determine whether the results were statistically significant.
Feldstein et al. (2012) Virginia State University	Study conducted in 2010	Students using OER had better grades and lower failure and withdrawal rates; results had statistical significance, but the two sets of courses were not the same.
Pawlyshyn et al. (2013) Mercy College	Study conducted in 2012	Student learning outcomes appeared to increase; no statement of statistical significance was mentioned.
Hilton et al. (2013) Scottsdale Community College	Study conducted in 2012	Differences were not statistically significant
Allen et al. (2015) University of California, Davis	Study conducted to test the efficacy of an OER in a general chemistry class	Researchers found no significant differences between the overall results of the two groups.

Continued

Table 1: Continued

Robinson (2015) Seven different institutions	Study examined OER adoption, the differences in final course grade, the percentage of students who completed the course with a grade of C- or better, and the number of credit hours taken	In five of the courses, there were no statistically significant differences in terms of final grades or completion rates; students in the Business course using OER performed significantly worse, and those in a Psychology course also showed poorer results.
Fischer et al. (2015)	Follow-up research	In two of the 15 classes, students in the treatment group were significantly more likely to complete the course--there were no differences in the remaining 13.

Source: Hilton III, 2016

Rationale

The purpose of this research study was to look at the learning outcomes of students by comparing the grades of students who were enrolled in the college's entry-level Foundations of Education course, housed in the Teacher Education unit's Early-Childhood Degree Program at HCC, using OER versus the grades of students who used traditional textbooks in their course sections. The goal was to determine if there was a *difference* in the *grades* achieved by students who were enrolled in the entry-level Foundations of Education course using OER versus the grades achieved by students who used textbooks in their course sections.

Setting

This research study was conducted at HCC, a two-year college of City University of New York (CUNY). The college's location is in the southern portion of Bronx, New York, which is one of the five boroughs in New York City and regrettably noted as the most impoverished in the nation. The Bronx is the northernmost of the five boroughs of New York City, within the state of New York. Geographically, it is south of Westchester County; north and east of the island and borough of Manhattan to the south and west across the Harlem River; and north of the borough of Queens, across the East River. Of the five boroughs, the Bronx is the only one that has the bulk of its area on the U.S. mainland and, with a land area of 42 square miles. In 2016, the Bronx had a population of 1,455,720, however, by 2019, the population decreased to 1,418,207 (Wikipedia, 2019).

College mission

The study was conducted in compliance with the community college's mission, which is to offer people access to higher education leading to intellectual growth and socio-economic mobility through the development of linguistic, mathematical, technological, and critical thinking proficiencies needed for lifelong learning and for success in a variety of programs including careers, liberal arts, transfer, and those professional programs leading to licensure, like Teacher Education.

Methodology

Participants

The research study was conducted in the Early-Childhood Education Program, which included 431 participants or 6.2% of the student body. The study covered nine (9) course sections, two of which were OER. One OER section was online and the other section met face-to-face with the professor. Two textbook course sections met online while two others met face-to-face with a professor. The other three textbook course sections were hybrid.

The average age by course section revealed that the OER online section had an average age of 25 while the OER face-to-face section had an average age of 22. With respect to the distribution of majors by section, results showed that in the OER online section, there was a mixture of majors with Liberal Arts majors being the most. In the face-to-face section, students majoring in Early-Childhood Education and Liberal Arts made up the section, with the Early-Childhood Education being the most.

The degree progress by section showed that many of the students had attended the college for less than a year. The English Language Learner (ELL) status revealed that there were some ELLs reflected in the distribution of students, however, most students were non-ELLs. The gender by section was evident in showcasing females in the majority to males. Moreover, ethnicity/race by section (Fig. 1) revealed that Hispanics made up most of the classes, followed by African Americans or Blacks, Asians, Whites, and Unknowns.
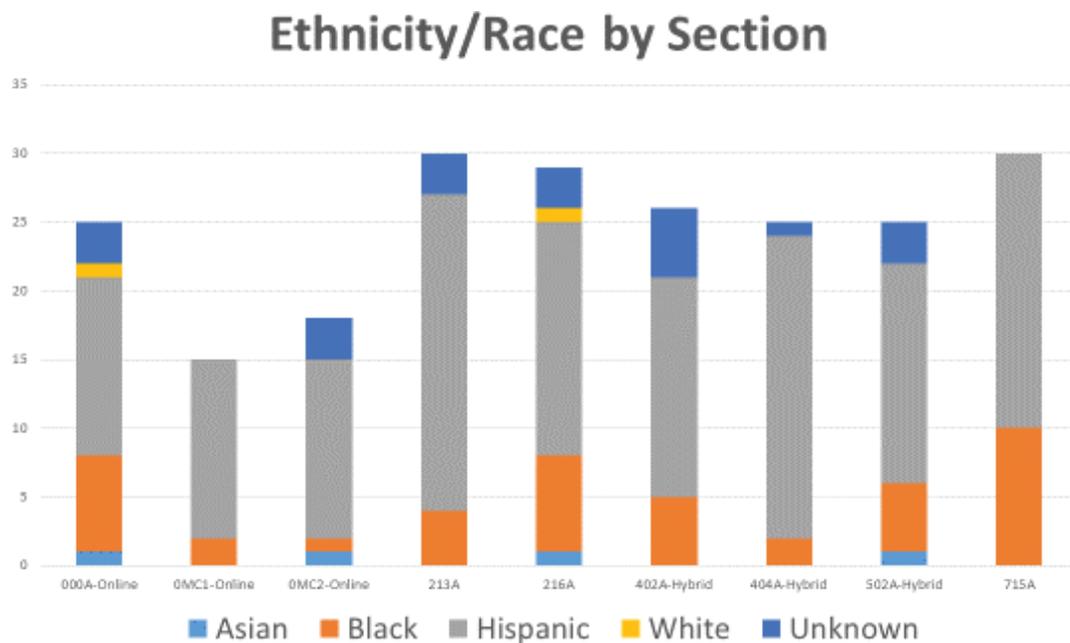

Figure 1: Ethnicity/Race by Section.

During the spring (2017) when the research study was conducted, the HCC enrollment was 6,979; 3,855 or 55.2% of the students were full-time and 3,124 or 44.8% were part-time students. A total of 6,233 (89.3%) of these students were degree-seeking students, while 746 (10.7%) were non-degree seeking students. The enrollment consisted of 4,706 or 67.4% female students, and 2,273 or 32.6% were male students.

Looking at the diversity of the student body, the percentages in the ethnic/racial background reflected 1.7% White, 21.6%-Black, 58.5% Hispanic, 3.3% Asian, 0.5% Native American, and 14.4% Other or Unknown. With respect to citizenship status, 69.1% were United States citizens, 20% were Permanent Residents, 2.4% possessed a Student Visa, and .1% had Temporary Visas.

In total, 431 or 6.2% of the student body participated in the study. Two of the nine course sections were OER, one online and the other, face-to-face with the professor. There were two textbook course sections that met online with two others that met face-to-face with the professor. The other three textbook course sections were Hybrid, meeting online half the time and meeting face-to-face with the professor the other half of the time.

Research Design

HCC awards letter grades to students to denote the level of achievement in each course. The grading system is displayed in table 2.

Table 2: Grading System

Letter Grade	Range	Quantity Point Value	Explanation
A	93 -100	4.0	Exceeding Standard
A-	90 - 92	3.7	
B+	87 – 89	3.5	Meeting Standard
B	83 – 86	3.0	
B-	80 – 82	2.7	
C+	77 – 79	2.3	Approaching Standard
C	70 – 76	2.0	
D	60 – 69	1.0	Far Below Standard
F	Failure	0	Unacceptable

An analysis of grade distribution histogram was used to determine whether there was a *difference* in the *grades* achieved by students who were enrolled in the entry-level Foundations of Education course using OER versus the grades achieved by students who used textbooks in their course sections. The Grade Distribution Histogram (Fig. 2) shows that students who received A's are represented by the color-gray; those who received B's are represented by the color-blue; and those who received C's are represented by the color-Carmel. To identify each section, Bar 1 is OER online; Bar 2 is Textbook online; Bar 3 is Textbook online; Bar 4 is Textbook face-to-face; Bar 5 (the middle bar) is OER face-to-face; Bar 6 is Textbook hybrid; Bar 7 is Textbook hybrid; Bar 8 is Textbook hybrid; and Bar 9 is Textbook face-to-face.
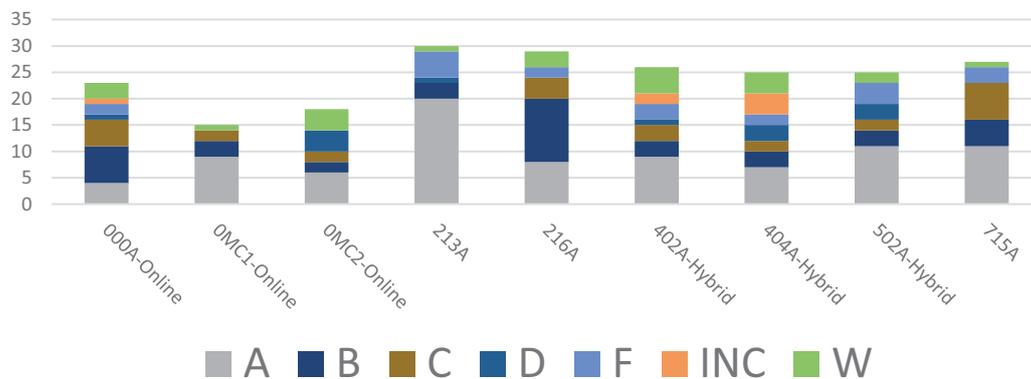
Grade Distribution

Figure 2: Grade Distribution Histogram

Results

The research outcomes (see Table 3) indicated that there were no significant differences found in the grades of students in the course sections using OER versus the grades of students who used textbooks across teaching modalities. These findings revealed that using OER had no adverse impact to student learning outcomes and the findings support the findings of other research studies cited previously in this article (Hilton, III, 2016).

Table 3: Research Outcomes

ANOVA (Grade Comparison)				
Mean Square	**Significance**	**F-ratio** (Difference among means)	*df* (Statistic for within groups)	**T** (Grade variance – standard of error)
1.461	.388	0.748	1	0.229

Research Analysis

There was no statistically significant difference in the grades that were achieved by students in the course sections using OER versus the grades achieved by students who used textbooks. This outcome implies that students achieved comparable grades whether they used OER or textbooks. From the author's perspective, the reasons why the study's outcomes might have failed to see a great difference is that the OER was available on Day 1 of classes and the content of the OER seemed to be as robust as the textbooks previously used. Furthermore, the OER conveyed academic content in the same way for which textbooks dispensed scholastic materials.

It is crucial to note that in both the OER online and face-to-face course sections, the OER was made available to students via the campus Blackboard online technology system whereby students had immediate access to the academic content. The design of the OER online course section was comprised of OER-based content with student readings and viewing, in the case of videos, while the design of the face-to-face course section was comprised of the same plus reporting on this same content and role playing through skits using a team-based learning methodology in the classroom.

When looking specifically at OER course sections versus textbook course sections that were online or face-to-face, there was no statistically significant difference in the grades that were achieved by students in the course sections. This outcome implies that students achieved comparable grades whether they used OER or textbooks amidst the fact that the classroom modalities were similar.

It must be noted that the design in the textbook course sections is unknown, and the quantitative results did not reflect a measurement of professors' teaching philosophy or methodologies employed in the classroom. Students were required to purchase textbooks in these course sections. The requirement might have caused a delay for a percentage of students to engage in the academic content due to high textbook costs and/or lack of student financial resources. Thus, the textbook online and face-to-face course sections might have had a delay in access to the academic content.

With respect to the OER course sections (online and face-to-face) versus the four textbook hybrid course sections, there was no statistically significant difference in the grades that were achieved by students in the course sections. This outcome implies that students achieved comparable grades whether they used OER or textbooks although they engaged the academic content online half the time and met face-to-face the other half of the time. Again, the design of the hybrid textbook course sections is unknown. Moreover, the research results did not include study of professors' teaching philosophy or methodologies employed in the classroom. In this instance as in the textbook online and face-to-face course sections, students were required to purchase textbooks in these hybrid course sections. The requirement might have caused similar challenges as those that were textbook online and face-to-face course sections. It is not known, further, whether the design of the hybrid textbook online and face-to-face segments of the hybrid course sections included similar methodologies to the OER online and face-to-face course sections.

The analysis of variance (ANOVA) "is a statistical procedure that compares the amount of between-groups variance in individuals' scores with the amount of within-groups variance" (Ary et al., 1996, p. 307). Specifically, the difference between two or more means can be tested via ANOVA (Ary et al., 1996).

> The assumption underlying the ANOVA procedure is that if the groups to be compared are truly random samples from the same population, then the between groups mean square should not differ from the within-groups mean square by more than the amount we would expect from chance alone. Thus, under a true null hypothesis we would expect the F-ratio to be approximately equal to 1.0. On the other hand, if the null hypothesis is false, the difference among group means will be greater than what is expected by chance, so the mean square between will exceed the mean square within. In such cases, the F-ratio, the mean square between divided by the mean square within, will have a value greater than 1.0. (Ary et al., 1996).

With respect to this research study, the ANOVA was used to compare the grades in two OER course sections using online and face-to-face modalities versus seven textbook course sections that included online, face-to-face, and hybrid modalities. The ANOVA consisted of a regression analysis

revealing that the test of significance in grades outcome had a mean square of 1.461 and indicating a significance of .388.

To determine whether the differences among the means were great enough to be statistically significant, or whether it was possible that they happened by chance, the F-ratio was computed. The F-ratio was 0.748. Since the F test statistic was less than 1, it can be determined that there was no statistical significance in variability among course sections. The degrees of freedom (df) statistic for within-groups was 1, which indicated that there was no statistical significance between course sections.

A t test was employed to determine any significance in grade variance. This was used because grades were the only sample drawn from each course section without other relationships between two groups (Ary, et al., 1996). There was no statistical significance since the standard of error was 0.229 as grades served as the only dependent variable used to measure any differences between OER course sections versus textbook course sections.

Limitations

Although this research study was important in determining the value of OER in a Teacher Education entry-level course, it failed to examine OER usage in each course of the Early-Childhood Education Program within the Teacher Education Unit. The examination of grades in nine course sections, two of which used OER, was constrained to a course-by-course analysis. In addition, this quantitative research study was limited in its scope in that it was unable to yield qualitative data like attitudes of students using OER versus students using textbooks or attitudes of students whose professors used OER as a tool in a flipped classroom format with purposeful requests of students to conduct additional research and/or requests for them to share personal learning outcomes related to knowledge gained from OER and linked to varied experiences.

Conclusion

The research findings revealed that using OER had no adverse impact to student learning outcomes. There were no significant differences found in the grades of students in the course sections using OER versus the grades of students who used textbooks across teaching modalities.

Thus, the author concludes that OER usage in all teaching modalities is optimum. The provision of learning materials for student usage free of charge is only one reason that OER is advantageous. The author is convinced that usage of OER in this technologically-focused era is cutting edge also due to its non-financial advantages like making the academic content accessible on the first day of classes in a semester; enhancing andragogy by using OER as a learning approach to help adults develop linkages between the OER and knowledge acquired in the family, at work, and in community settings; using OER as a tool in a flipped classroom whereby students engage in the course material (i.e., OER) outside of the classroom permitting them to study the OER data at their personal speed; and advancing student learning outcomes when the OER content is as comprehensive and robust as a hard copy textbook.

Future Directions

Studies are needed to replicate this research within Early-Childhood Education and in other disciplines. Furthermore, other aspects of OER usage need study. Examples include measuring attitudes of students using OER, looking at the textbook purchasing practices of students prior to the use of OER, or examining the attitudes of students who failed to buy required textbooks and are now using OER.

Research regarding the sustainability of OER in the CUNY educational system might be beneficial to all campuses in the CUNY system and other higher education institutions (Wiley et al., 2016). Both scholars and research investigators have dialogued about the prospects of sustaining the formation and distribution of OER (Dholokai et al., 2006; Wiley, 2006). Other research studies conducted recently have shown fiscal examples whereby more registrations generated new tuition income due to an institution's OER usage that covered a surplus of the costs of publishing OER (Johansen & Wiley, 2011). Looking for successful models that support an institution's OER usage is poor for learners if faculty fail to commit to its ongoing usage (Wiley et al., 2016).

While there are no content licensing costs associated with using open educational resources, there are several real costs that must be incurred by a faculty member or institution that chooses to adopt OER, including the costs of:

- Locating OER. There are well over half a billion openly licensed resources published on the Internet. At the time of this writing, a Google Advanced Search for the term 'biology' including only results that are licensed as being 'free to use share or modify' returned about 4,660,000 results.' Finding the needle that appears to be relevant for a specific use case in this haystack can be time consuming.
- Reviewing OER. After identifying OER that appear to be relevant, these must be checked for quality, accuracy, accessibility, and other desirable attributes.
- Managing open license compatibility and attribution requirements.
- Each open license imposes certain obligations on the user. One example is the *Creative Commons Attribution License*, which requires that users provide attribution to the copyright holder of the re-source. Each of these requirements must be tracked and managed for all OER used in a course.
- Effectively integrating OER into teaching and learning practices. The primary distinguishing attribute of OER is the broad range of copyright permissions granted by their licenses. Many faculty require additional training in order to understand the pedagogical opportunities afforded by these permissions. Many faculty also require additional training to use common online tech-nologies effectively in their teaching.
- Integrating OER into campus technologies like learning management systems. Most OER are provided in one or more digital formats. In order to take advantage of the permissions granted by OER, faculty will need to move them into a local learning management system or other tool with both editing and publishing capabilities. Many faculty require support in performing this ini-tial tool with both editing and publishing capabilities. Many faculty require support in performing this initial task as well as the eventual editing and localizing tasks (Wiley et al., 2016, p. 4).

When a higher education department determines to convert from the use of textbooks to OER, the higher education institution must identify how it will fund the necessary supports of its adoption (Wiley et al., 2016). For the author's higher education institution, the AtD grant was secured to finance the adoption of OER in various educational departments on the HCC campus. Hostos Library faculty were instrumental in the professional development of faculty regarding OER creation and adoption processes from the start. The Library secured an additional grant to continue the processes of OER to maintain its usage. Thus, library and teaching faculty at HCC located and reviewed OER, and now manage the open license compatibility and attribution requirements. OER were integrated in the Teacher Education unit fully and were made accessible to learners through the institution's learning-management system (i.e., the Blackboard system). Sustaining the use of OER has become an integral part of the author's institutional operations. As an addendum to sustaining the fiscal support for OER, faculty are now developing protocols to update OER as part of their regular reflective practice activities as was done previously when textbook usage was the norm. In conclusion, additional research on the topic of OER

sustainability might provide insight into OER sustainability at HCC, CUNY, and other higher education institutions in future years.

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