CLEVELAND STATE UNIVERSITY:

Adaptive Courseware for Early Success Case Study

Association of Public & Land-grant Universities

CSU | Cleveland State University

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The Association of Public and Land-grant Universities (APLU) is a research, policy, and advocacy organization dedicated to strengthening and advancing the work of public universities in the U.S., Canada, and Mexico. The association's membership consists of more than 250 public research universities, land-grant institutions, state university systems, and affiliated organizations. APLU works with members to expand access and improve student success to deliver the innovative workforce of tomorrow; advance and promote research and discovery to improve society, foster economic growth, and address global challenges; and build healthy, prosperous, equitable, and vibrant communities locally and globally. The association's work is furthered by an active and effective advocacy arm that works with Congress and the administration as well as the media to advance federal policies that strengthen public universities and benefit the students they serve.

Every Learner Everywhere is a network of twelve partner organizations with expertise in evaluating, implementing, scaling, and measuring the efficacy of education technologies, curriculum and course design strategies, teaching practices, and support services that personalize instruction for students in blended and online learning environments. Our mission is to help institutions use new technology to innovate teaching and learning, with the ultimate goal of improving learning outcomes for Black, Latinx, and Indigenous students, poverty-affected students, and first-generation students. Our collaborative work aims to advance equity in higher education centers on the transformation of postsecondary teaching and learning. We build capacity in colleges and universities to improve student outcomes with digital learning through direct technical assistance, timely resources and toolkits, and ongoing analysis of institution practices and market trends. For more information about Every Learner Everywhere and its collaborative approach to equitize higher education through digital learning, visit **everylearnereverywhere.org.**

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Cleveland State University (CSU) improved upon existing models of adaptive courseware implementation, while expanding applications of the technology into new academic departments to support collaborative course redesign efforts and increased student engagement.

ADAPTIVE COURSEWARE FOR EARLY SUCCESS INITIATIVE

The Adaptive Courseware for Early Success (ACES) Initiative was a grant-funded initiative supported through the Every Learner Everywhere network and funded by the Bill and Melinda Gates Foundation. In total, thirteen colleges and universities from Ohio, Texas, and Florida participated in this initiative from 2019 through 2021. Six 4-year universities, which are members of the Association of Public Land-grant Universities (APLU) received direct guidance and support from the Personalized Learning Consortium (PLC), located in the Office of Digital Transformation for Student Success (DTSS). The ACES Initiative centered around two primary goals:

- **To redesign critical gateway courses taught by faculty committed to integrating equity-centered, evidence-based teaching practices that are enhanced by adaptive courseware**
- **To create more equitable student outcomes by improving learning and educational experiences for poverty-impacted students, racially minoritized students, and first-generation students**

Over the course of two and a half years, the PLC provided intensive coaching, peer-mentorship, collaborative learning and networking opportunities, and educational resources and training to cross-functional, institutional teams at select institutions. These institutions received further support and benefits from the Every Learner network partners, including Achieving the Dream and Digital Promise who offered collaborative learning with participating two-year institutions and program evaluation support, respectively.

Note. It is critical to acknowledge that this initiative took place at the onset and height of the COVID-19 global pandemic crisis. The COVID pandemic dramatically altered the higher education landscape in 2020, requiring colleges and universities to rapidly transition to remote instruction and to reprioritize the allocation of their resources and institutional capacities to appropriately respond to the crisis. Despite facing these challenges, each of the participating institutions carried on their work, adapting in real-time and focusing on how to best leverage newly adopted technologies and supporting students with quality teaching practices. For more information on the impact of COVID on these grantees and other institutions, please see our network partner Digital Promise's report, *Suddenly Online: A National Survey of Undergraduates During the COVID-19 Pandemic.*

Cleveland State University Demographics

11,700 undergraduate students and **4,300 graduate** students

4-year public research institution in **Cleveland, Ohio**

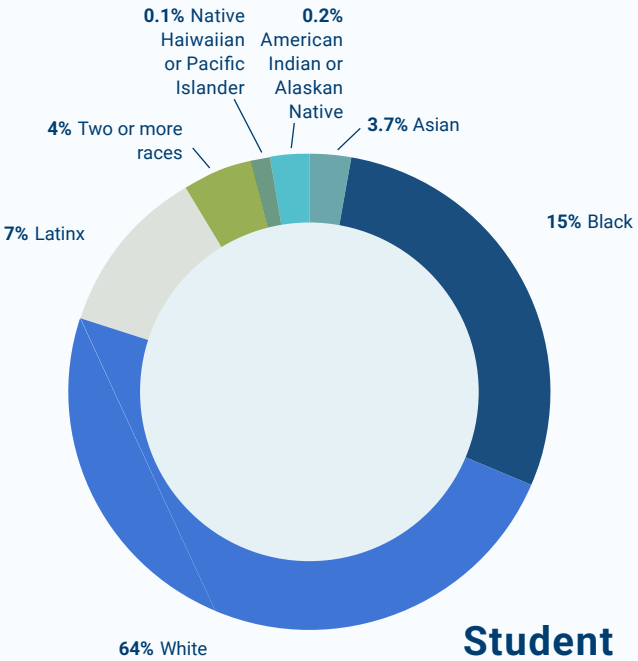
40% of undergraduate enrollment is transfer students.

90% of all students commute to campus.

38% of undergraduate students are eligible for a Pell Grant.

As of fall 2020,

48% of undergraduate students were enrolled in at least one online course, with **11% enrolled exclusively online.**



Student Demographics

Institutional Background

In December 2018, Harlan Sands released the "Statement of Strategic Priorities for Cleveland State University." This strategic plan outlined a variety of strategic goals that the institution would pursue moving forward, including an emphasis on student success. While CSU was enrolling a diverse student body, their graduation rates were below the averages of self-selected peer institutions at the time. Former President Sands articulated that "traditional approaches to collegiate education need to evolve if we are to gain further success with students from urban backgrounds" (p. 3, para. 6).

Improving pass rates in gateway courses was identified as an important goal for CSU to promote student success. Before participating in the ACES Initiative, the institution created a Mathematics Learning Center that used adaptive courseware to provide academic assistance in mathematics. Through these efforts, students' pass rates in mathematics gateway courses increased by 4 percent (Pearson, 2018). Additionally, adaptive courseware was being leveraged in several mathematics courses and sections across a range of academic programs, including a Liberal Arts and Business Mathematics sequence. Gateway mathematics courses were also in the process of being enhanced with corequisite courses at that time. In the Fall of 2018, faculty members within the College of Science and Health Professions made efforts to strengthen pedagogical practices in gateway courses through internal discussions and professional development. Faculty learned about the importance of gateway courses, and a faculty learning community was created that focused on gateway courses. Additionally, faculty discussed excerpts from James Lang's *Small Teaching: Everyday Lessons from the Science of Learning*.

While adaptive courseware was being implemented in both Introductory Chemistry and Biology at the university prior to the grant's initiation, it was primarily used as a homework and quizzing support feature, with little emphasis on using the courseware data or adopting evidence-based instructional practices such as active learning and equity-centered pedagogies into course design. By participating in the project, the departmental teams and institutional leadership hoped to improve how courseware was being used to support faculty and students in participating courses. They further hoped to refine and scale these practices with documented success to other courses and programs, such as the application of data analytics to inform instruction already taking place in Precalculus I and II (Baker, 2020).

Goals of Grant Participation

CSU sought to redesign a set of gateway courses in the College of Science and Health Professions by expanding the use of adaptive courseware in both scale and quality of implementation. CSU focused on the implementation of adaptive courseware in mathematics, biology, and chemistry gateway courses. Through these efforts, CSU hoped to improve pass rates for gateway courses, specifically for students from racially minoritized backgrounds. Research has found that Black, Latinx, and Indigenous college students are less likely to obtain a degree in STEM (science, technology, engineering, mathematics) after receiving a grade of "D" or lower in a gateway STEM course compared to White students, even after controlling for intent and academic preparation (Hatfield et al., 2022). As participants in the ACES Initiative, all grantees agreed that the prioritization of student success among minoritized student groups was of the utmost importance.

Course Implementation

CSU appointed Vice Provost of Academic Programs, Peter Meiksins to serve as lead administrator for the grant's implementation at the onset of the project. John Holcomb, as Interim Vice Provost of Academic Programs, took over leadership in July 2019. In spring and summer of 2019, faculty learned about adaptive courseware technologies available on the market, coordinated how participating faculty teams would align their instruction within their academic programs, and decided how student engagement data could be used to further support students and inform instruction. In a fall 2019 faculty survey, Digital Promise (2022) found that faculty participating in the ACES Initiative reported receiving more peer support and mentorship with their colleagues than did faculty who were not a part of the initiative. Peer-based learning and professional development communities can serve as a meaningful and impactful source of faculty professional development that leads to real changes in how faculty teach their courses. Neisler and Means (2021) found that faculty using adaptive courseware also reported using a variety of evidence-based instructional practices, with the most popular uses being immediate feedback on student's answers, instructor review and applications of student dashboard data, homework or practice problems, and short quizzes or comprehension checks.

Mathematics

Mathematics faculty used the adaptive product, ALEKS (Assessment and Learning in Knowledge Spaces) hosted by McGraw Hill, for three gateway courses: Intensive Pre-Calculus, College Algebra, and Trigonometry (Table 1). ALEKS provided homework problems and short assignments that were adapted weekly based on student performance. ALEKS also provided three practice exams comparable to in-class unit exams, and a practice final exam for each respective course. Mathematics faculty used student performance data from ALEKS to provide in-class support on learning objectives that students were struggling with and suggested optional tutoring when quiz scores were low.

Biology

Biology faculty used the adaptive product, Learnsmart Connect hosted by McGraw Hill, in their gateway course, The Living World, and for Introduction to Biology I & II, they used Mastering Biology hosted by Pearson (Table 1). The department implemented online readings, quizzes, and other practice assignments in which students received feedback. The faculty also used personal response systems (clickers) during instruction to facilitate engagement through polling, and they focused on learning objectives that students had not mastered yet based on performance data from the adaptive products.

Chemistry

Chemistry faculty used the adaptive product, Mastering Chemistry hosted by Pearson, in four gateway courses: General Chemistry I & II and Organic Chemistry I & II (Table 1). Student performance on assignments, exams, and pre-lecture quizzes were used to provide targeted coaching and tutorials by the adaptive product. During class, instructors used Pearson Learning Catalytics to generate discussions and promote peer-to-peer engagement through smartphones, tablets, or laptops.

Table 1.

Course Implementation of Adaptive Products at CSU

Discipline	Course Name	Adaptive Product	Students	Faculty
Biology	The Living World	Learnsmart Connect (McGraw Hill)	767	2
	Introduction to Biology	Mastering Biology (Pearson)	1,033	2
	Introduction to Biology II	Mastering Biology (Pearson)	719	3
Chemistry	General Chemistry I	Mastering Chemistry (Pearson)	878	5
	General Chemistry II	Mastering Chemistry (Pearson)	186	1
	Organic Chemistry I	Mastering Chemistry (Pearson)	630	1
	Organic Chemistry II	Mastering Chemistry (Pearson)	337	1
Mathematics	Intensive Pre-Calculus	ALEKS (McGraw Hill)	99	1
	College Algebra	ALEKS (McGraw Hill)	256	3
	Trigonometry	ALEKS (McGraw Hill)	393	4
Totals	**10**	**4**	**5,298**	**15** (with some faculty teaching across multiple courses)

Note: *Final data as reported by the university in fall 2019, spring 2020, summer 2020, fall 2020, and spring 2021.*

Implementation Challenges

The Mathematics department had previous experience with using adaptive learning in their courses, so faculty did not experience notable difficulties with becoming technologically proficient. However, the level to which faculty implemented courseware features such as supplementary homework, activities, and testing varied by professor, creating inconsistencies in the amount of work students had to complete across sections. This discrepancy led to reported frustrations by students who believed the level of work across sections should be comparable.

CSU faced initial technical difficulties with getting access to the products through their bookstore and determining the process for students to pay for them. Through its extensive work with universities in the adoption and implementation of adaptive courseware, APLU and their Every Learner network partners recommend that faculty and institutions adopting courseware make key equity considerations related to student access and use of courseware. For instance, institutions should determine whether the courseware is affordable and can be accessed on an array of devices such as laptops, tablets, and cell phones (Holiday et al., 2020; Vignare et al., 2018). Institutions should also ensure that students will have access to the technology on the first day of class. For many institutions, student financial aid packages are not processed until enrollment is confirmed 3-4 weeks into the academic term, leading some students to lack the funding required to purchase books and other resources. A common solution to this problem among APLU grantee institutions is to negotiate early access programs with their courseware vendors so that students have free access to courseware until financial aid funding becomes available.

In fall 2019, the lead administrator for the adaptive courseware implementation shared that there was a "*steep learning curve*" for the Biology and Chemistry departments to learn how to use the products. It is common for faculty members to need time to adjust to implementing new educational technologies. Through its support of several institutions adopting and implementing adaptive courseware, APLU leadership recommends that institutions provide faculty with the time and resources necessary for the front-end labor required to learn how to effectively use the technology and integrate it into one's course design and pedagogy. Further, by emphasizing a continuous improvement mindset in adoption and implementation, institutions can support a culture where teaching and learning is understood as an iterative and evolving practice and where improvements to teaching and outcomes occur over time.

Both the Biology and Chemistry departments reported that using clickers through Learning Catalytics in Pearson took up a lot of preparation and lecture time. Students logging in and answering the questions took longer than anticipated. The faculty struggled to cover all the necessary content because of this time loss. Such learnings serve as reminders that adding a new technology or teaching strategy can create new or different challenges that must be accounted for as instructors and institutions consider how to effectively redesign their courses and pedagogy.

COVID-19 Pandemic.

The COVID-19 pandemic forced CSU's campus to go fully remote in March 2020. While some faculty reported that the use of adaptive courseware eased the transition to remote learning, Vice Provost Holcomb noted that students were cut off from campus technological resources.

> ***"We learned from COVID that many of our students have inadequate technology needs (computers, webcams, Internet access). We did our best to provide these tools, but it is not clear if all students obtained needed resources or got by trying to use their phone extensively."***

The pandemic did not stop the implementation and data collection processes, which continued through spring 2021. John Holcomb later joined the CSU's Pandemic Response Team and that additional responsibility overtook much of the time he had to oversee the project's implementation. Shifts in project leadership were especially common across participating university teams during the COVID-19 Pandemic, as institutions had to reprioritize their institutional resources and capacity to manage the unprecedented health crises on their campuses. Informed by its work on an array of student success and institutional transformation initiatives, leadership from APLU recommends that, from the start, institutions build knowledge and capacity across their teams, with integrated and collaborative support woven into the design and implementation of projects to ensure success (Vignare et al., 2023).

Student Engagement.

While faculty members provided many class resources for students taking the biology and chemistry adaptive learning courses, engagement with those resources was low. Vice Provost Holcomb stated that students felt remote learning was more work for them, and this was especially true during the pandemic:

> ***"The biggest barrier to student success is having more students engage in the materials… Some of this might have been a response to faculty providing as many learning resources as possible and students getting overwhelmed. This was a problem with adaptive learning in Biology and Chemistry to begin with."***

Findings across institutions involved in the ACES Initiative found that participating faculty were engaged in a variety of evidence-based instructional styles, many of which were supported or enabled by their selected courseware products (Neisler & Means, 2021). In a separate study that documented student experiences with the rapid transition to remote instruction at the national level, Digital Promise (2020) noted a drastic drop in student satisfaction levels across the board. Therefore, it is possible that, while adaptive courseware may have provided faculty with new tools and strategies to engage students, the addition of those during the remote transition could have proven more challenging for students adjusting to remote student experiences. Overall, CSU faced challenges of training faculty who had not previously used adaptive courseware, technical issues, and student engagement during the implementation process.

Impact of Adaptive Learning Implementation

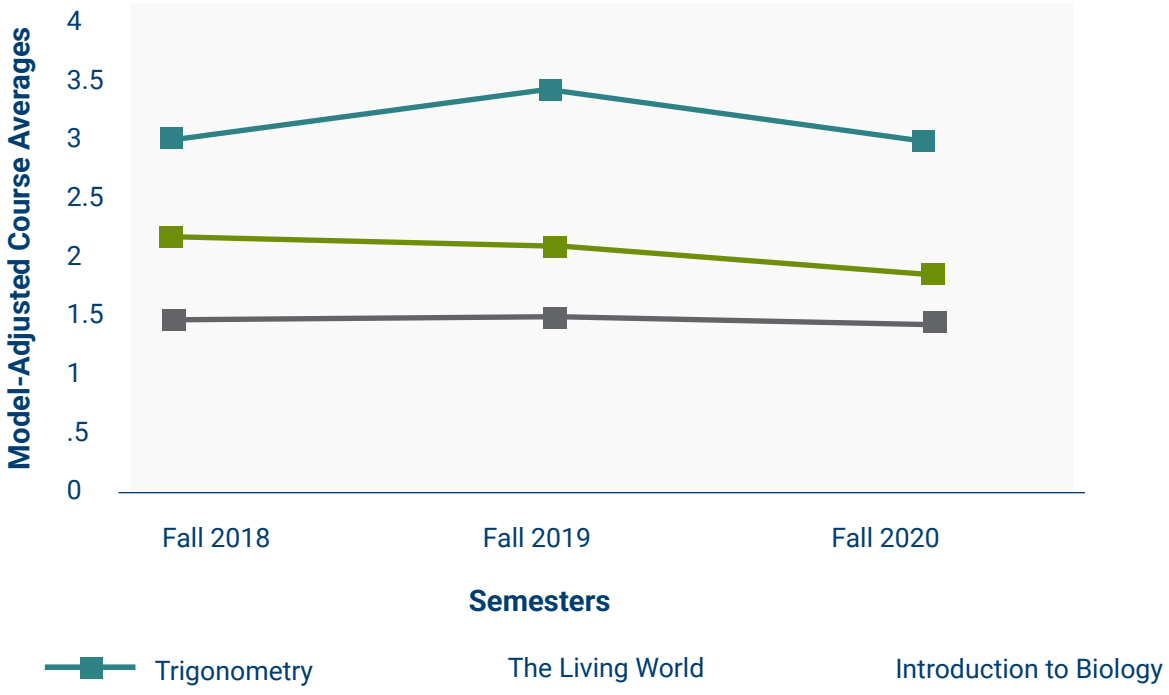
Student Average Course Grades

Student outcome data was analyzed and compared to outcomes from the same courses across semesters. However, several courses were not part of the analysis due to a lack of sufficient sample size (at least 30 students per group needed) or lack of baseline equivalence between student groups in comparison semesters (no more than 0.25 standard deviation difference). Fall semesters were compared for all students in Trigonometry, The Living World, and Introduction to Biology (Figure 1). Spring semesters were compared for Introduction to Biology among students from racially minoritized backgrounds (Figure 2) and Organic Chemistry II across all students (Figure 3). The all-student group did not meet baseline equivalence for Biology 200 across spring semesters, so it was not part of the analysis.

Course grade averages were compared across three semesters (fall 2018 without adaptive courseware, fall 2019 with adaptive courseware, and fall 2020 with adaptive courseware). The grade averages were adjusted for prior academic achievement, Pell eligibility, race, gender, enrollment status, and repeater status. When controlling for these factors, there was no significant difference for students engaged with adaptive learning in Trigonometry and The Living World across the semesters. This included fall 2018, when the course was taught without adaptive courseware. For students taking Introduction to Biology with adaptive learning, they had a significantly lower model-adjusted average course grade in fall 2020 compared to previous semesters (Figure 1). Unlike the comparison semesters, fall 2020 took place during the COVID-19 pandemic, which likely affected the results.

Figure 1.

Average Fall Semester Model-Adjusted Course Grades Across All Students



Spring course grade averages were compared across three semesters (spring 2019, spring 2020, and spring 2021 all with adaptive courseware). The grade averages were adjusted for prior academic achievement, Pell eligibility, race, gender, enrollment status, and repeater status. When controlling for these factors, Introduction to biology had significantly lower average course grades for students from racially minoritized backgrounds in spring 2021 compared to the same group in 2019 and 2020 (Figure 2). For all students taking Organic Chemistry II, the model-adjusted average course grade in spring 2021 was significantly lower compared to previous semesters (Figure 3). Spring 2020 and 2021 took place during the COVID-19 pandemic, which likely affected the results. Research also shows that it takes time for strategic change to occur when implementing new educational technology (Roberts, 2008).

Figure 2.

Introduction to Biology Average Spring Semester Course Grades Across All Students

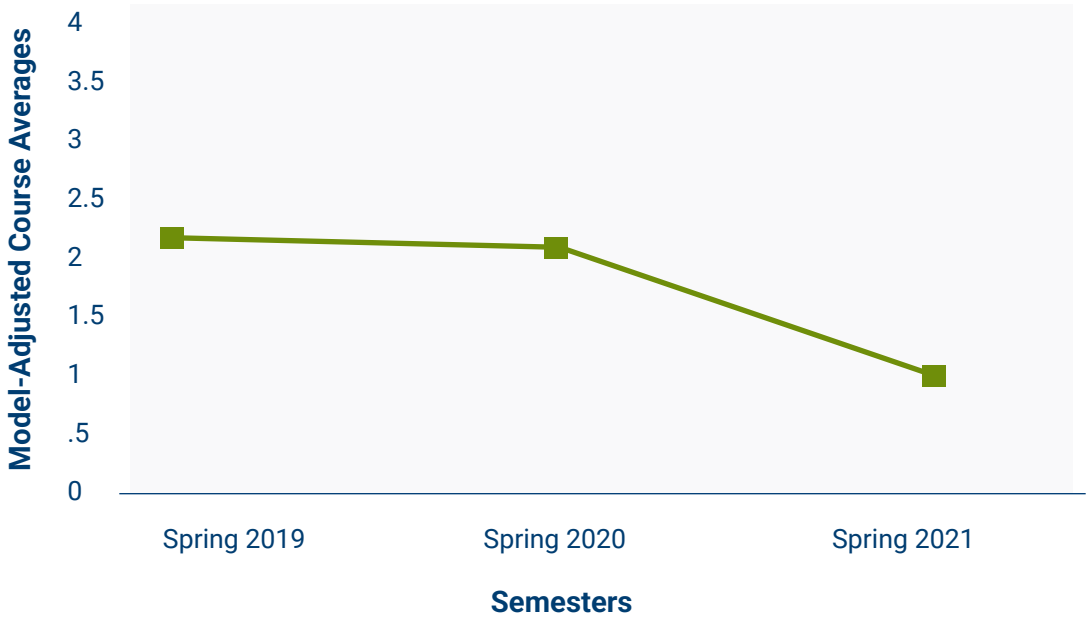
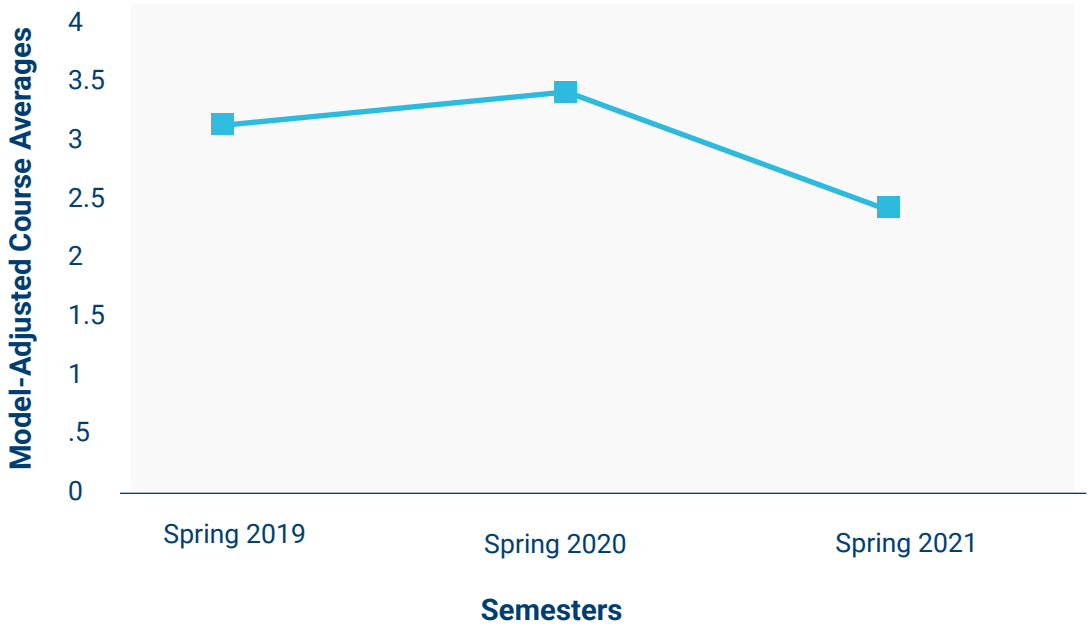


Figure 3.

Organic Chemistry II Average Spring Semester Course Grades Across All Students



Additional Course Improvements

While the analyzed average course grades did not significantly improve, Cleveland State faculty and administrators reported several positive changes to the class experience due to adaptive learning. The biology faculty noted to Vice Provost Holcomb that students were better prepared for class through the semester because they completed the assignments beforehand. Therefore, class time was more devoted to deeper learning.

> ***"In biology, faculty feel they do not need to cover in class basic definitions and foundational knowledge because the students are obtaining that information from the pre-work provided in Mastery. Thus, they have more time to spend on the college-level, conceptual ideas."***

Vice Provost Holcomb also stated that, while the ACES Initiative did not "transform anyone, it has enhanced our held beliefs [on course redesign]."

> ***"Both biology and chemistry are talking about coordinated efforts among all faculty teaching courses to provide uniform scaffolding for learning. It has happened in mathematics for quite some time. Biology has been doing something like it with the same teachers teaching all sections, but now they have more learning scaffolding in place that counts toward the final grade. Chemistry has just begun the process of course collaboration using a coordinated approach."***

Takeaways and Next Steps

Cleveland State University had several takeaways from their experience with implementing adaptive courseware across multiple departments and courses. The challenges they faced regarding student engagement, technical issues, and bringing on faculty members who had not previously used adaptive products greatly influenced the lessons the team took away from the experience:

1. Department-level leadership and engagement is critical to effectively support faculty in taking on and sustaining this work.
2. Change in practice takes time. It can take multiple semesters for faculty, faculty support staff, and students to get comfortable with using adaptive courseware or experiencing new instructional styles.
3. Those taking on this work should build in an iterative assessment and refinement process so that each successive iteration is improving over time.
4. Student engagement and understanding are critical to the success of adaptive learning adoptions. The implementation and instructional alignment of courseware must take into consideration student learning needs and capacities, and further ensure that students are prepared and supported to properly engage with new learning technologies.

Moving forward, CSU will continue to work with all three departments to replicate successes from their overall course alterations during the pandemic and determine the role adaptive learning plays in that process. The institution hopes to implement adaptive courseware in additional departments and connect their efforts on adaptive learning with the institution's other equity-related initiatives.

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