The Impact of Free and Open Educational Resource Adoption on Community College Student Achievement and Course Withdrawal Rates

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Abstract

This study examines the impact of free and open educational resource (OER) adoption on end-of-semester grades and withdrawal rates of community college students. Performance data for 1,209 students in seven courses were analyzed to determine if there was a significant impact of OER on student performance and persistence for all students and for Pell grant recipients, part-time, first-time and non-white students. Results found no significant difference on end-of-semester grades between students in OER courses and those in courses using a traditional textbook. In addition, no significant difference was found based on Pell grant status, part-time status, or full-time status. However, significant differences in withdrawal rates and end-of-semester grades exist based on ethnicity. When Hispanic students persist in OER courses to the same extent as their white peers, they are more likely to achieve a higher grade than Hispanic peers in non-OER courses. Yet Hispanic students withdrew from OER courses at higher rates than all other ethnicities. Black/African American students persist in OER courses at a higher rate than Hispanic students but receive lower final grade averages in these courses. The current research and findings are a valuable contribution to the body of research on adopting free and open resources at the community college level and suggest future areas of study regarding OER and non-white populations.

Keywords: community colleges; student achievement; withdrawal rates; marginalized populations; OER efficacy; underserved students

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El impacto de la adopción de recursos educativos abiertos y gratuitos en el rendimiento de los estudiantes de las universidades comunitarias

Resumen

Este estudio examina el impacto de la adopción de recursos educativos abiertos y gratuitos (FOER) en las calificaciones de fin de semestre y las tasas de abandono de los estudiantes de colegios comunitarios. Se analizaron los datos de desempeño de 1.209 estudiantes en siete cursos para determinar si hubo un impacto significativo de FOER en el desempeño y la persistencia de los estudiantes para todos los estudiantes y para los beneficiarios Pell, estudiantes a tiempo parcial, estudiantes por primera vez y no blancos. Los resultados no encontraron diferencias significativas en las calificaciones de fin de semestre entre los estudiantes de los cursos FOER y los de los cursos que utilizan un libro de texto tradicional. Además, no se encontraron diferencias significativas en función del estado Pell, el estado a tiempo parcial o el estado a tiempo completo. Sin embargo, existen diferencias significativas en las tasas de retiro y las calificaciones de fin de semestre según el origen étnico. Cuando los estudiantes hispanos persisten en los cursos FOER en la misma medida que sus compañeros blancos, es más probable que obtengan una calificación más alta que sus compañeros hispanos en cursos que no son FOER. Sin embargo, los estudiantes hispanos se retiraron de los cursos FOER en mayor proporción que todas las demás etnias. Los estudiantes negros / afroamericanos persisten en los cursos FOER a un ritmo más alto que los estudiantes hispanos, pero reciben promedios de calificaciones finales más bajos en estos cursos. La investigación y los hallazgos actuales son una contribución valiosa al cuerpo de investigación sobre la adopción de recursos abiertos y gratuitos a nivel de colegios comunitarios y sugieren áreas de estudio futuras con respecto a los REA y las poblaciones no blancas.

Palabras clave: colegios comunitarios; logro estudiantil; tasas de retiro; poblaciones marginadas; eficacia REA; estudiantes desatendidos

采纳免费的开放教育资源对社区大学学生成绩产生的影响

摘要

本研究分析了采纳免费的开放教育资源（FOER）对社区大学学生的期末成绩以及弃课率产生的影响。分析了7门课程中1209名学生的成绩数据，以确定FOER是否对以下学生的成绩和弃课率产生了显著影响：所有学生、佩尔助学金获得者、兼职学生、首次上大学的学生、以及非白人学生。分析结果发现，参加FOER课程的学生的期末成绩与使用传统课本的学生相比不存在显著差异。此外，是否获得佩尔助学金、兼职或全日制情况都未产生显著差异。不过，族群性会导致弃课率和期末成绩之间出现显著差异。当西班牙裔学生和其白人同学以同等程度参与FOER课程时，他们比参加非FOER课程的西班牙裔学生更有可能取得更高的成绩。不过，比起其他族群，西班牙裔学生在FOER课程上的弃课率更高。黑人/非裔美国人学生比西班牙裔学生更能坚持FOER课程学习，但取得的最终成绩低于后者。本研究及其研究发现对关于社区大学采纳免费开放资源的研究作出了宝贵贡献，并对有关OER和非白人群体的未来研究领域提出建议。

关键词：社区大学，学生成绩，弃课率，边缘化群体，OER效能，教育资源不足的学生

Introduction

Since May 2018, Raritan Valley Community College (RVCC) faculty have been offered mini-grants to adopt free and open educational resources (OER) in lieu of traditional, commercial textbooks to convert their course sections to "z-courses" (zero-textbook costs). Rather than strictly requiring the adoption of open educational resources, these grants allow faculty to also choose digital copyrighted materials that are free for students and can be legally used under Fair Use guidelines. Thus, a wide variety of free course materials could be adopted by faculty with the goal of eliminating commercial textbook costs for students. The first semester of grant-funded z-course conversions was Fall 2018, with seven courses converting to z-courses for at least one section. Five additional grant-funded courses implemented free and/or open resources in Spring 2019, and the grant program has continued since then. Faculty who convert to z-courses consistently report that their students were both surprised and relieved to find out that there was

no required textbook purchase for the course. Anecdotal evidence and results from a voluntary survey sent to students in these courses show that students are generally satisfied with the OER materials, prefer using OER over purchasing a textbook, and are likely to enroll in z-courses in future semesters.

As RVCC's initiative was growing, Colvard, Watson and Park (2018) published a large-scale study conducted at the University of Georgia that demonstrated a significant impact on student achievement in courses using OER. Their results indicated that end-of-course grades increased and DFW (Drop, Fail, Withdraw) rates decreased for all students across the courses they studied. More importantly, after disaggregating the data, they found that DFW rates "decreased dramatically for student populations [that they] hypothesized would benefit the most from free textbooks (e.g., Pell eligible students, underserved populations, and part-time students" (p. 272). The authors rightfully did not generalize their findings across all institution-types and recommended that other institutions perform similar research on the achievement of traditionally underserved students in OER courses.

RVCC, a mid-sized community college in central New Jersey, serves a population that could realize significant benefit from the use of OER in lieu of costly textbooks. In Fall 2018, 60.8% of RVCC students were part-time, 30% received a PELL grant, and 34% reported Hispanic, black, or African American ethnicity. The current study seeks to expand on Colvard, Watson and Park's (2018) research by applying a similar methodology in a community college setting. In addition, while the courses in the previous study all used a specific OER – OpenStax textbooks – this study will demonstrate whether the findings are applicable to students taking courses using a variety of OER.

The following research questions guided the study:

1. Is there a significant difference in student achievement for students in OER sections compared to sections of the same course taught by the same instructor in a previous semester using a commercial textbook?

2. Is there a significant difference in student achievement for Pell recipients, non-white students, first-time students, or part-time students in OER sections compared to previous semester sections taught by the same instructor using a commercial textbook?

Literature Review

Much of the OER research conducted at community colleges has focused on adoption of an open textbook in a specific course or discipline and on the perception of OER by students and/or faculty. Hilton, Gaudet, Clark, Robinson and Wiley (2013) found that student and faculty perceptions of OER used in five courses in the Scottsdale Community College math department were gener-

ally positive and that there were no significant negative or positive changes in educational outcomes. Several studies using surveys of students and faculty at community colleges found that respondents had positive experiences using open textbooks, appreciated the low/no cost of course materials compared to traditional textbooks, and perceived the quality of open textbooks to be the same as, or better than, commercial textbooks (Bliss, Hilton, Wiley & Thanos, 2013; Bliss, Robinson, Hilton & Wiley, 2013; Illowsky, Hilton, Whiting & Ackerman, 2016; Read, Tang, Dhamija & Bodily, 2020).

Moving beyond the perception of OER, researchers have examined OER's impact on grades, persistence, and retention. Allen, et al. (2016) compared exam grades of students taking an undergraduate chemistry course using either a traditional textbook or the ChemWiki OER and found no substantial difference in student performance between the two. Shaw, Irwin and Blanton (2019) analyzed DFWI (Drop, Fail, Withdrawal, Incomplete) rates in undergraduate business courses at an online university. Their data revealed that OER adoptions had a significant impact on both decreasing and increasing DFWI rates. However, no statistical significance was found when comparing DFWI rates across all courses, so they "conclude conversions to OER did not impact the course DFWI rates in online courses in undergraduate online education for the School of Business" (p. 13).

Fischer, Hilton, Robinson and Wiley (2015) conducted a study using student data from courses at four different institutions to measure course completion, final grades and enrollment intensity. While there were no significant differences found regarding achievement measures, they did find that students who took an OER course enrolled in a higher number of credits the next semester. Hilton, Fischer, Wiley and William (2016) examined the course throughput rates in 67 non-z courses (traditional textbook) and z-courses (OER) at Tidewater Community College. They found that students in z-courses were less likely to withdraw and more likely to receive the grade of C or higher than their peers in non-z courses. However, the drastic difference in the numbers of students enrolled in non-z versus z-courses is acknowledged by the authors as a study limitation because significantly fewer students were enrolled in the z-courses.

The previously mentioned study by Colvard, Watson and Park (2018) is a large-scale study across multiple disciplines to analyze the effect of OER on student grades and to disaggregate data by demographic factors for closer analysis. Their study of 21,822 students determined that the use of OpenStax textbooks in eight courses improved end of course grades and decreased DFWI rates for all students and did so at higher rates for specific populations of (potentially at-risk) students.

As the body of OER research has grown, literature reviews and meta-analyses have been published to synthesize the findings of similar studies. Hilton (2016) reviewed 16 published studies on OER: nine that analyzed student learning outcomes in courses

that adopted OER and seven that examined student and/or faculty perceptions of OER. In general, and as described above in specific studies, Hilton found that students and faculty members find OER comparable to their traditional, commercial textbooks and the use of OER does not appear to negatively affect student performance. Clinton (2018) synthesized the results of multiple studies of OER use in psychology and came to similar conclusions. Those studies also show a decrease in withdrawals from psychology courses, but it is unclear whether OER play a role in that decrease. Clinton and Khan (2019) performed a meta-analysis of the results of several studies comparing academic performance and withdrawal rates in courses using OER and traditional textbooks. Based on the findings of 22 independent studies, they likewise conclude that "there were no meaningful differences in learning efficacy between students using open textbooks and students using commercial textbooks" (p. 13) and students in OER courses appear to withdraw less frequently.

It should be noted that Grimaldi, Mallick, Waters and Baraniuk (2019) have published a strong criticism of the methodology and assumptions of OER efficacy research. By conducting a simulation analysis to test the "access hypothesis" - the assumption that because OER increase students' access to textbooks, students may potentially perform better - they determined that "[e]ven under ideal conditions, detecting positive effects of OER should be extremely difficult" (p. 9/14). They assert that it is virtually impossible to detect any effect of OER use on performance, and thus, studies like Colvard, Watson and Park (2018), Fischer, Hilton, Robinson and Wiley (2015), Clinton and Khan (2019), and the current study do not provide insight on if and how OER affect student learning. Still, the author of this paper believes that the current research and findings, including a contradictory finding on withdrawal rates that leads to more questions than answers, are a valuable contribution to the continually growing body of research on adopting free and open educational resources, especially at the community college level, for which, as previously described, the research has focused extensively on perceptions of cost and quality.

Methods

Seven RVCC courses that adopted free and open educational resources in either Spring 2018 or Fall 2019 were identified for inclusion in this study. The courses chosen were taught by the same faculty member in a previous semester using a commercial textbook and in one of the identified semesters using OER. For example, a course that used OER in Spring 2018 was selected only if the same faculty member taught the course in Spring 2017 using a commercial textbook. This selection process provides a control measure over the influence of faculty member and semester on the results. Approval for this study was granted by the RVCC Institutional Review Board.

The number of sections in each course used in the study varies for several reasons: some faculty members

taught multiple sections of the same course in both semesters; some courses were taught by multiple faculty members in both the non-OER and OER semesters; some courses are only offered once each semester and taught by a single faculty member. The courses and number of sections selected are listed in Table 1.

Table 1. Courses and the number of sections selected in each semester

Course	Semester commercial	No. of sections	Semester OER	No. of sections
BUSI-111 Introduction to Business	Fall 2017	10	Fall 2018	10
BIOL-124 Anatomy & Physiology I	Spring 2018	7	Spring 2019	4
COMM-101 Speech	Spring 2018	3	Spring 2019	3
ENGL-112 English Composition II	Spring 2018	2	Spring 2019	2
FITN-132 Cardiovascular Conditioning	Spring 2018	1	Spring 2019	1
HLTH-109 Pharmacology	Spring 2018	2	Spring 2019	1
PHYS-130 Astronomy	Spring 2018	2	Spring 2019	2

For all students in each section, Institutional Research provided the following de-identified data:

- final grade
- term GPA
- full-time/part-time status
- first-time student status
- gender
- ethnicity
- Pell eligibility

Data were received for a total of 1,212 students. Three students' final grades were listed as AU indicating they were Audit status. These three students were removed from the study for a total of 1,209 student grades for analysis. The breakdown of students by course is shown in Table 2.

W (withdrawal) grades were separated from A through F grades for analysis. The remaining 1,111 A through F grades were converted to the numeric scale used for GPA calculation at the institution:

A = 4.0

B+ = 3.5

B = 3.0

C+ = 2.5

C = 2.0

D = 1.0

F = 0

A two-sample *t*-test of means was performed for all A through F grades to determine if there was a significant difference in final course grades. Then, two- and three-way ANOVAs were used to determine if various demographic factors, when combined with

enrollment in OER courses, impacted student performance. With grade as the dependent variable, ANOVAs were performed with the following groups of fixed factors:

- OER status and first-time student status
- OER status and full-time/part-time status
- OER status and ethnicity
- OER status and gender
- OER status and Pell eligibility
- OER status, Pell eligibility and ethnicity

Finally, a *z*-test of proportions was used to determine if there was a statistically significant difference in the percentage of W grades between OER courses and non-OER courses.

Table 2. Course and number of students in both OER and non-OER sections

Course	Students in non-OER Sections	Students in OER Sections
BUSI-111 Introduction to Business	291	326
BIOL-124 Anatomy & Physiology I	95	71
COMM-101 Speech	75	47
ENGL-112 English Composition II	41	105
FITN-132 Cardiovascular Conditioning	10	8
HLTH-109 Pharmacology	30	21
PHYS-130 Astronomy	43	46
TOTAL	585	624

Results

Final grades across courses

There was no statistically significant difference in final grades between students in OER courses (M=2.756) and non-OER courses (M=2.821) (t = -0.818, p < .05). The finding of no difference in final course grades suggests that students perform as well in OER courses as they do in courses using a traditional, commercial textbook. While there is no significant improvement (or decline) in student achievement, there is the likely benefit that students have saved money by not having to purchase or rent a commercial textbook for the class.

Demographic factors

No significant difference in student performance between OER and non-OER courses was found based on a student's first-time, full-time, or part-time status, gender, or Pell eligibility. Although

these results fail to support the findings of Colvard, Watson and Park (2018), they suggest that student performance across these demographics is essentially unchanged when a faculty member switches to using free and open educational resources.

There was, however, a statistically significant difference in student performance based on the interaction of OER status and ethnicity, $F(1,111) = 2.546$, $p = .038$. This difference is attributable more to ethnicity than to OER status, particularly the differences in mean grades across all sections between white and black/African American students, between white and Hispanic students, and between Hispanic and black/African American students. Regardless of OER status, the average final grade for white students ($M = 2.939$) is .84 greater than for black/African American students ($M = 2.099$), the largest difference in the study ($p = .014$) and indicative of the known gap in grade-based academic performance between these two groups. The average final grade for black/African American students decreased in OER courses, from 2.35 in non-OER courses to 1.85 in OER courses. The average final grade for Hispanic students increased from 2.381 in non-OER courses to 2.845 in OER courses, but white students overall still received average final grades that were .319 higher than those of all Hispanic students ($M = 2.613$, $p = .014$). The average final grade for white students also increased slightly from 2.917 in non-OER courses to 2.960 in OER courses (see Figure 1 below).

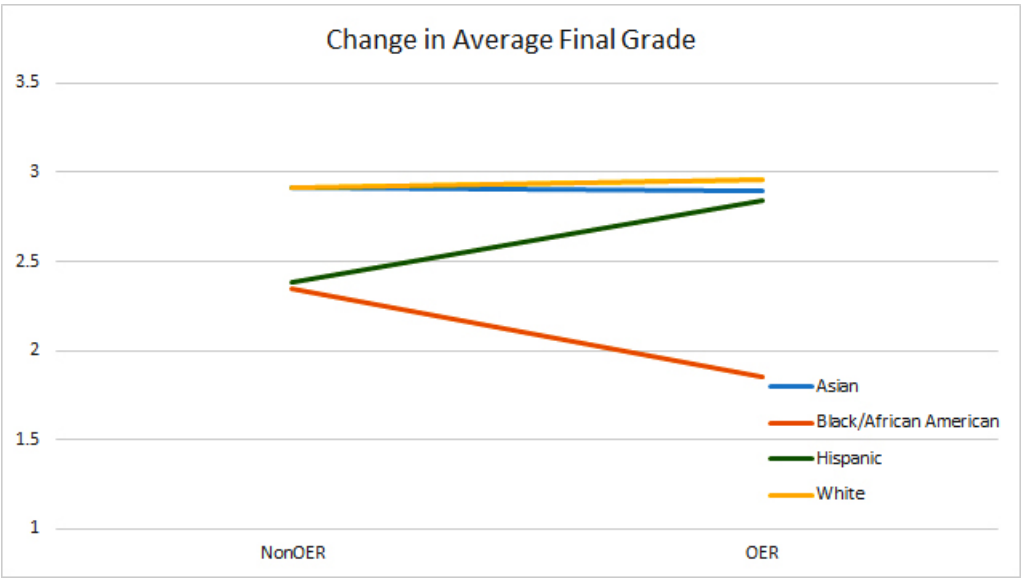

Figure 1. Change in average final grade between Non-OER and OER as a function of ethnicity

Withdrawal rates

During data analysis, it was noticed that there were a greater number of W grades for OER courses (n = 57, 10% of total grades) than for non-OER courses (n = 41, 7.5% of total grades). This was an unexpected observation if it is inferred that lack of access to course materials may trigger withdrawing from the course. A z-test of proportions revealed that OER courses had a statistically significant higher percentage of W grades than non-OER courses (z = 1.864, p = .03).

This data were also analyzed by ethnicity. Of 658 white students in the study, 7% (n = 46) received a W grade. Of 97 black/African American students, 11% (n = 11) received W grades, as did 11% of the 253 Hispanic students in the study (n = 28). The difference in proportion of black/African American students receiving W grades compared to white students did not exceed a 95% confidence level (z = 1.615, p = .053). However, the difference in proportion of Hispanic students receiving W grades compared to white students was significant (z = 2.358, p = .009) (refer to Table 3).

Table 3. Withdrawal rates by ethnicity across all courses

	A-F	W	Total	% Withdrawals
Asian	73	7	80	9%
Black/African American	86	11	97	11%
Hispanic	225	28	253	11%
White	612	46	658	7%
Total	996	92	1088	8%

Discussion

This study aimed to answer two research questions:

1. Is there a significant difference in student achievement for students in OER sections compared to sections of the same course taught by the same instructor in a previous semester using a commercial textbook?
2. Is there a significant difference in student achievement for Pell recipients, non-white students, first-time students or part-time students in OER sections compared to previous semester sections taught by the same instructor using a commercial textbook?

Consistent with the majority of OER research on academic performance, the results of this study found

no significant difference in student achievement for students in OER courses compared to courses taught by the same instructor in a previous semester using traditional textbooks.

Regarding the second question, no significant difference in student academic achievement was found for Pell recipients, first-time students or part-time students. These findings contradict those of Colvard, Watson and Park (2018) when applying a similar methodology to analysis of community college students. There are a number of differences between Colvard, Watson and Park (2018) and the current study, including the number of student grades analyzed, the type of course materials chosen to replace the commercial textbook, and the control of semester and instructor in the current study. Only 1,209 grades were used for this study, compared to over 21,000 in the previous. The number of students in each of the demographic categories in this study's sample is thus much smaller (305 Pell eligible; 317 first-time students; 381 part-time students). It is reasonable to conclude that the results of the larger study are more reliable but worth commenting on the other differences in these two studies. All courses analyzed by Colvard, Watson and Park (2018) used an OpenStax textbook. At RVCC, some courses used existing, published open textbooks (Anatomy & Physiology, for example) while others curated free and/or open digital materials in lieu of a commercial textbook (Cardiovascular Conditioning, for example). Potentially, the consistency of OER selection in the previous study, a one-to-one replacement of a traditional textbook with an OpenStax textbook, impacted students' learning experiences differently. Is it possible that students in underserved populations perform better with traditionally formatted textbooks like those published by OpenStax rather than curated materials that need to be accessed through the LMS and are organized in a structure determined by the individual faculty member? Student use of textbooks compared to curated materials is a potential area for future research.

There was an unanticipated finding on withdrawal rates in this study: students in OER courses withdrew at significantly higher rates than students in non-OER courses. This finding refutes the access hypothesis—that "day 1 access" to course materials has a positive impact on student performance (Hilton, 2016; Grimaldi, Mallick, Waters and Baraniuk, 2019). It also contradicts the findings of four prior studies conducted at community colleges that analyze differences in withdrawal rates (Hilton & Laman, 2012; Hilton, Gaudet, Clark, Robinson & Wiley, 2013; Hilton, Fischer, Wiley & William, 2016; Grewe & Davis, 2017)[1]. These studies either did not report student demographic data or did not disaggregate the data by demographics for analysis, so it is unclear whether there would have been significant findings based on ethnicity

1 Grewe and Davis (2017) combined W grades with F grades for analysis, potentially skewing a direct comparison.

or other factors. In addition, neither the current study nor any previous one has been able to draw causality between textbook choice and withdrawal rates, only correlation. Further qualitative research is needed to determine the relationship between students' motivation for withdrawing from classes and the use of OER.

Recommendations

This study's findings on overall grades and withdrawal rates with regard to students identifying as Hispanic or black/African American have the potential to inform strategic initiatives focused on closing the achievement gap (also called the opportunity gap). At RVCC, when Hispanic students persist in OER courses to the same extent as their white peers, they are more likely to achieve a higher grade than Hispanic peers in non-OER courses. This would suggest that increased offerings of OER courses would benefit our Hispanic population, an important finding considering RVCC's recent qualification as a Hispanic-serving institution. Yet there are unidentified factors that cause Hispanic students to withdraw from all courses at a higher rate than both white and black/African American students. Research is needed on why our Hispanic students are withdrawing at such high rates compared to non-Hispanic peers and what effect, if any, course material selection has on this decision. It may be worth determining how many of these students are also first-generation college students who have been found to be more likely to engage in negative academic behaviors, including dropping/withdrawing from classes (Nusbaum, Cuttler & Swindell, 2020).

On the other hand, although black/African American students are persisting in the courses studied overall at a higher rate than Hispanic students, they withdraw more frequently than white students *and* they receive lower final grade averages in OER courses. The reasons for this drop in average final grade in OER need to be explored, perhaps by examining if and how black/African American students use and engage with course materials in OER courses. For example, is the digital-first nature of OER course materials a barrier for this population, perhaps evidence of the digital divide?

Conclusion

Based on research that has consistently found no significant difference in academic performance between non-OER and OER courses, OER advocates have supported continued adoptions of OER because students are saving significant amounts of money and their performance is not being affected. Despite Grimaldi, Mallick, Waters and Baraniuk's (2019) assertion that it is virtually impossible to detect OER's effect on performance, this author would still argue that adopting free and open educational resources is a positive move for community colleges that want to demonstrate a commitment to student success and well-being. With access at the heart of the community college mission, OER

offerings demonstrate to students that the institution is aware of the countless barriers to obtaining a degree and is working to ensure that cost or access to course materials is not one of them. Nusbaum, Cuttler and Swindell (2020) found that first generation and ethnic minority students reported engaging in more negative behaviors, such as taking fewer classes, dropping/withdrawing from classes, and earning poor grades as a result of textbook cost compared to their ethnic majority and continuing-generation peers. Having conducted their study at a large, public university, Nusbaum, Cuttler and Swindell (2019) conclude that "[m]arginalized students are making a variety of decisions about their academic life based on textbook costs, including which courses to take and whether to drop particular courses" (p. 7). This is likely to be profoundly true of marginalized students who choose to enroll at lower cost, open admissions community colleges. Despite the uncertainty of whether student achievement is or is not directly impacted by OER adoptions, the goodwill effect of OER course offerings on students' perception of an institution's concern for their success and well-being should not be underestimated.

References

Allen, G., Guzman-Alvarez, A., Smith, A., Gamage, A., Molinaro, M., & Larsen, D. S. (2015). Evaluating the effectiveness of the open-access ChemWiki resource as a replacement for traditional general chemistry textbooks. *Chemistry Education Research and Practice, 16*, 939–48. https://doi.org/10.1039/C5RP00084J

Bliss, T. J., Hilton, J., Wiley, D., & Thanos, K. (2013). The cost and quality of online open textbooks: Perceptions of community college faculty and students. *First Monday, 18*(1). https://doi.org/10.5210/fm.v18i1.3972

Bliss, T. J., Robinson, J., Hilton, J., & Wiley, D. (2013). An OER COUP: College teacher and student perceptions of open educational resources. *Journal of Interactive Media in Education 2013*(1). http://doi.org/10.5334/2013-04

Clinton, V. (2018). Cost, outcomes, use, and perceptions of open educational resources in psychology: A narrative review of the literature. *Psychology Learning & Teaching 18*(1), 4-20. https://doi.org/10.1177%2F1475725718799511

Clinton, V., & Khan, S. (2019). Efficacy of open textbook adoption on learning performance and course withdrawal rates: A meta-analysis. *AERA Open 5*(3), 1-20. https://doi.org/10.1177/2332858419872212

Colvard, N. B., Watson, C. E., & Park, H. (2018). The impact of open education-

al resources on various student success metrics. *International Journal of Teaching and Learning in Higher Education 30*(2), 262-76. http://www.isetl.org/ijtlhe/pdf/IJTLHE3386.pdf

Fischer, L., Hilton, J., Robinson, T. J., & Wiley, D. (2015). A multi-institutional study of the impact of open textbook adoption on the learning outcomes of post-secondary students. *Journal of Computing in Higher Education 27*, 159–72. https://doi.org/10.1007/s12528-015-9101-x

Grewe, K., & Davis, W. (2017). The impact of enrollment in an OER course on student learning outcomes. *International Review of Research in Open and Distributed Learning, 18*(4). https://doi.org/10.19173/irrodl.v18i4.2986

Grimaldi, P. J., Basu Mallick, D., Waters, A. E., & Baraniuk, R. G. (2019). Do open educational resources improve student learning? Implications of the access hypothesis. *PLoS ONE 14*(3). https://doi.org/10.1371/journal.pone.0212508

Hilton, J. (2016). Open educational resources and college textbook choices: A review of research on efficacy and perceptions. *Education Technology Research and Development 64,* 573-90. https://doi.org/10.1007/s11423-016-9434-9

Hilton, J., Fischer, L., Wiley, D., & William, L. (2016). Maintaining momentum toward graduation: OER and the course throughput rate. *International Review of Research in Open and Distributed Learning, 17*(6). https://doi.org/10.19173/irrodl.v17i6.2686

Hilton, J., Gaudet, D., Clark, P., Robinson, J. & Wiley, D. (2013). The adoption of open educational resources by one community college math department. *International Review of Research in Open and Distributed Learning, 14*(4). https://doi.org/10.19173/irrodl.v14i4.1523

Hilton, J., & Laman, C. (2012). One college's use of an open psychology textbook. *Open Learning: The Journal of Open, Distance and e-Learning, 27*(3), 265-72. https://doi.org/10.1080/02680513.2012.716657

Illowsky, B. S., Hilton, J., Whiting, J., & Ackerman, J.D. (2016). Examining student perception of an open statistics book. *Open Praxis, 8*(3), 265-76. http://dx.doi.org/10.5944/openpraxis.8.3.304

Nusbaum, A. T., Cuttler, C., & Swindell, S. (2020). Open educational resources as a tool for educational equity: Evidence from an introductory psychology class. *Frontiers in Education 4*(152). https://doi.org/10.3389/feduc.2019.00152

Read, K., Tang, H., Dhamija, A., & Bodily, B. (2020). Understanding the impact of OER courses in relation to student socioeconomic status and employment. *IJOER 3*(1), doi: 10.18278/ijoer.3.1.5

Shaw, C. S., Irwin, K. C., & Blanton, D. (2019). Impact of open educational resources on course DFWI rates in undergraduate online education. *International Journal of Open Educational Resources, 1*(2). https://www.ijoer.org/impact-of-open-educational-resources-on-course-dfwi-rates-in-undergraduate-online-education