RESEARCH REPORT

macmillan learning

Reducing Distractions and Increasing Performance with Focus

AUTHOR **Marcy Baughman** Senior Director, Impact Research

Contents

Forward

At Macmillan Learning we are committed to developing learning solutions that help instructors and their students to achieve their full potential. We go about this by co-designing with students, collaborating with leading educators and learning scientists, and partnering with colleges and instructors to research effectiveness and efficacy and share insights for success. Our goal is to help advance teaching and learning by enabling evidence-based decision making and to contribute to research into educational technology. To these ends, we take a comprehensive approach to measuring the effectiveness and efficacy of the digital learning tools that we produce. This report represents one study that makes up the larger body of efficacy research into iClicker Reef.

We thank the incredible instructors and their students who partnered with us on this research:

Lisa Blue University of Kentucky
Matt Evans University of Wisconsin-Eau Claire
Warren McIntosh University of Louisville
Mike Shapiro Georgia State University
Brandon Tenn Merced Community College
Diego Valente University of Connecticut
An instructor from California State University-Long Beach

Research Ethics This research complied with APA ethical standards for research. It was approved by a third-party Institutional Review Board (IRB) prior to participant recruitment, and further approved by individual institutional IRBs at each participating college, where required.

Introduction

Educational technology has the potential to substantially improve student success, particularly when it comes to active learning. Yet, many instructors are concerned about the impact of internet-enabled devices like laptops and phones in their classrooms, and research demonstrates that using devices in the classroom can divide student's attention in class (Glass & Kang, 2017; Sana, Weston & Cepeda, 2013; Hembrooke & Gay, 2003; Grace-Martin & Gay, 2001). The division of student attention between classroom instruction and content on mobile devices is sometimes referred to as multitasking behavior. Previous research has indicated that multitasking behavior (Payne-Carter, Greenburg & Walker, 2017; Jacobsen & Forste, 2011; Fried, 2007) is negatively related to student performance on classroom exams and overall course grades, as well as student perception of content mastery.

Macmillan Learning's new Focus feature in iClicker Reef was created to help students manage the distractions that divide their attention while maintaining active learning in class. Focus is a setting instructors can enable in iClicker to help students stay on task when using mobile devices for participation in iClicker classroom activities. Students log into their iClicker sessions during class and are sent a reminder to remain focused in class if they choose to leave the iClicker session to browse the web, answer texts, or watch videos. Students and their instructor are provided a summary of information about students' time spent in and out of Focus while using iClicker. The goal of providing this information is to increase students' awareness of any multitasking behavior and to help them self-regulate their ability to stay on task during class.

In the Fall 2019 semester, eight instructors partnered with Macmillan Learning to better understand whether iClicker Focus supports student learning and self-regulation of multitasking behavior. This research brief outlines those partnerships and highlights the results of the study. The report begins with an overview of iClicker Reef and the Focus feature, the research procedures including samples and methods are presented next, followed by results and implications for instructors

iClicker Reef

In 1997, a team of physicists at the University of Illinois (Tim Stelzer, Mats Selen, Gary Gladding, and Benny Brown) developed their own wireless radio frequency system as part of the university's overall effort to make large introductory classes more engaging. With its simple, reliable technology and focus on pedagogical content, iClicker made it possible for instructors to take attendance, engage students in even the largest classrooms and lecture halls, and use the students' responses to decide which topics to emphasize.

Macmillan acquired iClicker in 2005, making significant investments in its hardware and software. In 2014, the iClicker team introduced Reef Education (now called iClicker Reef), a mobile-optimized, cloud-based classroom engagement solution that gave instructors a choice between a clicker-based infrared system and one students could access through a computer, smartphone, or tablet.

To date, twenty-one iClicker Reef case studies, which have covered a range of content areas, have been conducted at universities of different geographical location, size, and type (four year/two year). The case studies included an overview of the course(s), motivation for using iClicker, implementation and use, results, and conclusions. Many learning outcomes have been associated with the case studies (e.g. attendance, subject matter understanding and learning, class participation and interactivity, student interest, teacher feedback, etc.). The results of these studies have been descriptive in nature.

A correlational implementation study (Baughman, 2018) has also been conducted. The implementation study provided an overall positive correlation between student iClicker usage and learning, as well as instructor-level correlations with use case descriptions. Finally, a quasi-experimental study (Baughman, 2018) has been conducted. The quasi-experimental study provided evidence that students in classrooms that used iClicker had significantly higher course grades than students in classrooms that did not use iClicker.

Products developed by Macmillan Learning have followed a research, design, and evaluation life cycle. At each stage of this lifecycle, evidence is collected and, as a product matures, the claims made based on that evidence become more rigorous. Given the breadth of studies that provide evidence of overall iClicker Reef impact, the goal of this study is to explore the relationship of the Focus feature specifically to student learning and self-regulating behavior.

iClicker Focus

The iClicker Focus feature was developed in 2019 as an offering in the iClicker Reef application. Macmillan Learning routinely checks in with instructors and students to understand their classroom needs and challenges. Some instructors expressed concern that technology in the classroom, particularly mobile devices, could be used for non-educational purposes during class time and therefore would distract students from learning.

iClicker Focus was created to support instructor and student use of technology during class time by helping students self-regulate their behavior. Self-regulated learning is an active constructive process whereby learners set goals for their learning and monitor, regulate, and control their cognition, motivation, and behaviour guided and constrained by their goals and the contextual features of the environment (Pintrich & Zusho, 2002). Self-regulating behaviors are the chosen actions and strategies a learner takes during efforts to reach a learning goal or outcome (Zimmerman, 1990; 2002). Self-regulated learning (overt) strategies and (covert) cognitive processes are tightly linked in that the (internalized) cognitive processes lead to (externalized) strategies (Meijer, Veenman & von Hout-Wolters, 2006; Zimmerman, 1990). During synchronous learning environments, effective self-regulating behaviors should encompass strategies that reflect control of attention, such as avoiding multitasking with electronic devices (Douglas, Angel & Bethany, 2012; Junco, 2012) and directing attention to the learning task at hand rather than nearby peers (Glass & Kang, 2019; Sana, Weston & Cepeda, 2013).

While using iClicker Reef in class, instructors have the option to designate any course to run as a "Focused Class" via their course settings. During class, Focus reminds students to come back to iClicker Reef if they exit the application. The reminder process should help facilitate student self-regulation of their learning. After class, both instructors and students receive reports on in-class engagement. Instructors receive an overview of the number of students who stayed in Focus the entire class and a detailed view that shows the amount of time individual students spent in and out of Focus, as well as the number of times that students chose to leave the iClicker Reef application. Students receive an update on their overall time both in and out of Focus, as well as the number of times they chose to leave the iClicker Reef application.

Research Procedures

This research complied with American Psychological Association ethical standards for research. It was approved by a third-party Institutional Review Board (IRB) prior to participant recruitment, and then approved by instructor participant's individual institutional IRBs where required.

In the Fall 2019 semester, eight instructors from various disciplines agreed to participate in an evaluation of the Focus feature in iClicker Reef during the beta release of the product feature. Each instructor had used iClicker Reef in previous semesters and was invited to try out this new feature of iClicker Reef. Instructors were provided instructions to activate the Focus feature and a general overview of the information available from the Focus reports. However, instructors were not given specific requirements for how to implement Focus in the classroom nor how to use the information from Focus. The only requirement was that Focus be used consistently throughout the semester.

DATA COLLECTION AND RESEARCH QUESTIONS

Data were collected for a mixed-methods analysis. Students and instructors completed surveys at the beginning and end of the semester. Students also completed a survey after two weeks using Focus, and instructor interviews were conducted mid-semester. Product usage data were extracted at the end of study, and student course records — quiz, test, exam grades, attendance records, etc. — were shared by instructors at the end of the semester. Data were matched across sources, and descriptive and empirical analyses were conducted.

This study addressed four research questions designed to help educators better understand whether iClicker Focus might be useful in their classes and how they might implement it to best effect.

1. How are instructors and students using iClicker Focus?
2. Do students and instructors believe iClicker Focus helps students stay on-task?
3. What are student and instructor perceptions of iClicker Focus?
4. Does participation in iClicker Focus influence student learning after accounting for high school grade point average and number of times students left their Focus sessions?

Sample Description

In total, eight instructors across eight institutions partnered with researchers at Macmillan Learning to evaluate the effectiveness of iClicker Focus. The institutions included the University of Kentucky, University of Wisconsin Eau Claire, Gadsden State Community College, University of Louisville, Georgia State University, Merced Community College, California State University Long Beach, and University of Connecticut. The majority (75%) are four-year institutions and all are public.

The background and experiences of the instructors in this sample varied. Five instructors taught STEM courses and the remaining instructors taught business or criminology courses. All instructors had been teaching at least five years and more than half (62.5%) had been teaching more than 10 years. All of the instructors reported that they were comfortable using technology in the classroom and that digital tools enhanced student learning. Each instructor had used iClicker Reef in previous semesters, and they all reported that they implemented active learning strategies in their classrooms. The class sizes varied across instructors with the majority (64%) of classes having 25 - 100 students registered, while 22% had less than 25 students and 14% had more than 100 students.

In total, 643 students consented to participate in this study. The student sample (65% of the population of students enrolled across the eight participating instructors) was also varied. Most students were enrolled in either their first year (32%) or second year (40%); 52% identified as female; many (60%) were eligible for federally funded financial aid; 46% identified as being part of a traditionally underrepresented racial/ethnic group; and 26% reported being the first person in their family to attend higher education (first generation student). Most (72%) students were classified as "college ready" (as measured by meeting or exceeding the college readiness benchmark on either the SAT or ACT). Students were enrolled in classes across a variety of disciplines: 40% in Chemistry courses, 23% Communication Studies, 16% Computer Information and Science, 12% Physics, and 9% Criminal Studies. The majority (89%) of students agreed or strongly agreed that digital tools enhanced their learning.

Results

Research Question 1. How are instructors and students using iClicker Focus?

INSTRUCTOR PERCEPTIONS

Six instructors chose to use iClicker Focus sessions to help minimize distractions from mobile devices during class or to ensure students were strictly using their mobile devices to participate in iClicker Reef sessions. The remaining two instructors did not have specific goals for using iClicker Focus sessions but were instead curious what usage might look like with their students.

iClicker Focus sessions are initiated by the instructor as part of their iClicker Reef usage. Students are invited to participate in iClicker Focus sessions when they log into the iClicker Reef application on either their mobile device, tablet, or laptop. Students may then opt to participate in the Focus session, or not. All of the instructors required students to use iClicker Reef during each class, and six instructors also required that students opt into Focus sessions during classes. Two instructors strongly encouraged students to use Focus during their classes, but it was not mandatory. Even when instructors required students to use Focus, some students chose not to do so.

The data available to instructors from Focus reports were amount of time in Focus, amount of time out of Focus, number of times a student left the iClicker Reef application, and whether a student used the web-based version of Focus or the app version. For this version (beta) of iClicker Focus, data from students using the web-based version of Focus sessions was limited. In these cases, the only data available was whether the student opted into the Focus session or not. The fully released version of iClicker Focus (fall 2020) will have more data available for all types of users.

Fifty percent of the instructors believed the data in the Focus reports was accurate. For the fifty percent of instructors who did not believe the data was accurate, primary concerns were the lack of data from students using the web-based application, instructor inability to stop Focus sessions when they instructed students to access a specific application or video, and lack of ability to differentiate between when a student was absent and when a student chose not to participate in the Focus session. These concerns were reported to the product team and have been addressed for the full release in fall 2020.

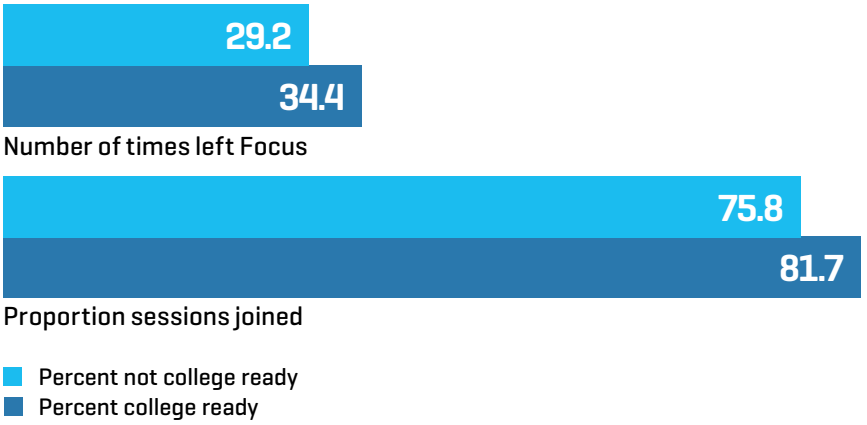
All instructors chose to use the data from the Focus sessions reports for informational purposes only this semester. They did not use the data to contribute to student course grades. Two instructors used the Focus reports to identify students leaving iClicker Reef during class and advise those students to remain on task during class. Five instructors reviewed the reports to identify trends in usage for their own knowledge but did not take action based on the information. The remaining instructor did not use the reports. When instructors were asked if they planned to use the Focus report data differently next semester, two instructors reported that they would use the data to award bonus points to students who remained "in Focus" for entire class sessions.

STUDENT PERCEPTIONS

There was variability in the proportion of Focus sessions students chose to join. The majority (62.8%) of students participated in 81% or more of their Focus sessions, 23.4% participated in 51 - 80% of sessions, and 13.8% participated in less than 50% of sessions. Students joining Focus sessions from a mobile device left their Focus sessions an average of 37 times over the semester. This trend differed by proportion of Focus sessions attended. Students participating in fewer Focus sessions (less than 50%) left an average of 15 sessions while students attending more than 81% of sessions left an average of 44 times over the course of the semester.

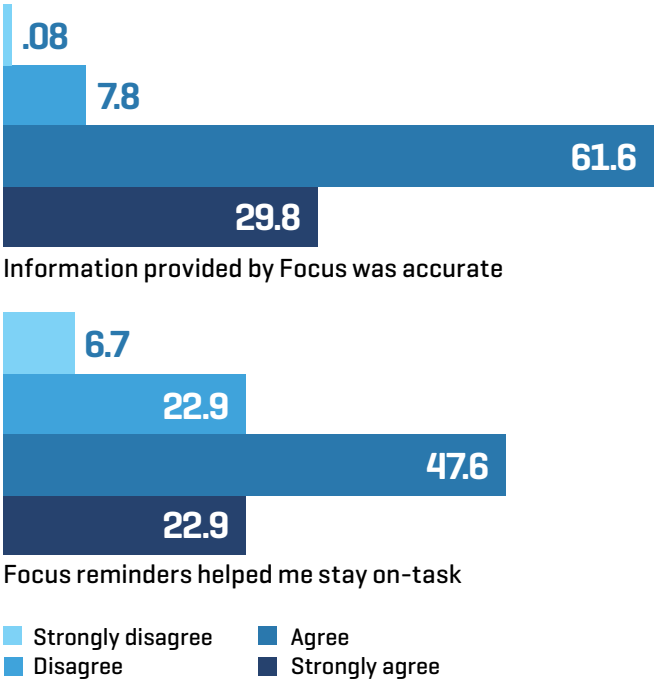
Usage data was also analyzed by students who were college ready as compared to not college ready. College ready students participated in significantly (F=6.61, p=.011) more Focus sessions (81.7%) than their not college ready peers (75.8%). Students who were college ready left Focus more (an average of 34 times) as compared to their not college ready peers (29 times), however this difference was not statistically significant. Refer to Figure 1 for usage trends.

FIGURE 1. iClicker Focus usage for college and not college ready students



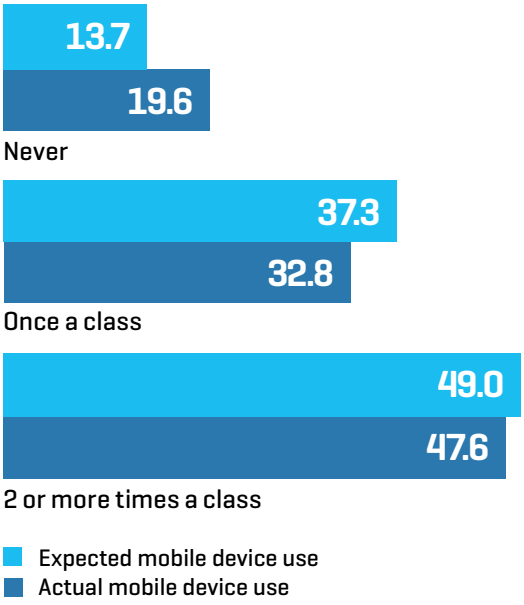
iClicker Focus sends students a reminder to go back to the iClicker Reef application if they choose to leave Focus during class. A majority (91%) of students reported that the reminders provided to them by Focus were accurate (see Figure 2). Most (71%) students also said the reminders they received from Focus helped them stay on-task during their class sessions.

FIGURE 2. Usefulness of iClicker Focus data



Students were asked to estimate how often they would use their mobile devices for non-educational purposes in class (i.e., checking text messages, browsing the web) at the beginning of the semester. At the end of the semester, they were asked how often they actually did use their mobile devices in class. The trend of responses (Figure 3) indicates that students overestimated the number of times they would use their mobile devices for non-educational purposes, and that they actually used the mobile devices less than anticipated.

FIGURE 3. Student estimated and actual mobile usage during class

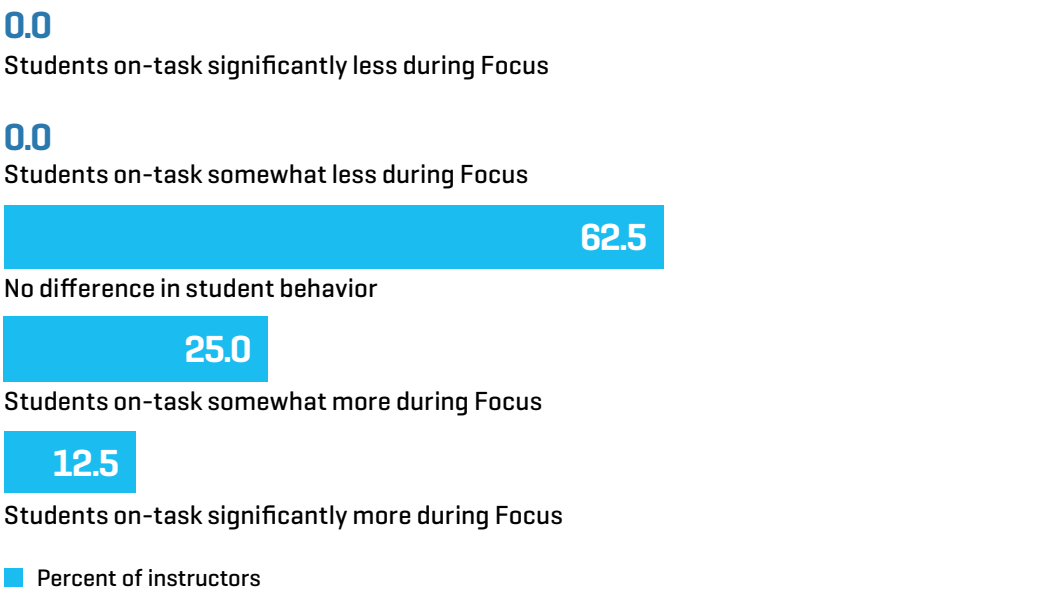


Research Question 2. Do students and instructors believe iClicker Focus helps students stay on-task?

INSTRUCTOR PERCEPTIONS

Instructors were asked whether they believed iClicker Focus caused their students stay on task during class. Half of the instructors agreed that Focus did help their students stay on task and half disagreed. Instructors were also asked to consider if student multitasking behavior in classes had changed from last semester (pre-Focus) to this semester (with Focus). Five instructors observed no difference in student behavior, two instructors reported that Focus helped students stay on-task somewhat more than in previous semesters, and one instructor felt that students were on-task significantly more this semester with Focus usage (Figure 4). The degree to which instructors believed using Focus helped students gain better mastery in their course was also divided, with half of the instructors agreeing that students gained better mastery with Focus usage and half reporting the students did not gain better mastery of content. When asked at the end of the semester to describe their best experience with Focus, three instructors responded that Focus helped students learn to regulate their own behaviors in class and to focus on the lecture.

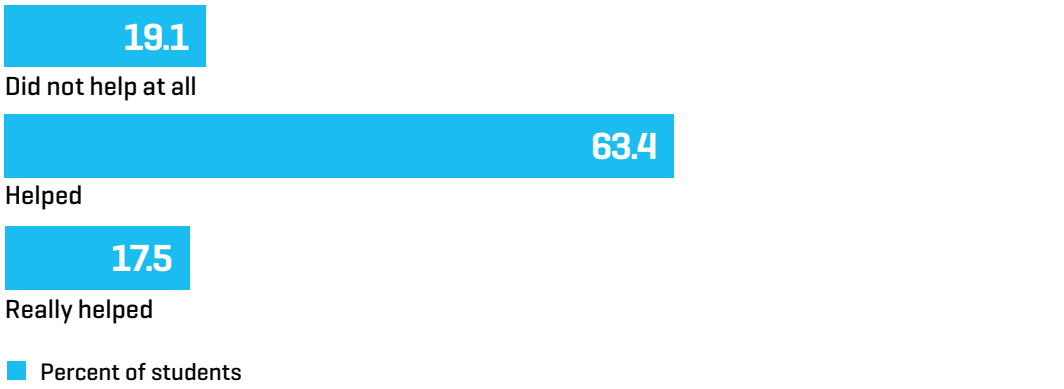
Figure 4. Instructor perception of student multi-tasking behaviors with Focus usage



STUDENT PERCEPTIONS

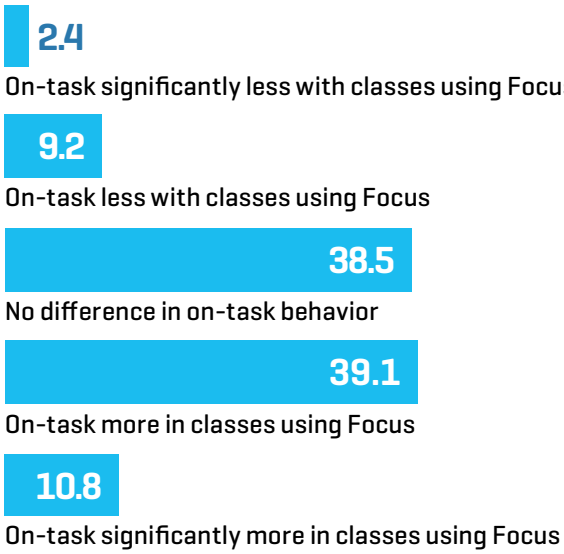
Students differed from instructors in their perceptions of whether using Focus influenced their multitasking behaviors. Eighty-one percent of students reported that using Focus "helped" or "really helped" them stay on task during class (Figure 5). This finding was exactly the same when examining the attitudes of college ready and not college ready students—81% of students in both cohorts felt Focus helped or really helped them stay on task during class.

Figure 5. Student perception of Focus helping stay on task during class



When asked to consider the difference in their time spent on-task in classes that used Focus versus those that did not, 50% of students said they were on task "more" or "significantly more" in classes that used Focus. Thirty-nine percent of students noticed no difference in their behavior, and 11% felt they were on task less in classes using Focus (Figure 6). The findings from college and non college ready students were also similar, with 49% of non college ready and 51% of college ready students saying they were on task more or significantly more in classes that used Focus.

Figure 6. Student perception of differences in on-task behavior between classes using Focus compared to classes not using Focus



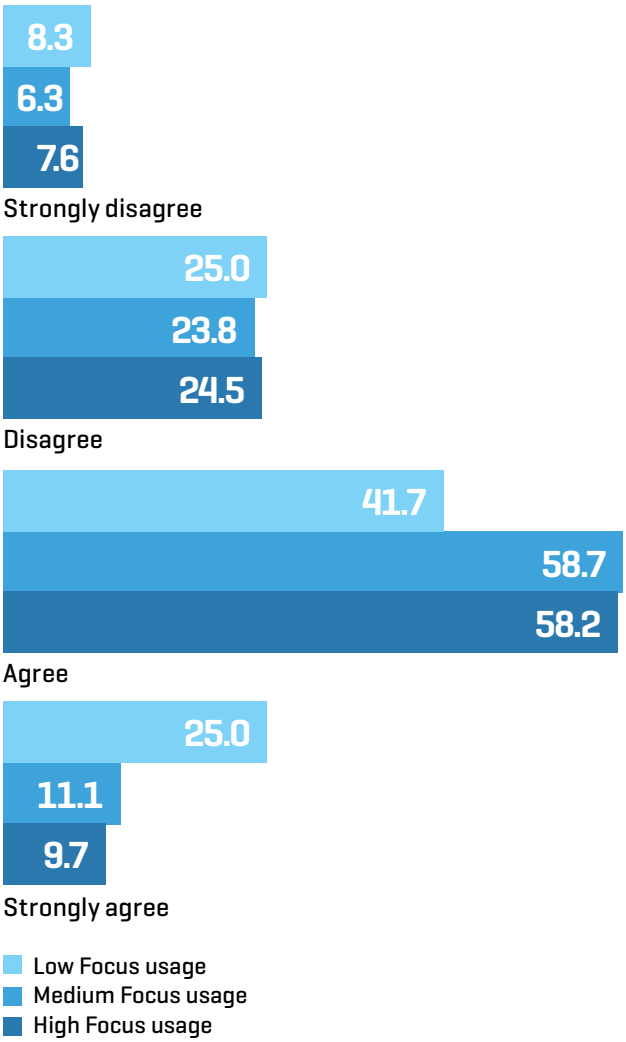
Twenty-six percent of students reported that using Focus caused them to multitask less when in other classes that were not using Focus while 56% reported that their behavior did not change in other classes, and 18% reported that they multitasked more in other classes after using Focus. Once again, trends were fairly similar for college and non college ready students with 29% of non college ready and 23% of college ready students reporting they multitasked less in other classes not using Focus.

The majority (68%) of students felt that using Focus helped them gain better mastery of their course content, and 32% said they did not gain better mastery. Results were similar for non college ready (69%) and college ready (69%) students. When examining this finding by level at which Focus was used, students who used Focus

least (less than 50% of their class sessions) tended to most strongly agree that Focus helped them gain better mastery in their course (Figure 7).

Students were asked via an open-ended question to describe their favorite aspect of using Focus. Twenty-eight percent of students reported that using Focus provided them the ability to focus on their lecture and classroom tasks better, and 14% reported that Focus helped them become more engaged in their class.

FIGURE 7. Student perception of Focus sessions helping gain mastery of course content when compared to classes without Focus usage



Research Question 3. What are student and instructor perceptions of iClicker Focus?

INSTRUCTOR PERCEPTIONS

Instructors reported that iClicker Focus was easy to use. A single ease-of-use question using a scale of 1 (strongly disagree) to 4 (strongly agree) was administered at the end of the semester. The instructor rating was 3.1, which indicates that instructors agreed iClicker Focus is easy to use. The System Usability Scale was also utilized to evaluate the usability of iClicker Focus. This scale provides a reliable measurement of usability through a ten-item questionnaire with a rating scale of (1) strongly disagree to (5) strongly agree. A score of 68 is generally considered desirable and indicates ease of use. Instructors provided a rating of 91 to iClicker Focus, which is considered very high.

iClicker Focus is a feature of the iClicker Reef system; and therefore it was important to include some questions about instructor and student perceptions of iClicker Reef, as well as Focus specifically. At the beginning of the semester, instructors were asked to think about previous digital tools they had used in their classes and to rate a set of items using the scale 1 = strongly disagree, 2 = disagree, 3 = agree, or 4 = strongly agree. This process was repeated at the end of the semester, except instructors were asked to think specifically about the iClicker Reef system in relation to these statements.

Instructor perceptions increased or remained the same for eight of the ten statements (Figures 8 and 9). Instructors strongly agreed that iClicker Reef was easy to set up and use, promoted active learning, and enhanced their pedagogical framework. They also agreed that iClicker Reef saved them time in the classroom, promoted student engagement, offered data and analytics to inform instruction, and stood alone effectively. Instructors reported that iClicker Reef helped identify content gaps for students and was flexible enough to meet pedagogical needs, but they rated these statements slightly lower (.1) at the end of semester

FIGURE 8. Instructor perceptions of iClicker Reef

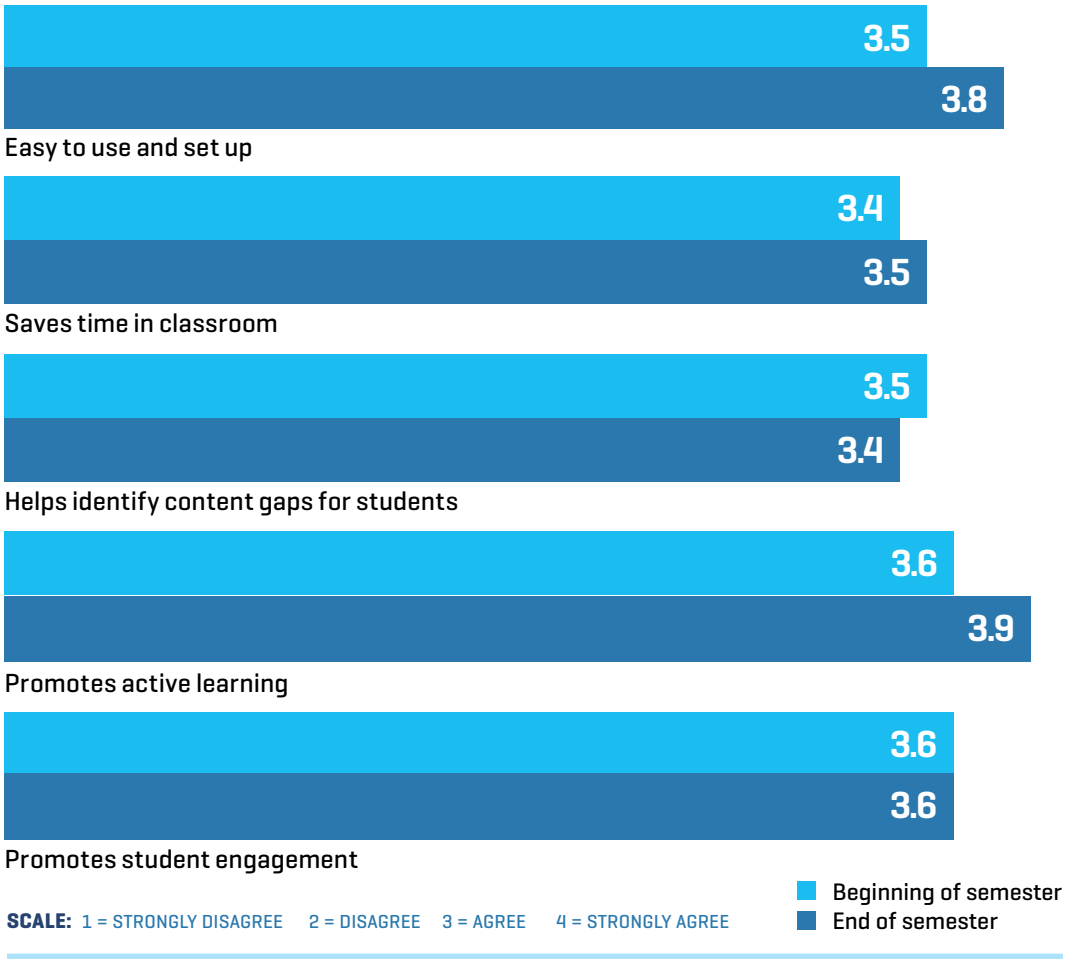
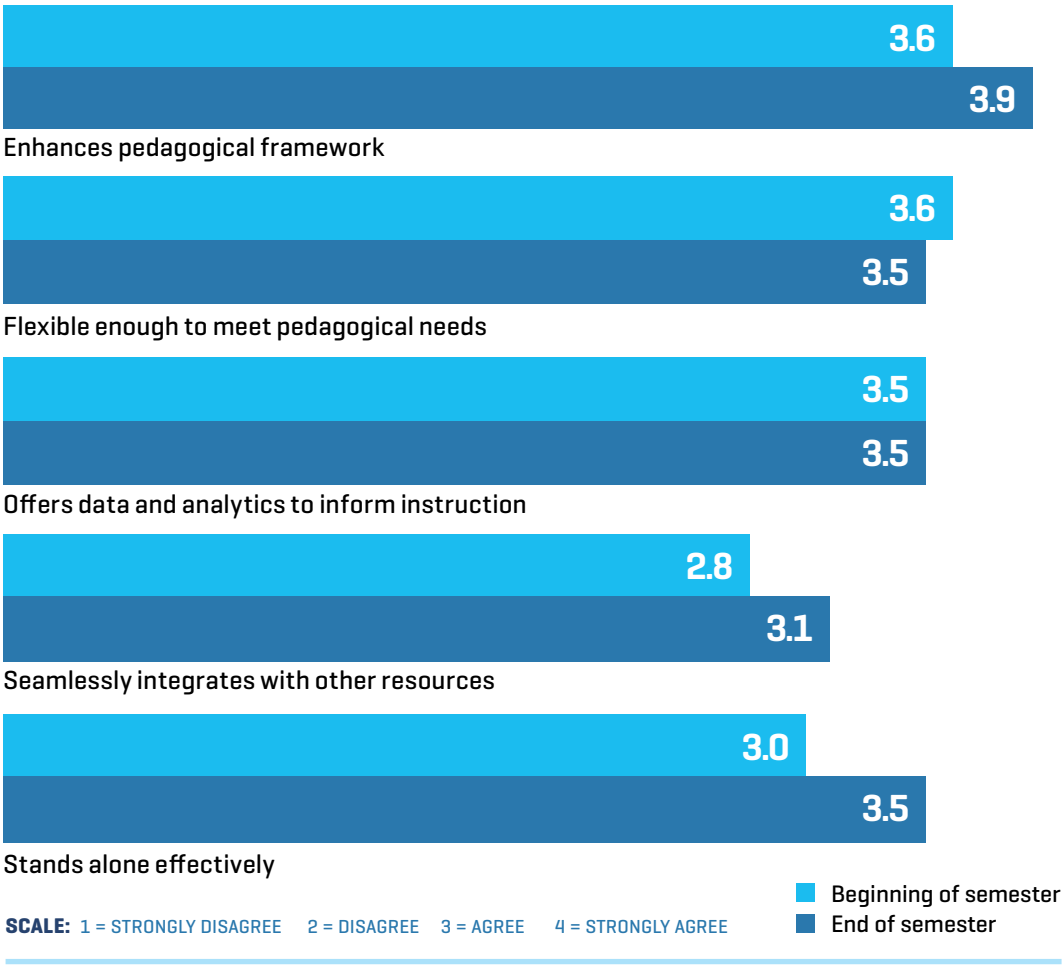
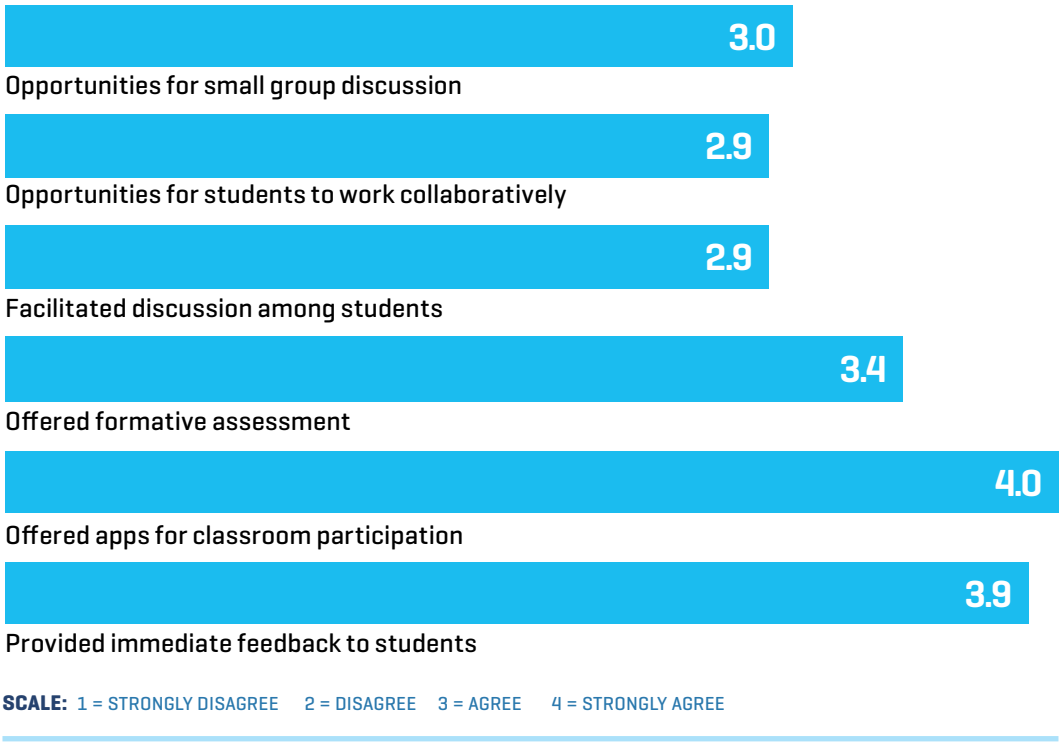


FIGURE 9. Instructor perceptions of iClicker Reef



Using the same scale, instructors rated the degree to which iClicker Reef supported specific classroom actions (Figure 10). Instructors very strongly agreed that iClicker Reef offered opportunities for classroom participation and provided immediate feedback to students. They also agreed that it offered opportunities for small group discussion and for students to work collaboratively, facilitated discussions among students, and offered formative assessment.

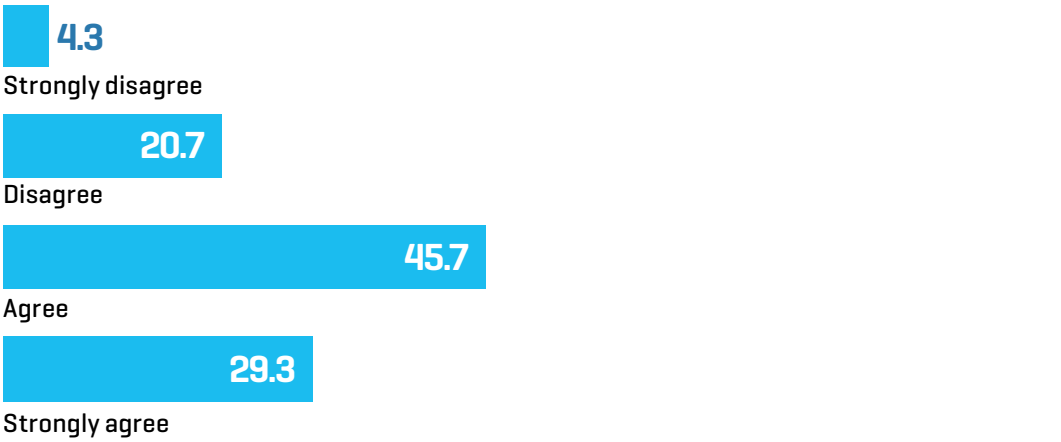
FIGURE 10. Instructor perceptions of iClicker Reef support of classroom actions



STUDENT PERCEPTIONS

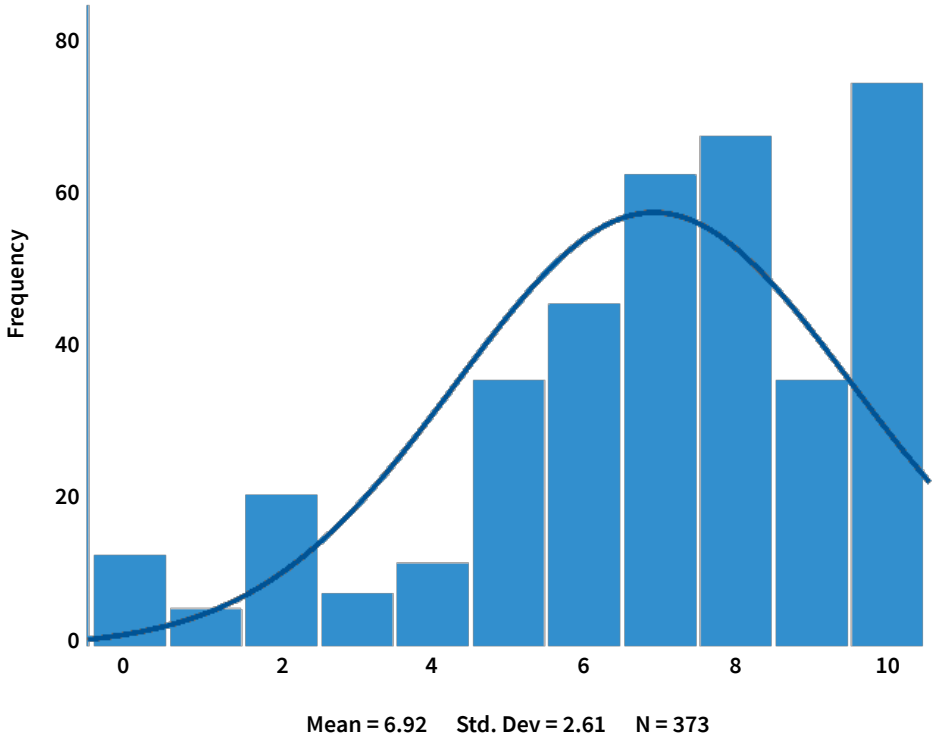
Similarly to instructors, eighty-nine percent of students reported that iClicker Focus was easy to use, and 75% said they had no problems accessing iClicker Focus (Figure 11). Students also completed the System Usability Scale, and provided a rating of 66 to iClicker Focus. This score is lower than the instructor score, but still indicates that students believe iClicker Focus has fairly good usability.

FIGURE 11. Student perception of ease of accessing iClicker Reef



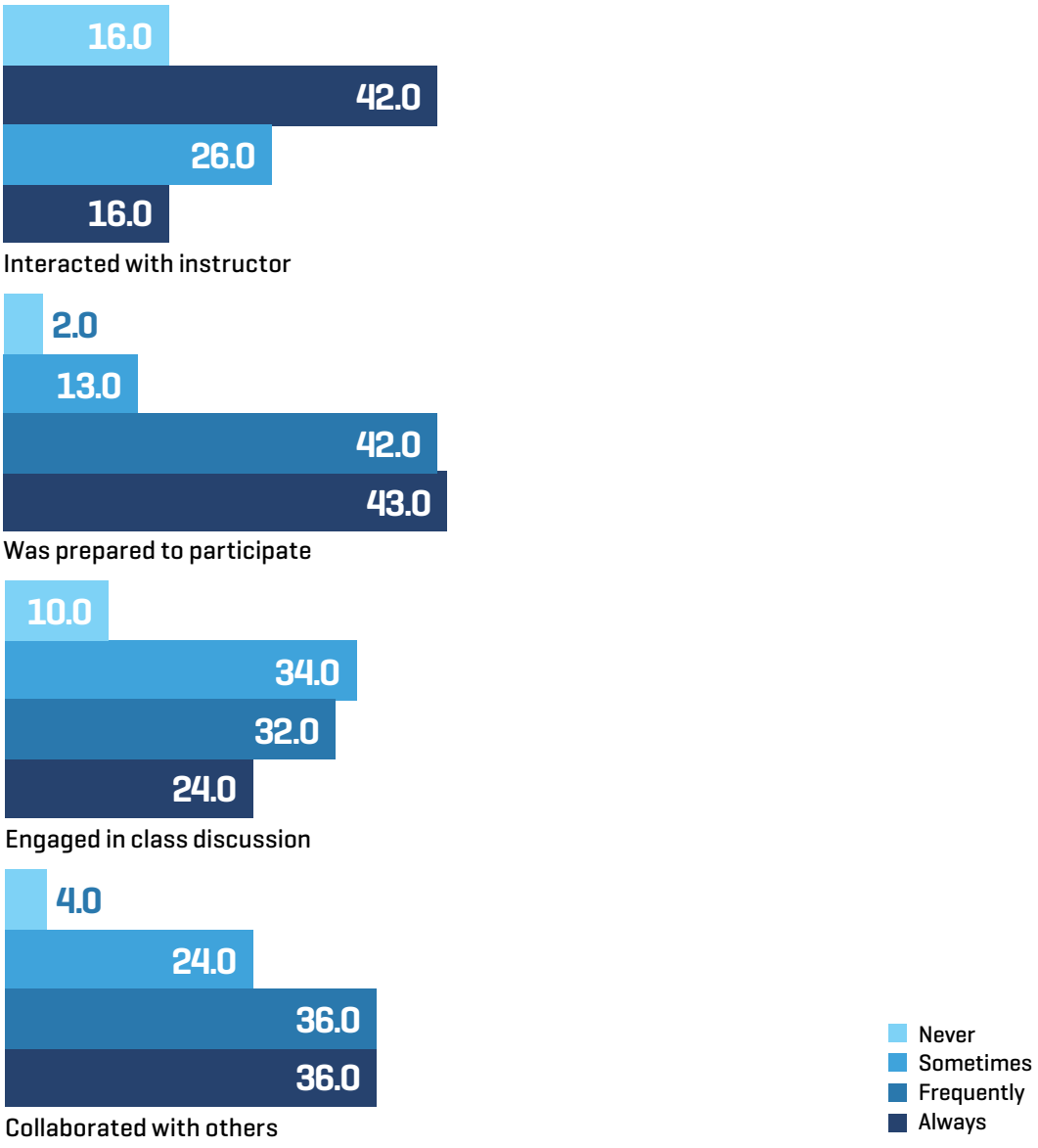
Students were asked to rate, on a scale of 0 (very unlikely) to ten (very likely), how likely they were to recommend a course to a friend if they knew that iClicker Focus would be used. Figure 12 presents the distribution of student responses. The average response among students was 6.92.

FIGURE 12. Distribution of student responses to recommend iClicker Focus to friend



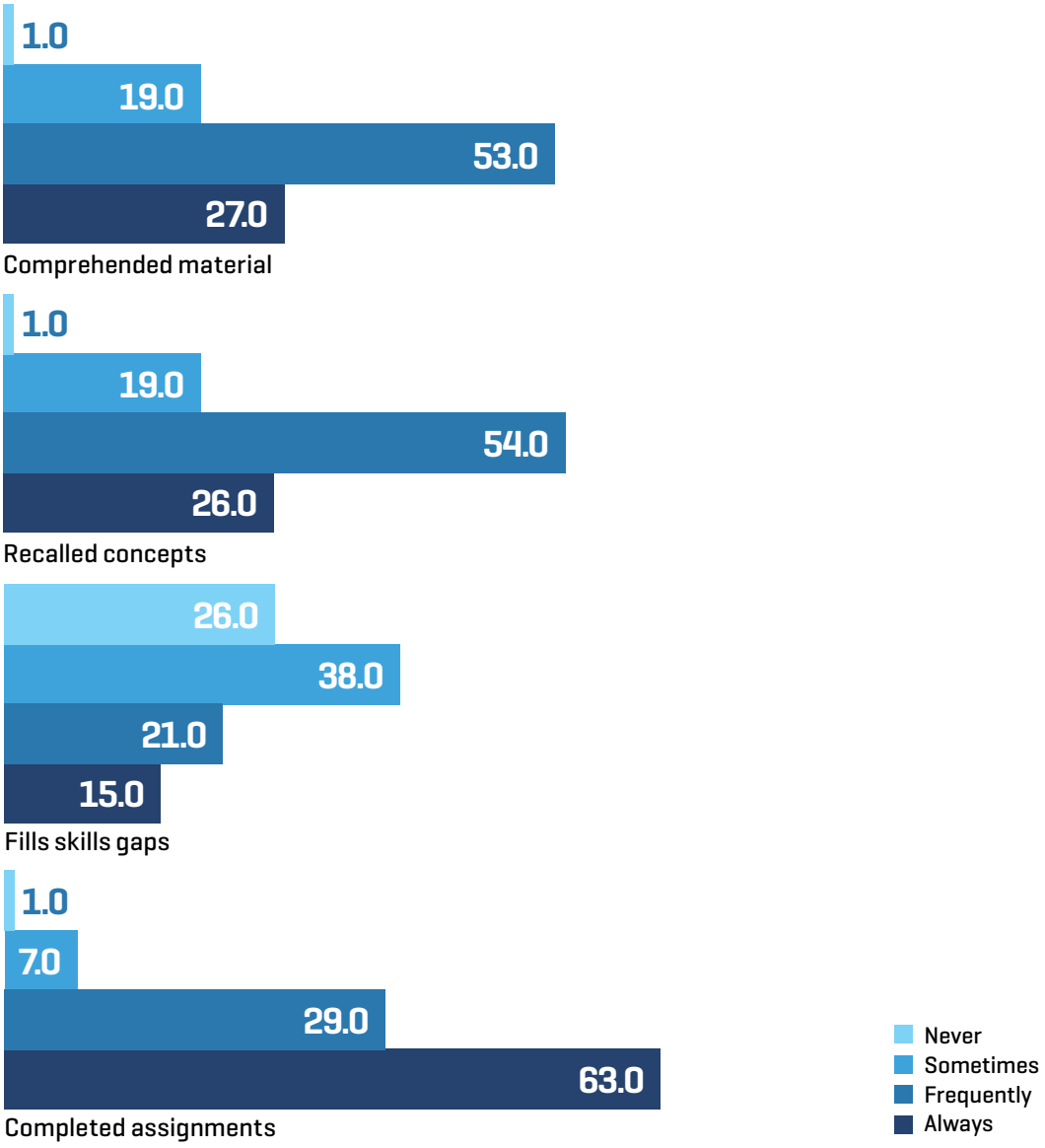
Students offered their perspectives on the frequency at which iClicker Reef supported active learning practices in class (Figure 13). The majority of students said they frequently or always were prepared to participate in class and collaborated with others in class. To a lesser extent, students also interacted with their instructor and engaged in class discussion.

FIGURE 13. Student perception of iClicker Reef support of active learning practices in class



The use of iClicker Reef can also be used to support student learning (Figure 14). The majority of students reported they frequently or always comprehended material, recalled concepts, and completed assignments.

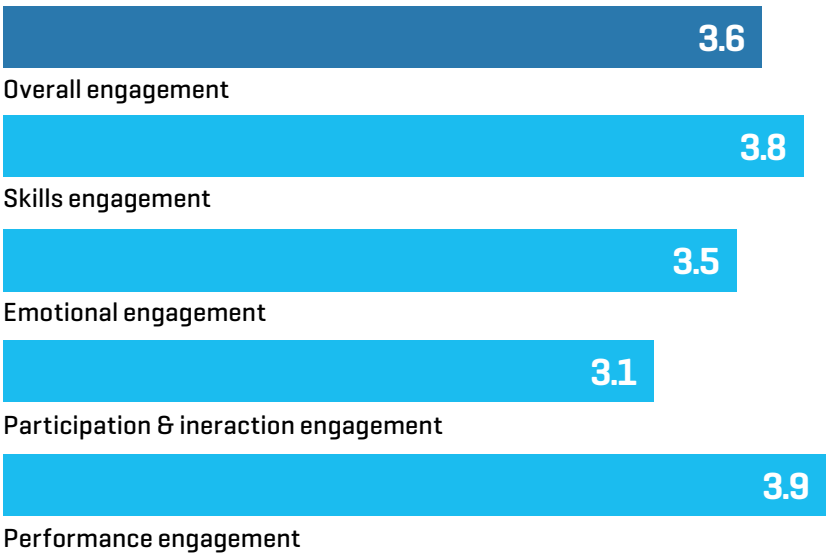
FIGURE 14. Student perception of iClicker Reef support of student learning



Student engagement in their courses that used iClicker Focus was high. The Handelsman, Briggs, Sullivan & Towler (2010) Survey of Student Course Engagement was used to measure several constructs of engagement: skills, participation/interaction, emotional, and performance. Twenty-three statements were rated on a five-point scale ranging from "not at all characteristic of me" to "very characteristic of me". Student overall engagement was 3.6 which indicated engagement in their course, and students rated their skills (3.8) and performance (3.9) engagement particularly high (Figure 15). Skills engagement represents student engagement through the practicing of skills, and performance engagement indicates student course goals and mastery of content.

Students were also asked a series of open-ended questions to understand their favorite and most challenging experiences using iClicker Focus. Twenty-eight percent of students reported that attentiveness during class was their favorite aspect of using iClicker Focus, 17% reported ease of use, 15% reported being able to track their data or work, and 14% reported increased engagement. Fifty-one percent of students reported technology glitches being the most challenging part of using iClicker Focus, 27% reported no challenges, and 13% disliked having restrictions on their mobile device use during class (i.e., not being able to check texts, take phone calls, etc.).

Figure 15. Student perceptions of course engagement



SCALE: 1 = NOT AT ALL CHARACTERISTIC OF ME 2 = NOT REALLY CHARACTERISTIC OF ME
3 = MODERATELY CHARACTERISTIC OF ME 4 = CHARACTERISTIC OF ME 5 = VERY CHARACTERISTIC OF ME

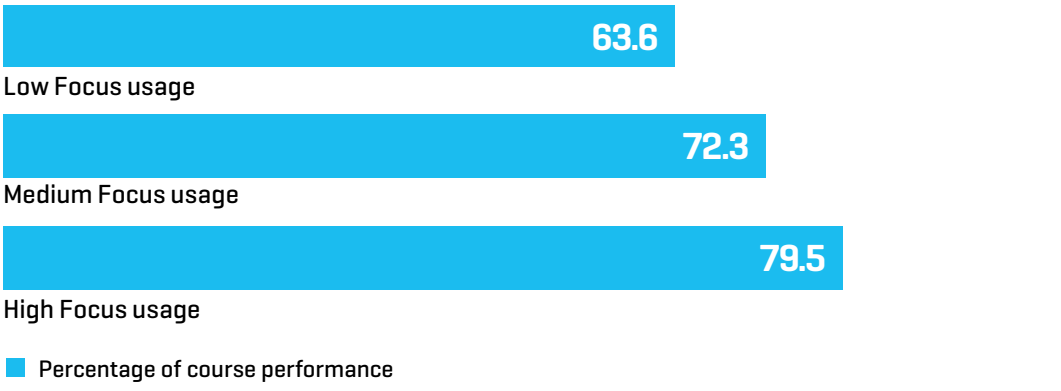
Research Question 4. Does participation in iClicker Focus influence student learning after accounting for high school GPA and number of times students left their Focus sessions?

Results from a previous research study on iClicker Reef show that student usage of iClicker Reef in class had a significant positive correlation to student course grades. For this study, we wanted to understand whether using iClicker Focus could predict student course performance while controlling for the effects of high school grade point average and the number of times a student chose to leave their Focus session.

Course grade was used to represent student performance since data from iClicker Focus did not contribute to course grade. iClicker Focus usage was represented by the proportion of sessions (number of Focus sessions joined/number of Focus sessions available to student) that a student chose to use iClicker Focus. A multiple regression was run using SPSS to predict course performance from iClicker Focus participation, high school grade point average, and number of times a student left their Focus session. These variables significantly predicted course performance ($F(3, 446)=40.10$, $p<.001$, $R^2=.212$). For every 10% increase in Focus session participation, student course performance will increase by 3% while controlling for high school grade point average and number of times a student left their Focus sessions.

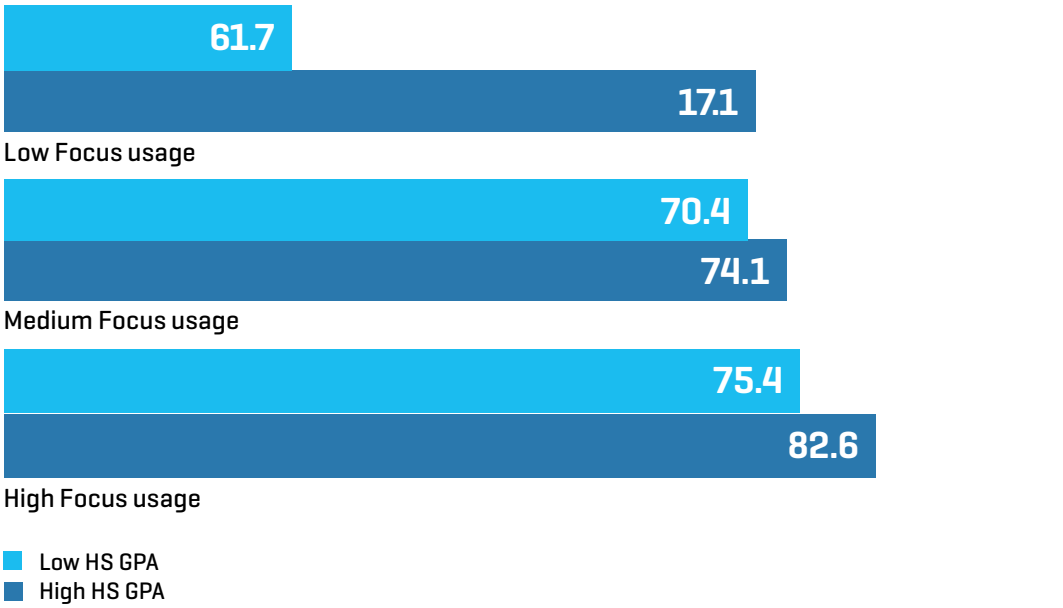
To help visualize this finding, the iClicker Focus data was split into three usage bands based on the proportion of sessions that students used iClicker Focus; (≤ 50%, 51 - 80%, ≥ 81%). After controlling for high school grade point average and number of Focus sessions left, student course performance significantly increased with each level of iClicker Focus usage ($F(2,445)=26.36$, $p<.001$). See figure 16.

Figure 16. Student course performance by Focus usage



The data was also disaggregated by whether a student fell above or below the mean high school grade point average (Mean = 3.58, SD=0.55) while still looking at the trend of course performance and Focus participation. As figure 17 shows, students with both low and high GPAs saw an increase in course performance as their participation in Focus sessions increased. Students with low GPAs and high Focus usage had similar course grades to students with high GPAs but only moderate Focus usage. Also, the course performance of students with low GPAs increases 13.7% by increasing their Focus usage from low to high.

FIGURE 17. Student course performance by Focus usage and high school GPA category



Discussion

The results from this study suggest that iClicker Focus was easy to use for both instructors and students and that most students believed it helped them stay on task during class and gain better mastery of the content in their course. Student usage of Focus varied, and increased usage was associated with increased course performance. Most importantly, the findings indicate that use of Focus is able to predict student course performance when controlling for the effects of high school grade point average and number of Focus sessions left. As students increase their Focus participation by 10%, their course performance increases by three percent

The findings also suggest that less academically prepared students who engage in at least 81% of their Focus sessions can move from a failing grade (62%) to a passing grade (75%) at most US colleges. With an average of 50% of students failing their introductory college courses, many educators may find this difference important.

Conclusion

Macmillan Learning has undertaken a robust research agenda to support iClicker Reef. The positive impact of the tool as a whole has been documented, and this latest study examined a specific feature — Focus. The results documented in this report were used for the optimization iClicker Focus feature, and so that instructors could have insight into how usage of Focus may influence student performance. The findings from this study are promising and suggest that iClicker Focus can help students perform better in class, but should be interpreted with caution as this is not a causal study.

Limitations

The results in this study are very promising and contribute sound evidence to the efficacy of the iClicker Focus feature, but like all applied research, there are important limitations to discuss. Most important to note is that the design and analyses presented in this study are descriptive and correlational, and therefore causal statements cannot be made based on the results. Although we controlled for student prior academic performance when measuring the relationship with course performance, there are other factors that could be contributing to the outcomes measured. Previous research on iClicker Reef has included replications of correlational studies as well as a quasi-experimental study. This study is meant to contribute to the wider research portfolio supporting iClicker Reef.

Note on data privacy

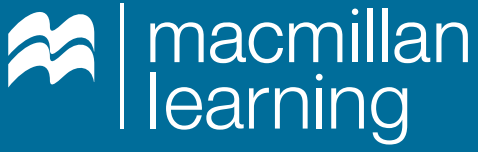
Prior to data collection, this study and the associated consent forms and instruments were reviewed and approved (found exempt) by the Human Resources Research Organization (HumRRO). HumRRO is a third-party Institutional Review Board organization with no affiliation with Macmillan Learning (federal wide assurance number 00009492 and IRB number 00000257). Macmillan Learning seeks independent and unfunded third-party review to eliminate any bias in decision of exemption. Macmillan Learning then seeks local Institutional Review Board approval at each participating institution, where required. The data collected in this study, which are provided by the instructor and consenting students, are initially identifiable. However, once a random identifier is generated identifiable data are destroyed. Data are provided in secure storage locations, and access is permitted only to the primary investigator in the study. For full details of our data handling and storage privacy procedures, contact Marcy Baughman, Senior Director Impact Research at Macmillan Learning at marcy.baughman@macmillan.com.

About Macmillan Learning

Macmillan Learning improves lives through learning. Our legacy of excellence in education continues to inform our approach to developing world-class content with pioneering, interactive tools. Through deep partnership with the world's best researchers, educators, administrators, and developers, we facilitate teaching and learning opportunities that spark student engagement and improve outcomes. We provide educators with tailored solutions designed to inspire curiosity and measure progress. Our commitment to teaching and discovery upholds our mission to improve lives through learning. To learn more, please visit http://www.macmillanlearning.com or see us on Facebook, Twitter, LinkedIN or join our Macmillan Community.

About the Learning Science and Insights Team

As the Learning Insights company, we are passionate and scientific about helping students, instructors, and institutions to achieve their full potential. We use a unique combination of user-centered design, research from the learning sciences, and empirical insights from extensive data mining and Impact Research. To learn more about this approach, please visit https://www.macmillanlearning.com/college/us/learning-science/


macmillan
learning