



IN VIVO

The Publication of the Metropolitan Association of College and University Biologists

Spring 2020

Volume 41, Issue 3

Message from Dr. Kathleen Nolan President of MACUB

Dear MACUB Members,

It is with a heavy heart that I am writing to you today! Who would have known that this terrible COVID-19 pandemic would descend upon us? We all know people that have contracted, and even died from this disease. We are all trying to carry on with our teaching while helping and supporting our families as best as we can. The transition to online has been unsettling, and the students have had to adjust as well. We are all scrambling for online resources, especially in teaching labs. I would like to put in a plug for the Association of Biology Laboratory Education, <http://ableweb.net>, as they are offering ideas on online laboratory education. We encourage you to write articles about how you have been coping with your teaching during this crisis. Please send them to Dr. Edward Catapane, the editor of In Vivo at catapane@mec.cuny.edu. We are preparing a special issue on these ideas that we would like to disseminate to you. Please go to our website: <http://www.macub.org> to keep posted on our latest issues of In Vivo.

The MACUB Board met last week, and I regret to tell you that we will not be hosting an in-place conference this year. HOWEVER, we are doing our best to try to organize a VIRTUAL CONFERENCE, hopefully during the fall at the end of October, 2020. We are trying to find a platform that would accommodate a large group of people, as well as solicit some compelling speakers. We would also like to have student involvement. We are in the beginning stages of this planning, so please turn to our website for more information as the summer progresses.

I am very much looking forward to seeing you in the fall (virtually, at least)! Please stay safe and sane.

Sincerely yours,

Kathleen A. Nolan, Ph.D.
President of MACUB

**The Metropolitan Association of
College & University Biologists**
Serving the Metropolitan New York Area
Since 1967

**MACUB 2019-2020
EXECUTIVE BOARD MEMBERS**

PRESIDENT

Dr. Kathleen Nolan
Saint Francis College

VICE-PRESIDENT, Interim

Dr. Fernando Nieto
SUNY College at Old Westbury

TREASURER

Dr. Margaret Carroll
Medgar Evers College

CORRESPONDING SECRETARY

Dr. Paul Russo
Bloomfield College

RECORDING SECRETARY

Dr. Jill Callahan
Saint Peter's University

MEMBERS-AT-LARGE

Dr. Tin Chun Chu
Seton Hall University

Dr. Donald Stearns
Wagner College

2019 CONFERNCE CHAIRS

Dr. Martin J. Hicks and Dr. Jonathan Ouellet
Monmouth University

2018 CONFERENCE CHAIRS

Dr. Bryn J. Mader and Dr. Regina Sullivan
Queensborough Community College

IN VIVO EDITOR

Dr. Edward Catapane
Medgar Evers College

AWARDS CHAIR

Dr. Anthony DePass
Long Island University

ARCHIVIST

Dr. Kumkum Prabhakar
Nassau Community College

PAST PRESIDENT

Prof. Gary Sarinsky
Kingsborough Community College

TREASURER EMERITUS

Dr. Gerhard Spory
Farmingdale State University

MEMBER-AT-LARGE EMERITUS

Dr. Michael Palladino
Monmouth University

Instructions for Authors

IN VIVO is a peer-reviewed journal that is published three times yearly during the Fall, Winter, and Spring. Original research articles in the field of biology in addition to original articles of general interest to faculty and students may be submitted to the editor to be considered for publication. Manuscripts can be in the form of a) full length manuscripts, b) mini-reviews or c) short communications of particularly significant and timely information.

Articles can be submitted electronically to invivo@mec.cuny.edu or mailed as a printed copy (preferably with a diskette that contains the file) to the Editorial Board at Medgar Evers College. All submissions should be formatted double spaced with 1 inch margins. The title of the article, the full names of each author, their academic affiliations and addresses, and the name of the person to whom correspondence should be sent must be given. As a rule, full length articles should include a brief abstract and be divided into the following sections: introduction, materials and methods, results, discussion, acknowledgments and references. Reviews and short communications can be arranged differently. References should be identified in the text by using numerical superscripts in consecutive order. In the reference section, references should be arranged in the order that they appeared in the text using the following format: last name, initials., year of publication. title of article, journal volume number: page numbers. (eg. - ¹Hassan, M. and V. Herbert, 2000. Colon Cancer. *In Vivo* **32**: 3 - 8). For books the order should be last name, initial, year of publication, title of book in italics, publisher and city, and page number referred to. (eg. - Prosser, C.L., 1973. *Comparative Animal Physiology*, Saunders Co., Philadelphia, p 59.). Abbreviations and technical jargon should be avoided. Tables and figures should be submitted on separate pages with the desired locations in the text indicated in the margins.

IN VIVO Editorial Board

Editor:

Dr. Edward J. Catapane,
Medgar Evers College

Associate Editors:

Dr. Ann Brown,
Dr. Margaret A. Carroll,
Medgar Evers College

In Vivo (Brooklyn) is published by
The Metropolitan Association of College and
University Biologists
Brooklyn, NY
ISSN: 2639-2658
<https://macub.org>

In This Issue:

Message from Dr. Kathleen Nolan	front Cover
MACUB 2019-2020 Executive Board	inside cover
Instruction for Authors	inside cover
Low Stakes Lecture Quizzes and Voluntary Final Review Pools Help Improve Performance in Anatomy and Physiology, by Abass Abdullahi	67
Survivorship of Red Oak Seedlings at Alley Pond Park, Queens County, New York, by Richard Stalter, Khadija Yousuff, Ali Mian, Liam Chapman, Hayden DiMaio, Selin Ipe and Amanda Garcia	80
Affiliate Members	inside back cover

Call for Manuscripts

Publish your manuscripts in *In Vivo*
Follow the Instructions for Authors on the inside cover and submit your
manuscripts electronically to the Editorial Board at invivo@mec.cuny.edu

Low Stakes Lecture Quizzes and Voluntary Final Review Pools Help Improve Performance in Anatomy and Physiology

Abass Abdullahi

Bronx Community College of the City University of New York, Bronx, NY 10453

Abstract

Low stakes formative quizzes and voluntary final review pools were effectively used to better guide Anatomy and Physiology I review sessions and helped slightly improve student performance in summative exams including the cumulative common finals. The online quizzes designed to have unlimited attempts, covered similar topics as the exams and were of similar format, in order to be more effective study material and better gauge performance levels. Then, the overall class quiz performance data was used to screen for potential challenging areas to focus review sessions on, before the upcoming summative exams. This strategy may have been effective in accounting for the improved performance, especially calming student anxiety, ahead of the exams. Linear regression analysis showed that the lecture quizzes as well as the final review pools were relatively good predictors of student performance, agreeing with faculty and student general perceptions. It was especially great to see that the students that attempted the formative assessments multiple times were the most likely ones to achieve the C+ and better grades required to transition into their dream allied health and nursing majors. The predictive nature of the quizzes in making the relationship between this desirable student characteristic and optimal student outcome, as well as the opposite scenario for those attempting the quizzes fewer times or not attempting at all, may be useful information that could be used for targeted advisement earlier in the semester. For instance, just with lecture quiz 1 data, students that never attempted this quiz had a very high chance of failing or withdrawing from the course, or score in the D/C category. These at-risk students will likely benefit from early feedback and targeted one on one discussion to better awaken them to what's at stake and suggested study strategies to remedy the situation sooner.

Introduction

The use of formative assessment techniques like practice quizzes at the end of textbook chapters and as a component of their online repertoire is very common^{1,2}. The idea is for students to have instant feedback to assess whether or not they understand the study material covered in the given chapter. The fact that such formative quizzes don't contribute to student grades, whilst giving them much needed guidance on areas to focus on is very important, in that formative assessment generally need not to be intimidating³. The potential benefits of such formative assessment are enormous if used properly^{4,5}. Imagine if students could routinely use these quizzes for their intended purposes of self-assessment or if it could be used to quiz fellow students on the same. There is enough literature to suggest that students that can effectively use these end chapter self-assessment quizzes or other instructor provided formative quizzes will do significantly better in class⁴⁻¹⁰. Perhaps, it is for these reasons that it is not unusual for instructors

to provide students with practice test material from previous semesters or as a component of course guide study materials.

Yet the main challenge to such readily available formative assessment tools is the motivation to do them. While a higher performance in an upcoming exam seems like a good motivation, students may be more motivated if there was an incentive for doing the formative quiz itself^{11,12}. It is for these reasons that instructors that effectively use flipped classroom models typically give some component of "non-threatening" low stakes pre-lecture quizzes that have a very small percentage of course grade included^{13,14}. In our own experience, we were able to use lecture PowerPoint embedded questions¹⁵ or open note quizzes¹⁶ with some success in helping improve student preparedness, participation and performance. However, we were able to be more effective in our online Pre-Anatomy and Physiology preparatory course^{17, 18}, when we assigned up to 10% credit on exam 1 performance, which is essentially about 1% of overall course grade. If grades were assigned for

the assessment, however, then it may no longer be entirely formative, but may have some elements of summative assessment^{8,10,11}. The right balance between formative and summative assessment needs to be established. The latter is more commonly used to evaluate student understanding of concepts after a certain period of time has elapsed, typically at the end of an educational process, after coverage of certain amount of course work.

Low stakes online lecture quizzes that have unlimited attempts can thus serve both formative and summative assessment purposes^{11,13,14} in that they could be used to give feedback to students and be used as review material (formative) while also having some grades assigned as incentive (summative). They may even be of more value if there is a gap of time between the time the quizzes are done and when the exams are scheduled, such that students have ample opportunities to fix any misconceptions identified through this approach. In addition to the lecture quizzes, other readily available course review material, like in our case practice test and review material provided as optional additives in course guides, may be related to relevant quiz questions that students find challenging and used during reviews. It also helps that the formative quizzes are a similar format to the summative exams¹⁰. Then towards the end of the semester when students have hopefully appreciated the value of the formative assessments in helping with the summative assessments, it may be possible to provide online formative review material, similar to the quizzes but with no grades assigned at all. This could be a potential intervention for courses that students generally find difficult to understand.

Anatomy and Physiology I is one such course that has been shown to be highly challenging for nursing and allied health students that typically use these courses as a pre-requisite for joining their chosen majors^{19,20}. A major contributing factor to this may be due to the student's limited science and English backgrounds, poor study habits and socio-economic issues that effectively combine to limit their potential²¹. Since students feel the course is difficult, they may have confidence issues taking the summative exams and therefore the low stakes lecture formative quizzes may help ease their fears²². A higher performance in the quizzes may make some students feel all of a sudden that they can successfully do the course. The lecture exam may not be as overwhelming after all and students could potentially ease any confidence issues they may have had. This may then help improve on overall student retention and make it relatively easier to transition to their chosen allied health majors and ultimately help with their graduation rates, one of the measures of good student outcomes.

Therefore, mandatory low stakes online lecture quizzes were introduced as a potential intervention at least a week or two before high stakes hourly lecture exams, with a review session generally scheduled the week between the formative quizzes and the summative exams. Then, towards the end of the semester, once students had appreciated the potential benefits of the lecture quizzes, a voluntary lecture online final review pool similar in format to the quizzes, was given to students. The aim of the study was to evaluate whether these interventions (mandatory quizzes and voluntary review pools) were helpful to the student's performance in the summative hourly exams and the cumulative final. For instance, did students that attempted these unlimited interventions as many times as possible outperform their peers that did not do them or only attempted them less times. Also, could the low stakes formative quizzes have any predictive ability regarding the summative exams.

Materials and Methods

Study was based on seven A&P I sections comparing quizzes and final review interventions

The study was based on a total of seven sections of Anatomy and Physiology I taught between the Fall 2015 and Spring 2018 as described in Table 1 (n=164). Five of these sections were traditional sections, with two of these traditional sections (Fall 2015 and Summer 2016; n=48) conducted before the incorporation of the lecture quizzes and three sections that took place after the formative quiz interventions (Spring 2017, Fall 2017 and Spring 2018; n=76). Then, with the formative quiz interventions constant, data from two hybrid sections (Fall 2017 and Spring 2018, n=40) were included to show that the incorporation of the quizzes was universal irrespective of the mode of delivery (i.e. traditional and hybrid sections).

Performance comparisons in the four lecture exams and the finals were made and related to the quizzes and finals review pool interventions. Student participation in the lecture quizzes and the review final pools were noted and compared to the overall performance in the course.

Lecture quizzes covered the same topics as lecture exams and were good review material

Lecture quizzes covering similar test topics were performed at least a week or two before each of the four lecture tests in Anatomy and Physiology I as shown in Table 2. The low stakes lecture quizzes comprised of ten questions ranging from multiple choice, true and false, ordering and matching questions. They

contributed only about 5-10% of the course grade, but could act as an indicator of performance in the high stakes lecture exams, scheduled only a week or so later. This was especially so because the lecture quizzes were offered with unlimited attempts and there was an opportunity for students to ask the professor any areas that needed clarification. In fact, the professor made a point of going over the lecture quizzes as a potential review material before the tests.

In lieu of the lecture quizzes ahead of the final, there were discussion summaries and voluntary review pools

A similar design was used for the lecture final with two key exceptions. The first was that in lieu of an actual lecture quiz, students were asked to summarize one of the semester topics that challenged them the most, either through an online discussion board or as an in-class discussion ahead of the finals. Students were also

Table 1: The seven study sections with relevant details like sample size, course mode of delivery and whether lecture quizzes and/or final review pools were implemented.

Section	Sample size (n)	Mode of delivery	Lecture quiz	Final review pool
Fall 15	23	Traditional	No	No
Summer 16	25	Traditional	No	No
Spring 17	24	Traditional	Yes	No
Fall 17	26	Traditional	Yes	Yes
Spring 18	26	Traditional	Yes	Yes
Fall 17	19	Hybrid	Yes	Yes
Spring 18	21	Hybrid	Yes	Yes

Table 2: A typical schedule with the lecture quizzes and exams, covering the same topics, separated by at least a week of reviews. However, due to time limitations the reviews were very short on some occasions. Also, note that there were discussion summaries and final review pools for both the traditional and hybrid sections as well.

Week/Lecture	Lecture quizzes and exams	Lecture Topics
1-4	Lecture quiz 1 (week 2-3) and Exam 1 (week 4); covering the same topics i.e. 1 & 2. Reviews were done on week 3.	1 and 2
4-8	Lecture quiz 2 (week 6-7) and Exam 2 (week 8); covering the same topics i.e. 3, 4 & 5. Reviews were done on week 7.	3, 4 and 5
8-11	Lecture quiz 3 (week 9-10) and Exam 3 (week 11); covering the same topics i.e. 6, 7 & 8. Reviews were done on week 10.	6, 7 and 8
11-14	Lecture quiz 4 (week 12-13) and Exam 4 (week 14); covering the same topics i.e. 9, 10, 11 & 12. Reviews were done on week 13.	9, 10, 11 and 12
15-16	In lieu of Lecture quiz 5; discussion on select topics and an online final voluntary review pools were done.	Review pools covering topics 1-12

given an opportunity to do an entirely voluntary formative lecture final review pool with no contribution to the overall grade. All that the professor could note was whether they were attempted and completed or not and how many attempts were made over the last few weeks of the semester. Still, it was possible to access how students performed through the grade history search on the Blackboard grade center, but it had no effect on course grades. The voluntary final review comprised of a pool of questions, with each student given 100 questions, mainly multiple choice, but also including matching, ordering and true and false type questions.

Correlation between the formative and summative assessments including faculty and student perspectives were noted

Efforts were made to look for any correlation between the formative quizzes/review pools and the summative exams, including analysis of students attempts data as related to overall course performance. Linear regression analysis was performed to look for trends that could suggest the predictive power of the formative assessment in determining the performance of the summative exams.

Students' perspectives were also sought to gauge their views on whether they thought the formative assessments were helpful in preparing them for the summative tests. Since a number of faculty also used similar quizzes in their courses, their views were included as well, when asked to reflect on whether they thought their students benefited from using similar formative quizzes in summative exam preparations.

Results

Students high performance in the lecture quizzes carried on to the corresponding exams

As shown in Figure 1, students scored over 80% in the low stakes online lecture formative quizzes and their performance in the corresponding in-class lecture exams was only slightly lower, generally over 70%. This was a very impressive performance by the students, although they were also helped by the unlimited nature of the formative lecture quizzes. Overall performance seems to have improved over time, with students scoring close to 90% from lecture quiz 2 and subsequent quizzes. Lecture quiz 5 that preceded the finals was the best performed at around 95%; however, it wasn't a traditional quiz in that it was more of a discussion summary on the topics that challenged individual students the most.

Students participation was slightly higher for the exams than quizzes and earlier in the semester

Figure 2 shows the overall participation levels in the online quizzes and the in-class tests. Generally, as expected more students took part in the in-class tests than the online quizzes. Also, there was a general decline in the number of students taking the quizzes and tests as the semester progressed, dropping from a high of about 90% in exam 1 to around 70% in the final. Still, given the lower retention rates of Anatomy and Physiology I, it was impressive to see such a high number of students still participating in the end semester finals.

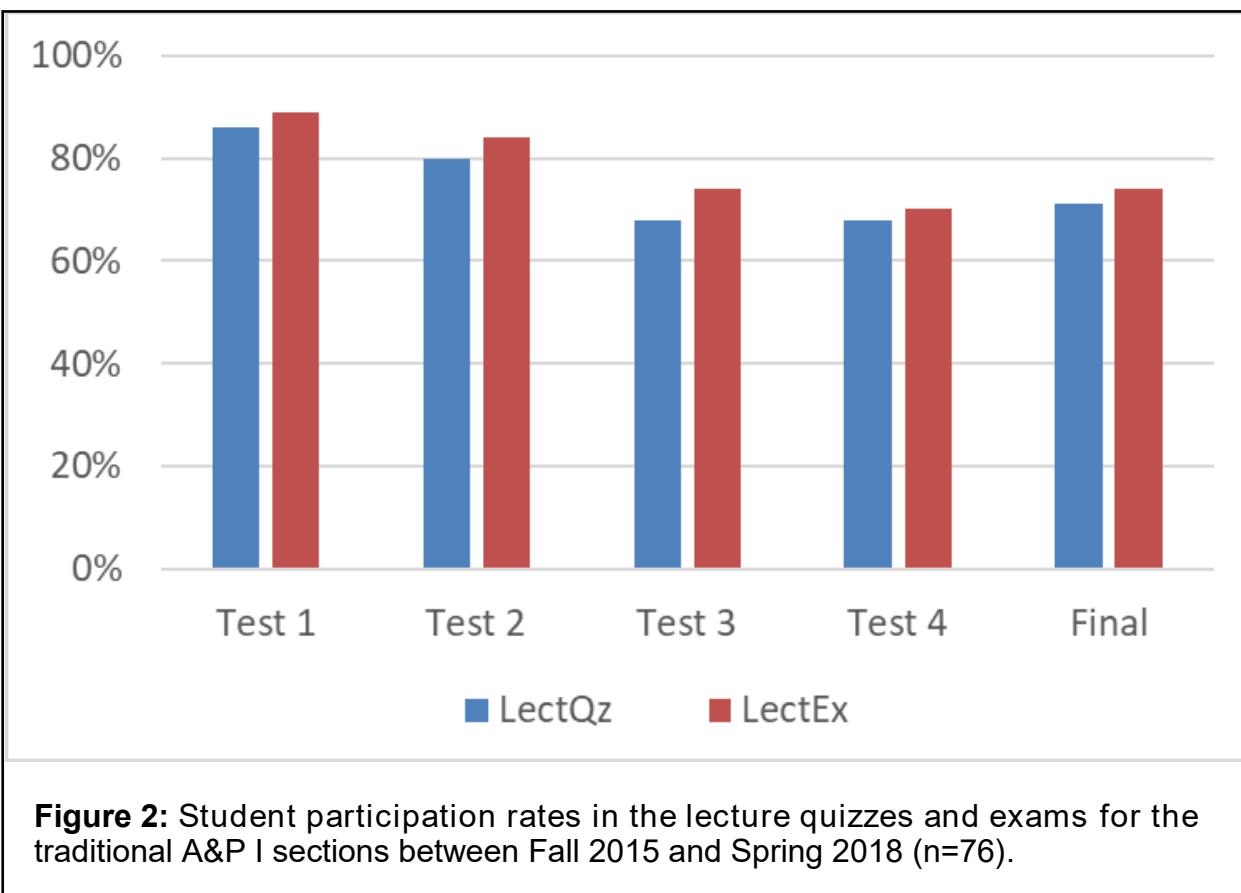
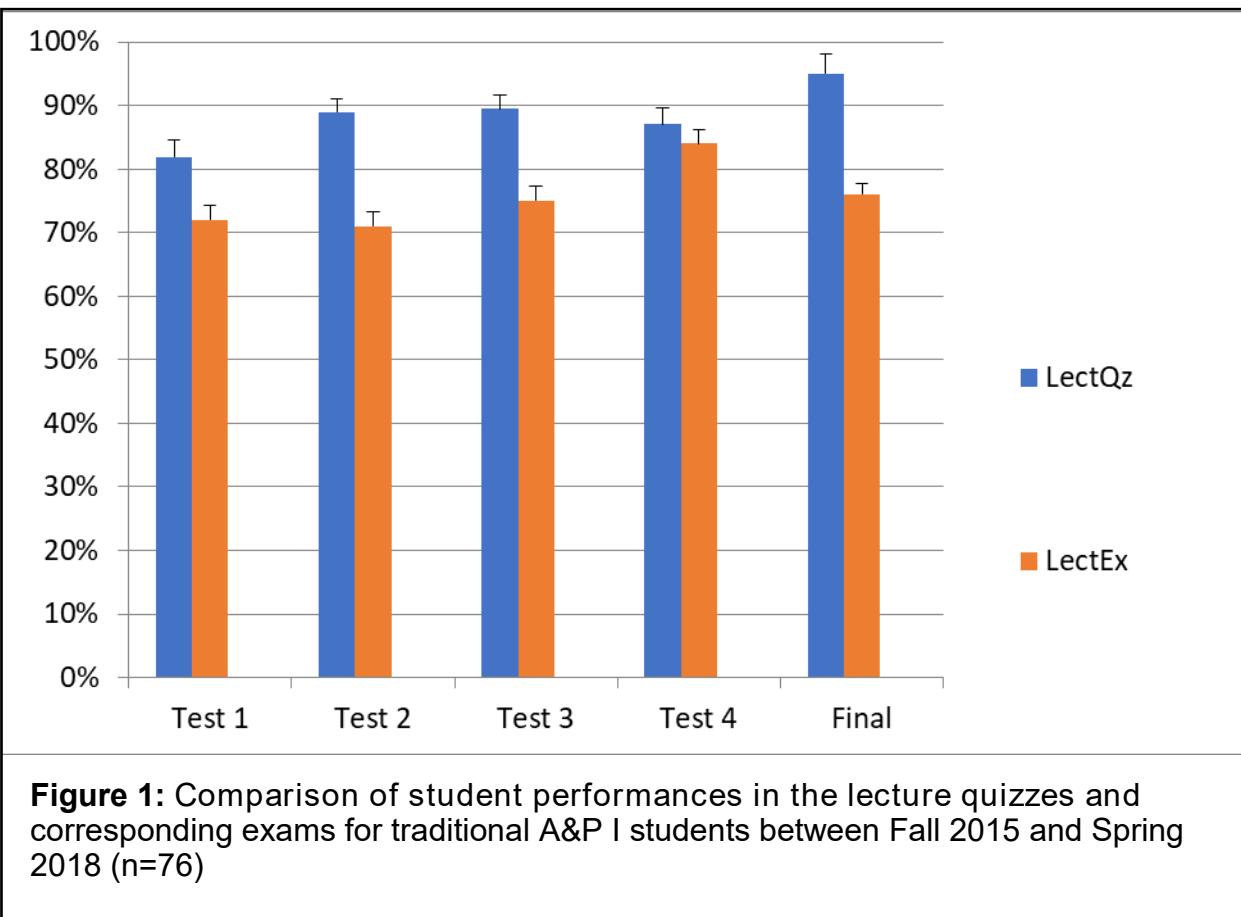
Students had slightly better performances in the exams and finals after the lecture quiz intervention

When compared to courses taught pre-intervention, there was a tendency for slight improvements after the quizzes were introduced as illustrated in Figure 3. For instance, exams 2 and 4 were 6% and 3% better respectively after the lecture quizzes were implemented, with exam 3 also showing a modest 2% gain. Perhaps, the biggest improvement was in the final, where there was an average improvement of about 7% (Figure 3).

There is some correlation between performance in the quizzes and exams and even better correlation between the review pool as well as lecture exams and the finals

Linear regression analysis revealed that there was some correlation between the quiz scores and the corresponding lecture exams. For instance, as illustrated in Figure 4A, the performance on Lecture quiz 1 may explain up to about 31% of the performance of the corresponding Lecture exam 1. Similarly, the performance on the voluntary review final pool was slightly better correlated, as it may explain up to about 38% of the performance in the lecture final (Figure 4B).

However, given that the quizzes improved the test scores, it was great to see an even better correlation between performance in the lecture exams and the overall performance in the comprehensive final. In this case, the regression analysis indicated with over 55% final score prediction accuracy for most students, only after taking the first exam (Figure 4C). The accuracy level improved as more exams were assigned over the course of the semester, such that by the time the students took their third exam (test 3), the final



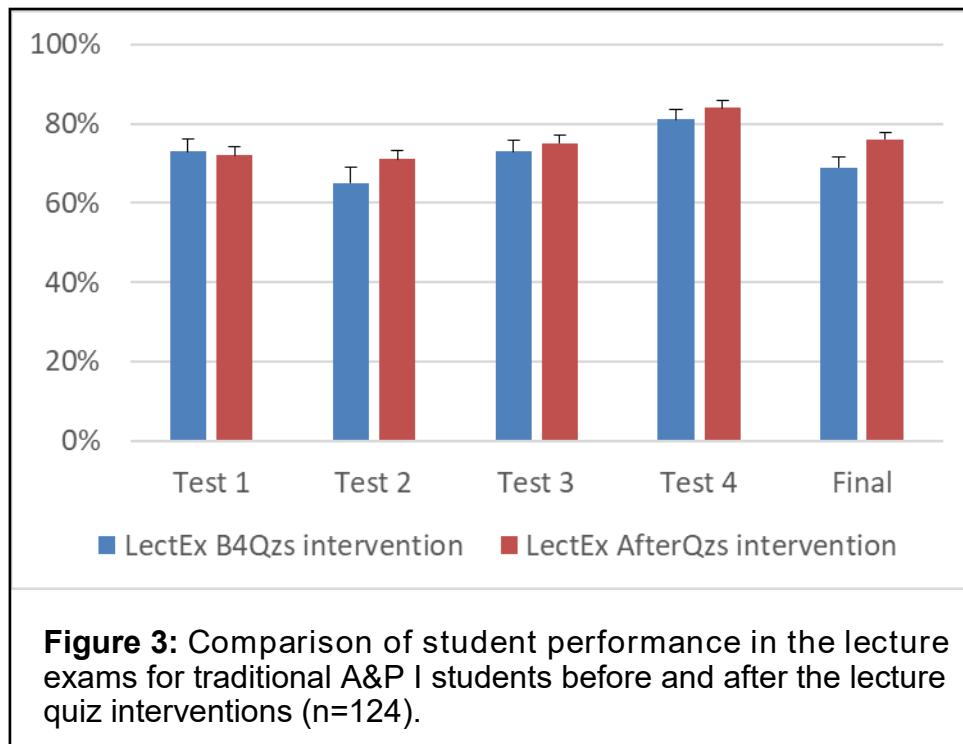


Figure 3: Comparison of student performance in the lecture exams for traditional A&P I students before and after the lecture quiz interventions (n=124).

score prediction accuracy improved to 75% (Figure 4D). Since this is considered relatively strong correlation, accounting for about three quarters of the students, the relevant equation was included in the graph as well.

Student and faculty responses also highlight the helpfulness of the formative quizzes in the summative exams, but with some negative comments as well

Generally, students and faculty comments suggested that the formative lecture quizzes were helpful in improving summative exam scores as described in Table 3. Some faculty observed that since there was a better correlation between the quizzes and exams for the relatively stronger students, and even for the weaker ones, it may help with general class preparedness. However, there were a relatively larger number of individuals, mostly students, who weren't sure or didn't think the formative quizzes were helpful in preparing for the summative exams.

Student lecture quiz and finals review pool performance analysis helped guide review strategy

One of the main advantages of the low stakes lecture quizzes and the finals review pool, later in the semester, were that student performance data was used to better target review sessions as

described in Table 4. Usually, the first attempt data of the lecture quiz attempts was used as that was a potentially better indicator of student understanding (or misunderstanding) of course content. Although students could have improved their quiz scores by doing multiple attempts, it is always good to know their first instinctive response. In other words, it is possible that improving on their quiz grades, could have been the motivation for doing the multiple attempts and their initial misconceptions in attempt 1, if any, still needed some attention. That was not the case for the final review pools as it was entirely formative, with no contribution to overall course grades.

Students were more likely to complete more lecture quiz attempts later in the semester; less so for the voluntary final review pools

Since the low stakes online lecture quizzes was not just for assessment, but also for content mastery that was to be useful during review sessions and the in-class exams, it was interesting to see whether students took advantage of its unlimited attempts options. In the beginning, a relatively large number of students seem to have been comfortable doing only the first or second attempt (Figure 5). For instance, about 31% of students completed just attempt 1 for the first lecture quiz and a further 46% attempted the quiz twice, but there was a gradual decline in the first attempt only category as the semester

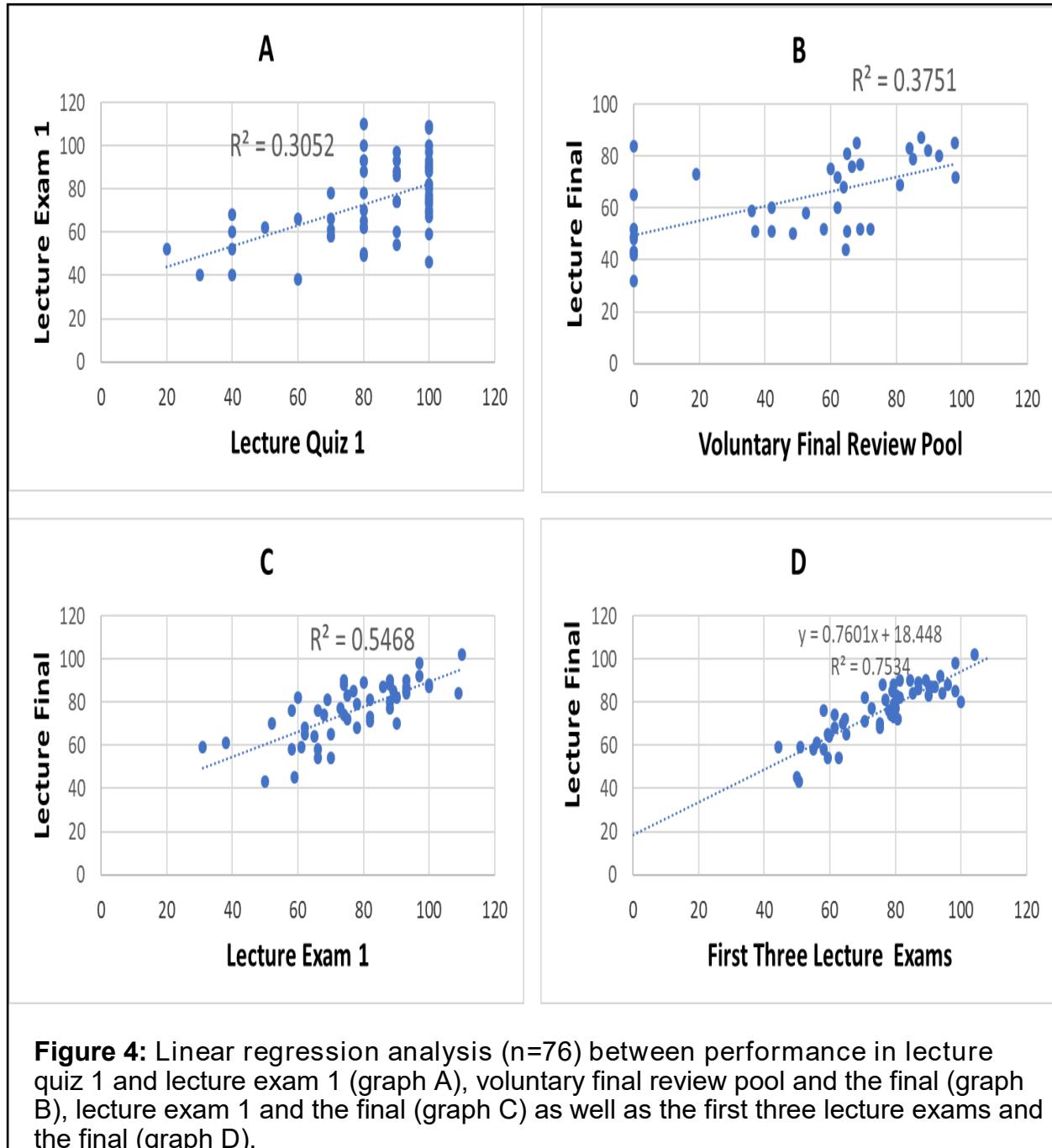


Figure 4: Linear regression analysis ($n=76$) between performance in lecture quiz 1 and lecture exam 1 (graph A), voluntary final review pool and the final (graph B), lecture exam 1 and the final (graph C) as well as the first three lecture exams and the final (graph D).

Table 3: Student and faculty responses when asked whether they thought the formative quizzes helped with the summative exams.

Respondents	Yes	No or Not sure
Students	<p>“...these quizzes have helped me a lot for midterms and finals. Along with the class lecture tests...”</p> <p>“...those quizzes helped towards my final grade...”</p> <p>“...the quizzes helped a lot to prepare for the final...”</p> <p>“...building up me intellectually to achieve a greater score of grades towards the end of the semester...”</p> <p>“...I think the quizzes that he uses helped in guidance, models, and pictures...”</p> <p>“...Prof walk us through questions we found challenging the most after exam...”</p> <p>“...these have been incredibly helpful...”</p>	<p>“...Not really; Not sure yet...”</p> <p>“...Not really because sometimes you don't know what material will be covered too general...”</p> <p>“...it has not improved...”</p> <p>“...homework on the next chapter that we haven't gone over yet and giving us a quiz on it (not helpful at all) ...”</p>
Faculty	<p>“...To a limited extent; I believe it did...”</p> <p>“...I suspect only the stronger students benefited...”</p> <p>“... the in-class quizzes seem to (at the very least) improve preparedness, improve attendance, and reduce lateness...”</p> <p>“...especially for reinforcement of ideas...”</p> <p>“...For the best performing students, high quiz grades led to high exam grades...”</p>	<p>“...I hope so, but I am not sure...”</p> <p>“...Unfortunately, only the serious students acknowledge this and take advantage of the resources that the instructor provided for them...”</p> <p>“... some performances on quizzes did not correlate to exam performance...”</p> <p>“...No, but the midterm exam grade is identical to the final exam grade. So, this method is a good prediction of a student's final performance...”</p>

Table 4: A typical example of how information from the formative quizzes and/or final review pools were used to guide reviews for the summative exams including the cumulative final.

Lect Qz or Final Review Pool Question	Analysis	Review Strategy (Emphasized relevant section of student course guides as indicated below) plus more general review
Which of the following pathways causes muscle soreness usually associated with strenuous exercise? Anabolism, electron transport chain Anaerobic resp.; Aerobic resp	40% of students chose correct answer, with 30% going for aerobic and the rest equally split between the other choices and no response (Lecture Qz attempt 1)	“...Draw and describe the pathways that a cell would utilize if there were no oxygen available...”
How many nucleotides would be required to synthesize a protein of 60 amino acids? 90; 180 ; 10; 20; 30	36% of students chose correct answer, with almost even split between the other choices (Final review pool)	“...Explain the relationship between: triplet, codon, anti-codon, amino acid...”
The uterus is a target organ of: oxytocin ; testosterone; FSH; LH	50% of students chose correct answer, with 31% picking FSH and the rest equally split between the other choices and no response (Lecture Qz attempt 1)	“...Name the target tissue for various hormones and describe the effect(s) of the given hormones...”
When a muscle develops increased tension, but does not shorten, it is said to exhibit? Isotonic-; isometric -; no- contraction; none of these	36% of students chose correct answer, with 27% choosing isotonic and the rest split between none of these and no response (Final review pool)	“...Isotonic vs Isometric contraction...”
Order the following in the correct sequence that nervous signal travels to and from the CNS: Effector (5); interneuron (3); receptor (1); sensory- (2) and motor- (4) neuron	About 60% of students got the correct sequence of events in order, with sensory and motor neurons sometimes misplaced (Lecture Qz attempt 1)	“...Describe reflex responses ... and... components of a reflex arc...”

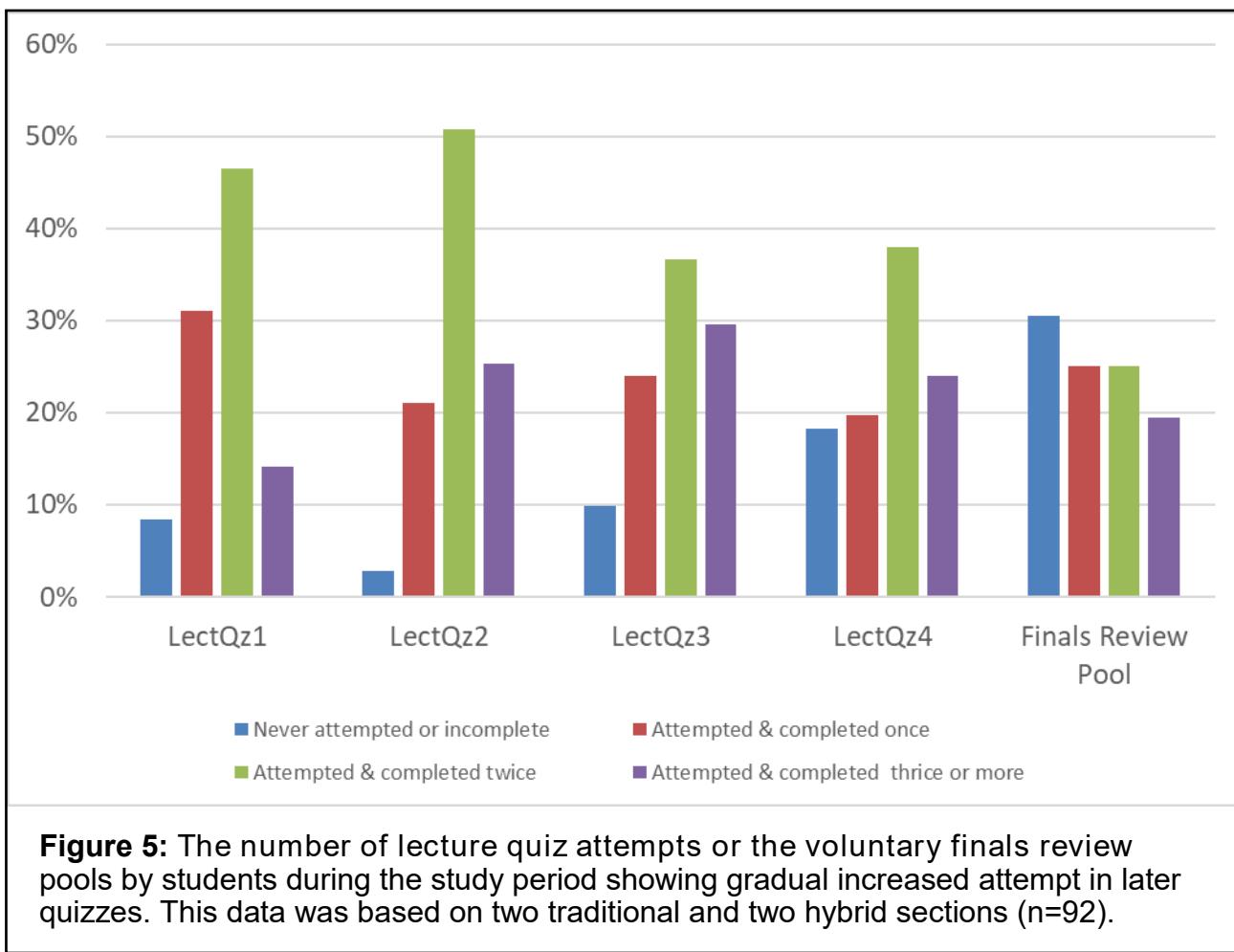
progressed. More students seem not to settle for just one attempt, but were more interested in doing the quizzes two or even three times and more in subsequent quizzes. Students attempting the tests three or more times doubled from a low 14% in lecture quiz 1 to a high 30% in quiz 3, with combined attempts of 2 and 3 approaching two thirds of the student population at about 62% by the time the students were doing lecture quiz 4.

Also, since the online lecture finals review pool had unlimited attempts and grades weren't part of the overall course grades, it was nice to see whether students took advantage of the given opportunities. A relatively large proportion of students never attempted the voluntary lecture review pool or tried it but never actually completed it (Figure 5). A quarter of the students completed one attempt, with another quarter attempting the quizzes twice. The rest of the class, representing a minor 19%, did three attempts or more. The traditional class had less students in the less desirable category that never attempted or completed the quizzes and had more students

with more positive attributes like completing the review pool three times or more (data not shown). The hybrid class on the other hand had close to 40% of the class in the least favorable category of not attempting or leaving incomplete work regarding the lecture final pool review. Moreover, only a small number of the distance learning students completed the review tests three times or more.

Students doing the lecture quizzes or final review pool multiple times were more likely to be C+ or better students

Overall, students that never attempted or completed the lecture quiz 1 were most likely to be F students or withdraw from the course, with a very small proportion of those students ending up in the D and C category and almost none in the A and B category (Figure 6A). Those that did attempt the first quiz only once, were more spread out in various grade categories, but their highest percentage was in the C category.



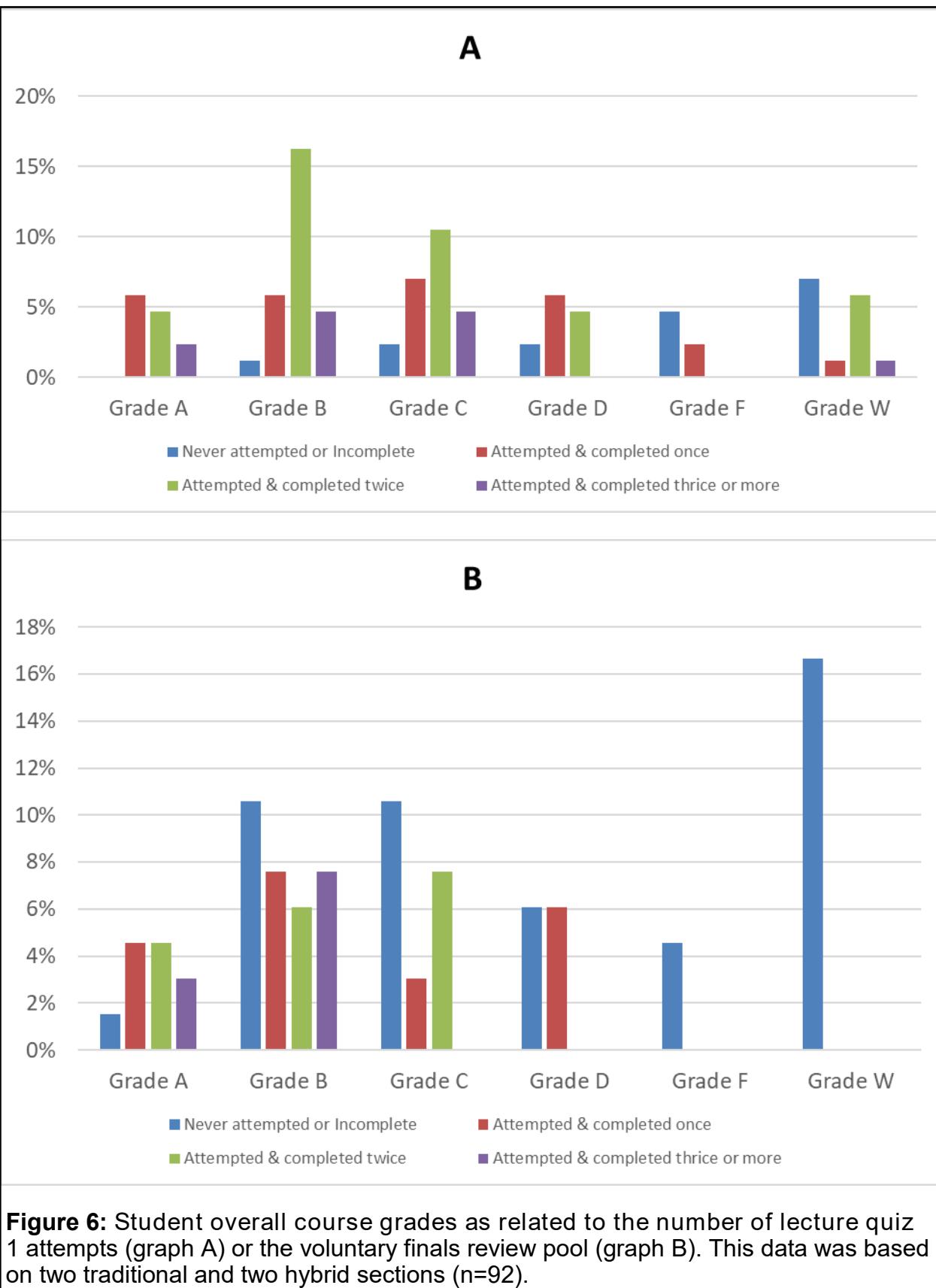
Students completing the tests twice were most likely to be B students, followed by the C category and then A and D categories in equal proportions. The most hardworking group, completing the lecture quizzes thrice or more, were almost always found in the A, B and C categories. The Cs scored by students completing the tests multiple times (twice or thrice and more) were generally more likely to be the C+ type, typically needed to pass the course, for progression into relevant majors in the allied health programs.

Next, we made a comparison between performances in overall grades and lecture final review pool attempts. Needless to say, that the hard-working students that attempted the reviews three or more times were likely to be either A or B students (Figure 6B). Students attempting the reviews twice were more likely to be A, B or C students. Those completing the final reviews once were more likely to be in the A, B, C and D categories, whereas those never attempting the reviews were found in all grade categories including F and W grades.

Discussion

The introduction of formative lecture quizzes and final review pools coupled with review sessions mainly based on it ahead of summative lecture exams seems to have slightly improved performances and participation, similar to previous studies^{4,6-10}. Given that the lecture quizzes tested the same concepts as the in-class exams and was scheduled at least a week or two before the summative exams, there was ample time for students to fix any deficiencies revealed through this formative assessment. It also served as an additional review resource that clarified any confusing misconceptions. Students that did this unlimited quiz attempts multiple times were more likely to fully utilize its benefits, with such students typically coming up with well-thought questions for the instructor during review sessions.

The study showed that those were the type of students that were more likely to end up with "A" and "B" grades. Faculty comments also showed that these formative quiz interventions were more



likely to help such stronger students that could take advantage of the given resources. Positive student comments that found the quizzes very helpful were probably more likely to be the better students in this category³. A good performance in the lecture quiz could boost confidence that students will do well in the exams too^{4,16,23}. Thus, generally a high performance in the lecture quizzes typically meant respectable performance in the corresponding lecture exams, with faculty comments noting such correlation better exemplified among stronger students. Since the quizzes helped boost exam scores, albeit slightly, and our data showed that such exams were strongly correlated with better performance in the final and overall course grades, it means this could be used as a potential predictor of student success²³.

That students found the usefulness of the formative lecture quizzes in helping with subsequent summative exams can be implied from the fact that they were more likely to do more attempts, a potential marker for success, later in the semester. In other words, at the beginning of the semester when we still didn't necessarily have student "buy in" to the concept, they were only doing the bare minimum, perhaps incentivized by the assigned course grades. But the true value of the useful formative feedback they were getting became more obvious to them as the semester progressed, such that by the later weeks of the semester, a relatively good number of them were able to do the formative quizzes multiple times. Further support for this view can be implied from students' commitment in doing the final review pools, when it was made to be completely voluntary ahead of the finals. However, assigning a small percentage of the course grade in the low stakes quizzes seems to have been more effective in motivating the students^{11,13,14} than the entirely formative lecture final review pools, that had lower participation even among relatively stronger students.

The instructor made efforts to use feedback obtained through the formative assessments to help tailor review sessions based on course material that most students found challenging¹⁹. It therefore became obvious to the students that even a bad performance in the formative quizzes could still be an important feedback and that there could be enough room for improvement ahead of the tests. This can be useful for student feedback during advisement earlier in the semester and it can, for instance, be used to track troubled students early on in the semester and ask them to remedy the situation sooner. This is especially so since linear regression analysis showed the relative predictive value of these formative quizzes and voluntary final review pools in the summative exams. That students doing the formative quizzes

multiple times were more likely to gain the required C+ or better for most allied health majors of interest to them should perhaps encourage more students to be actively engaged in the quizzes.

In summary, the study successfully showed the usefulness of formative assessments in helping with summative exams, including revealing important student characteristics such as the predictive nature of the number of student quiz attempt(s) and student outcomes¹⁵. Students that attempted the lecture quizzes multiple times were the most likely ones to have positive student outcomes like the desired C+ or better grades required for most allied health careers. This data, along with the linear regression analysis that showed the relative predictive ability of formative quizzes and the widely held faculty views supporting this shows the potential importance of the quizzes in guiding early advisement feedback to at risk students. There needs to be more studies to further pursue more student characteristics and the relationship between formative and summative assessments.

References

- ¹Besser, D., G. Stone and L. Nan, 1999. Textbooks and teaching: a lesson from students. *J Mass Commun Educ.* **53**: 4–18.
- ²Sikorski, J.F., K. Rick, B.K. Saville, W. Buskist, O. Drogan and S.F. Davis, 2002. Student use of introductory texts: comparative survey findings from two universities. *Teach Psychol.* **29**: 272–274.
- ³Rolfe, I. and J. McPherson, 1995. Formative assessment: how am I doing? *Lancet.* **345**: 837–839.
- ⁴Dobson, J.L., 2008. The use of formative online quizzes to enhance class preparation and scores on summative exams. *Adv. Physiol. Educ.* **32**: 297–302.
- ⁵Haberyan, K.A., 2003. Do weekly quizzes improve student performance on general biology exams? *Am. Biol. Teacher.* **65**: 110–114.
- ⁶Buchanan, T., 2000. The efficacy of a World-Wide Web mediated formative assessment. *J. Comput. Assist. Learn.* **16**: 193–200.
- ⁷Smith, G., 2007. How does student performance on formative assessments relate to learning assessed by exams? *J. College Sci. Teach.* **36**: 28–34.
- ⁸Olson, B.L. and J/L. McDonald, 2004. Influence of online formative assessment upon student learning in biomedical science courses. *J. Dent. Educ.* **68(6)**: 656–659.
- ⁹Orr R. and S. Foster, 2013. Increasing student success using online quizzing in introductory (majors) biology. *Life Sci. Educ.* **12**: 509–214.

- ¹⁰Zhang, N. and C.N.R. Henderson, 2015. Can formative quizzes predict or improve summative exam performance? *J. Chiropr. Educ.* **29(1)**: 16–21. doi: [10.7899/JCE-14-12](https://doi.org/10.7899/JCE-14-12)
- ¹¹Kibble, J., 2007. Use of unsupervised online quizzes as formative assessment in a medical physiology course: effects of incentives on student participation and performance. *Adv. Physiol. Educ.* **31**: 253–260.
- ¹²Kibble, J.D., T.R. Johnson, M.K. Khalil, L.D. Nelson, G.H. Riggs, J.L. Borrero and A.F. Payer, 2011. Insights gained from the analysis of performance and participation in online formative assessment. *Teach. Learn Med.* **23**: 125 – 129.
- ¹³Akkaraju, S., 2016. The role of flipped learning on managing cognitive load in a threshold concept in physiology. *J. Effective Teaching*. **16(3)**: 8–43.
- ¹⁴Gopalan, C., 2019. Effect of flipped teaching on student performance and perceptions in an Introductory Physiology course. *Adv. Physiol. Educ.* **43**: 28–33.
- ¹⁵Abdullahi, A.S., 2011. Student Exam Participation and Performances in a Web -Enhanced Traditional and Hybrid Allied Health Biology Course. *J. Online Learning and Teaching*. **7(4)**: 426-438. Available online at http://jolt.merlot.org/vol7no4/abdullahi_1211.pdf
- ¹⁶Gannon, M.N. and A.S. Abdullahi, 2013. Effect of Open Note Quizzes on Community College Science Students Grades and Attrition Rates. *JCT*. **2(2)**: 1-10.
- ¹⁷Abdullahi, A.S. and M.N. Gannon, 2012. Improving college students' success in gateway science courses: lessons learned from an anatomy and physiology workshop. *Am. J. of Health Sciences*. **3 (3)**: 159-168.
- ¹⁸Liachovitzky, C., 2015. Human Anatomy and Physiology Preparatory Course. *CUNY Academic Works*. https://academicworks.cuny.edu/bx_oers/1
- ¹⁹Abdullahi, A.S., 2019. Common final cumulative exam in anatomy and physiology: A decade of summative assessment reveals most challenging concepts and prompts various interventions. *HETS* online journal. **Volume X**: 8-40
- ²⁰Caon, M. and D. Treagust, 1993. Why do some nursing students find their science courses difficult? *J. Nurse Ed.* **32(6)**: 255 –259.
- ²¹Abdullahi, A.S. and M. Gannon, 2015. Assessment of Student Learning and Retention of Chemical and Cellular Concepts in Human Anatomy and Physiology. *In Vivo*. **36(3)**: 109-122.
- ²²Zakrzewski, S., 1998. The mass implementation and evaluation of computer-based assessments. *Assess Eval. Higher Educ.* **23**: 141–152.
- ²³Harris, D.E., L. Hannum and S. Gupta. 2004. Contributing factors to student success in Anatomy and Physiology: Lower outside workload and better preparation. *Am. Biol. Teacher*. **66 (3)**: 168-175.

Survivorship of Red Oak Seedlings at Alley Pond Park, Queens County, New York

Richard Stalter, Khadija Yousuff, Ali Mian, Liam Chapman,
Hayden DiMaio, Selin Ipe and Amanda Garcia

St. John's University, Jamaica, NY 11439

Abstract

The objective of this preliminary study was to document Red Oak (*Quercus rubra* L.) seedling survival at Alley Pond Park, New York, 2018-2019. The study was initiated at 3 sites in Alley Pond Park in 2018. Seedling stems were marked with white paint and survival was recorded in November, 2019. One year survival was high at all 3 sites ranging from 90% to 98%. The study will continue for 4 additional years. Light intensity may be the key to seedling survival as no surviving Red Oak saplings were observed at site 1, a low light intensity site burned 20 years ago.

Key words: Alley Pond Park, *Quercus rubra*, seedling survival.

Introduction

Though there is copious information on survival curves for animals, little has been published for plants. Generally, seed viability for many vascular plant species is high though seed production may also be low and variable. Stalter conducted a 3 year study of viable production by the American beech (*Fagus grandifolia* Ehrh.) from 1968 to 1970 over its natural range in the eastern United States¹. Beech nuts were collected from mid October to mid November from 26 stations within the range of *Fagus grandifolia* in the United States. Beech in many locations produced no viable seed over a 3 year period though there were exceptions. *Fagus* seeds at Morgantown, West Virginia, were 93% viable in 1969. Several sites exhibited little cyclic variation in viable beech seed production while others showed good year, poor year seed production.

Stalter has observed good year, poor year seed production in red, black and white oaks over a period of fifty years. In numerous botany and ecology laboratory field trips to Alley Pond and Cunningham Park he observed copious oak seedlings but few seedlings survived for more than 2 or 3 years. In a study at Sandy Hook, New Jersey, Stalter and McArthur monitored survival of Black Cherry (*Prunus serotina* L.) seedlings over the growing season². None of the Black Cherry seedlings survived. In the present preliminary study we examined the survival of Red Oak seedlings for one year, 2018 to 2019.

There are a number of factors that may be responsible for the "good year" "poor year" phenomenon of seed production. In American

Beech, *F. grandifolia*, several factors were cited as causing poor seed production. E.L. Core, L.N. Miller and T.R. Manley (personnel communication) cited frost as a factor reducing seed production for a given year. Poor pollination was another factor that may result in few seeds^{3,4}.

We collected 100 mature Red Oak acorns and examined them for soundness. Four aborted, 7 exhibited 40-70% rot, 1 exhibited 20% rot while 88 were sound. Red oak acorns are much larger than Pin Oak (*Quercus palustris* Muenchh.) acorns (Figure 1). Red Oak acorns take 2 years to mature and need a period of cold to germinate. Germination requirements can be duplicated in the laboratory by storing acorns in a cold moist environment, a procedure known as stratification.



Figure 1. Red Oak acorn, left, Pin Oak acorn on the right. Red Oak acorns take two years to mature.

Most acorns are viable thus yielding a prodigious number of seedlings. At St. John's University where Stalter teaches, the Great Lawn is often carpeted with Pin Oak (*Quercus palustris*) seedlings. The common grey squirrel, *Sciurus carolinensis* buries acorns that enhance seed survival. Squirrels caching acorns and acorns lying on the surface of the soil produced a bumper crop of *Quercus palustris* seedlings on St. John's University's Great Lawn during the 2018-growing season.

The present study was conducted in Alley Park (2.5 km²) located in Northern Queens County (40° 46'N., 73° 54' W.), north of Harbor Hill moraine, 3 km west of Queens County-Nassau County line. In October, 2018, 115 year old Red Oak seedling stems at Alley Park were marked with water based white paint (Figure 2). Survival of these seedlings will be monitored over a five year period terminating in 2023.

The vegetation at Alley Pond Park, in northern Queens, New York, where the present study was conducted, was probably similar to the vegetation observed by the original Dutch settlers in the 1600s⁵⁻⁷(Figure 3). Though most of Queens County, New York, has been developed, forest vegetation has been preserved in Queens County parks⁵⁻⁸.

Studies of the vegetation in New York City parks include those by Greller^{5,6}, Lefkowitz and Greller⁷ for Cunningham Park, Stalter for Alley Pond Park⁸. Stalter and Kincaid for Inwood Park, New York⁹. The WPA study produced a map of the trees at Alley and Inwood Parks, their location and DBH (diameter at 1.5 meters). Stalter⁸ incorporated the WPA study map of the trees at Alley Pond Park and compared the trees at Alley Pond Park sampled in 1975 with trees found at the same points on the WPA map prepared in 1936. The dominant arborescent vegetation at Alley Pond Park changed little from 1936 to 2018. *Quercus rubra* was dominant; Dogwood (*Cornus florida L.*) the principal sub-canopy tree in 1975 was virtually eliminated from Alley Pond Park, a victim of dogwood anthracnose.

Stalter has observed numerous Red Oak seedlings at Alley Pond Park during research forays and botany and ecology laboratory field trips over the last 48 years. Few of these seedlings have survived to maturity. Accordingly, the objective of the present study was to initiate a 5 year study of Red Oak seedling survival at Alley Pond Park, New York. The study was initiated in October, 2018 and survival of the seedlings was recorded in November, 2019 (Table 1). The study will continue for 4 more years, ending in 2023.

Study Site	Date of Study	
	2018	2019 (% of 2018)
#1	40	37 (93%)
#2	45	44 (98%)
#3	30	27 (90%)

Table 1. Preliminary data on the survival of *Quercus rubra* seedlings at 3 study sites, Alley Pond Park, New York, 2018-2019.



Figure 2. Red Oak seedlings marked with white paint.



Figure 3. The Oak Woodland, Alley Pond Park, New York, November, 2018. Red Oak center, large black oak on left.

Geology, Soils, Climate

Most of Alley Pond Park lies on the end of the Harbor Hill Moraine and exhibits a knob-and-kettle topography. The glacial till is 3 to 6 meters deep and is underlain with gravel and coarse sand⁸. The soil at Alley Pond Park is classified as Miami Stony Loam. Brown loam extends from the surface to a depth of 20-35cm, while yellow loam

forms the subsoil to a depth of 76cm. The soils are acid in reaction with a pH of 5.1-5.7⁸. The nearest weather station to Alley Pond Park is at Mineola, New York in Nassau County. January is the coldest month with a mean temperature of -0.56°C, while July is the warmest month with a mean of 23°C. Yearly rainfall totals 1146 mm. February is the driest month with an average of 75 mm. May is the wettest month averaging 108 mm. Snowfall averages 605 mm with most falling in February, 234 mm¹⁰.

Infrequent hurricanes cause serious damage to trees in the vicinity of Long Island¹¹. Freezing rain may occur on one or more occasions during the winter in south-eastern New York. One freezing rain in mid-December, 1974, crippled many trees in Alley Pond Park, especially dogwood, *Cornus florida*⁸.

Methods

The present preliminary study was conducted at Alley Pond Park (2.57 km²) located in Northern Queens County (40° 46' N, 73° 54' W), north of the Harbor Hill moraine, 3km west of the Queens County Nassau County line. The study was initiated in October 2018. Seedling stems at 3 sites were marked with white paint, 40 at Site 1, 45 at Site 2, and 30 at Site 3, survival of the marked seedlings was recorded in November 2019 (Table 1).

The point centered quarter method was used to sample trees 7.5 cm DBH (diameter at 1.5m height) within the Alley Pond Park woodland October 2018. This was part of a larger study dealing with change in arborescent composition of the Alley Pond Park woodland by Stalter and Rachlin¹². One hundred points were used to sample trees, closest to the center point in four quadrants sampled, 400 individual trees (Table 2). Size class (cm) of Red Oak identified in the aforementioned sample are presented in Table 3. Nomenclature follows Werier¹³.

Results and Discussion

Seedling survival of *Quercus rubra* seedlings after one year was high ranging from 90% at site 3 to 98% at site 2 (Table 1). Seedlings have a greater chance of survival when tree fall creates gaps in the canopy allowing light to reach the forest floor. None of the *Q. rubra* seedlings observed immediately after the fire of 2000 survived because there was insufficient light for effective photosynthesis.

Quercus rubra was the dominant and most important tree in the 2018 survey (Table 2). American Beech was the tree ranked second in importance followed by Sweet Gum (*Liquidambar styraciflua* L.) Sweet Birch (*Betula lenta* L.) and Black Oak (*Quercus velutina* Lam.). *Quercus velutina*, ranked second in relative dominance followed by *F. grandifolia*.

Species	2018			
	F	N	RD	IV
<i>Quercus rubra</i>	52	73	1	1
<i>Fagus grandifolia</i>	47	84	3	2
<i>Liquidambar styraciflua</i>	40	58	4	3
<i>Betula lenta</i>	46	59	5	4
<i>Quercus velutina</i>	23	24	2	5
<i>Carya glabra</i>	19	23	6	6
<i>Liriodendron tulipifera</i>	17	22	8	7
<i>Acer rubrum</i>	11	13	9	8
<i>Quercus alba</i>	5	7	7	9
<i>Acer platanoides</i>	7	7	18	10
<i>Prunus serotina</i>	9	9	11	11
<i>Prunus avium</i>	6	6	10	12
<i>Sassafras albidum</i>	3	3	12	13
<i>Nyssa sylvatica</i>	3	3	17	14
<i>Carya tomentosa</i>	2	2	13	15
<i>Cornus florida</i>	2	2	21	16
<i>Quercus palustris</i>	1	1	15	17
<i>Ulmus americana</i>	1	1	14	18
<i>Ailanthus altissima</i>	1	1	16	19
<i>Quercus coccinea</i>	1	1	19	20
<i>Morus alba</i>	1	1	20	21
<i>Carpinus caroliniana</i>	1	1	22	22

Table 2. Frequency (F), number of individuals (N), relative dominance (RD) rank (based on basal area), and importance value (IV) rank of trees in Alley Park, Queens, New York, in 2018.

Size Class (cm)	# of Individuals	% of Population
2.5-15.00	1	3.3
15.1-25.0	3	10.0
25.1-50.0	3	10.0
50.1- 100.0	20	66.7
<100	3	10.0

Table 3. Size classes of *Quercus rubra*, Alley

Conclusion

There has been high survival rate of Red Oak seedlings at 3 sites at Alley Pond Park, 2018-2019 (Table 1). That there was no survival of *Q. rubra* seedlings over a 20 year period at site one suggests that long range studies on seedling survival are necessary to understand the dynamics of tree replacement at Alley Pond Park and at similar oak dominated woodlands in the northeastern United States.

Most of the Red Oak encountered in the 400 tree sample, 30 individuals, were large mature trees (Table 3). Twenty trees had a dbh (Diameter at breast height) between 50.1 and 100.0 cm; 3 trees had a dbh greater than 100 cm (40 inches).

Red and Black Oak (*Quercus velutina*) are the dominant trees at Alley Pond Park (Table 2). *Cornus florida*, the most numerous and dominant understory tree in Stalter's 1975 study at the park has been nearly eliminated from the forested portions of the park a victim of Dogwood anthracnose. Norway maple (*Acer platanoides* L.) has invaded the park. It is the first tree to leaf out in spring and the last to lose its leaves in the fall. Few vascular plant species can survive under its' dense shade. However because of their longevity the oaks will continue to be dominant and important trees at Alley Pond Park for the duration of the 21st century.

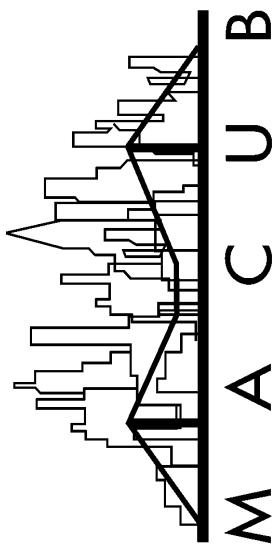
References

- ¹Stalter, R., 1982. Production of viable seed by the American Beech (*Fagus grandifolia*) Bulletin of the Torrey Botanical club **109**: 542-544.
- ²Stalter, R. and J. McArthur, 1998. Growth and survival of *Ilex opaca* Ait. at the Bayside Holly Forest, Sandy Hook New Jersey. Holly Society Journal **16**: 3-8.
- ³Rehder, A., 1921. Why is American Beech nut not developed? Amer. Nut. J. **21**: 73.
- ⁴Sain, R.E. and K.E. BLUM. 1981. Seedling production in the high- elevation beech (*Fagus grandifolia* Ehrh.) Forests of the Great Smoky Mountains National Park. Castanea **16**: 217-24.
- ⁵Greller, A.M., 1975. Persisting natural vegetation in Northern Queens County, New York. Environmental Conservation **2**: 61-69.
- ⁶Greller, A.M., 1972. Observations on the forests of Northern Queens County, Long Island, from colonial times to the present. Bulletin of the Torrey Botanical Club **99**: 202-209.
- ⁷Lefkowitz, A. and A. Greller, 1973. The distribution of tree species on the uplands of Cunningham Park, Queens County, New York. Bulletin of the Torrey Bot. Club **100**: 313-318.
- ⁸Stalter, R., 1981. A thirty-nine year history of the arborescent vegetation of Alley Pond Park, Queens County, New York. Bulletin of the Torrey Botanical Club. **108**: 485-487.
- ⁹Stalter, R. and D.T. Kincaid, 2008. A seventy year history of arborescent vegetation of Inwood Park, Manhattan, New York. USA. Arborescent and Urban Forestry **34**: 245-251.
- ¹⁰Garwood, A.N., 1996. Weather America. Toucan Valley Publications, Inc. Milpitas, CA.
- ¹¹Pack, A.B., 1972. Climate of New York. U.S. Dept. of Commerce, Natl. Oceanic and Atmos. Administration, Environ. Data Service, Silver Springs Md. 29pp.
- ¹²Stalter, R. and J. Rachlin, 2020. Eighty-three years of arborescent plant change at Alley Pond Park, Queens County, New York. Bulletin of the Torrey Botanical Club (in press).
- ¹³Werier, D., 2017. Catalogue of the vascular plants of New York. Memoirs of the Torrey Botanical Society **27**. The New York Botanical Garden. Bronx, New York.

**The Metropolitan Association of College and
University Biologists thanks the following
Affiliate Members for their support**

**AD Instruments
Anatomy in Clay Systems
BioPac Systems
Cengage Learning
Heyden McNeil Publishing
I. Miller Microscopes
John Wiley & Sons
McGraw Hill Publishing
Micro-Optics Precision Instruments
Pasco Scientific
Pearson Education
W. H. Freeman and Company**

Please make every effort to support these affiliate members.
Their participation help us keep registration fees at a reasonable price.



Dr. Edward J. Catapano
Department of Biology
Medgar Evers College
1638 Bedford Ave
Brooklyn, New York 11225