

INTRODUCTION

Regular retrieval of information from memory helps students learn and retain knowledge^{1,2}. Many pharmacy school curricula teach foundational material in the first professional (P1) year with the expectation that students will retain and apply this material in subsequent (second professional, P2; third professional, P3) years. However, separating foundational instruction from application, at times multiple semesters, can result in a perceived knowledge gap later in the curriculum as students have ‘forgotten’ material that they are required to regularly recall. This “forgotten material” represents marginal knowledge, knowledge that a student once knew but cannot readily recall at a given time³, which needs to be reactivated, either by classroom instruction or student-driven outside studies.

Utilizing multiple choice testing has been shown to help reactivate marginal knowledge³. Further, repeated testing, either as multiple choice or short answer⁴, has been demonstrated to promote acquisition and assist in retention of knowledge⁵.

OBJECTIVE

To assess vertical and horizontal retention of foundational microbiology material in a required third-year infectious disease integrated therapeutics course.

METHODS

Students in a third-year (P3) infectious disease pharmacy course were administered a nine-question pre-quiz for bonus points at the start of the course to permit students to self-assess their retention of foundational microbiology material from their first professional year (P1). Students were then provided with review material. The same assessment was administered two weeks later as a quiz that contributed to the course grade and again at the end of the course as a post-quiz for bonus points to allow students to self-assess retention of material. Results from nine similar questions on the first-year microbiology exam and the three third year quizzes were analyzed using paired t-tests and ANOVA. (Shenandoah University, IRB #532)

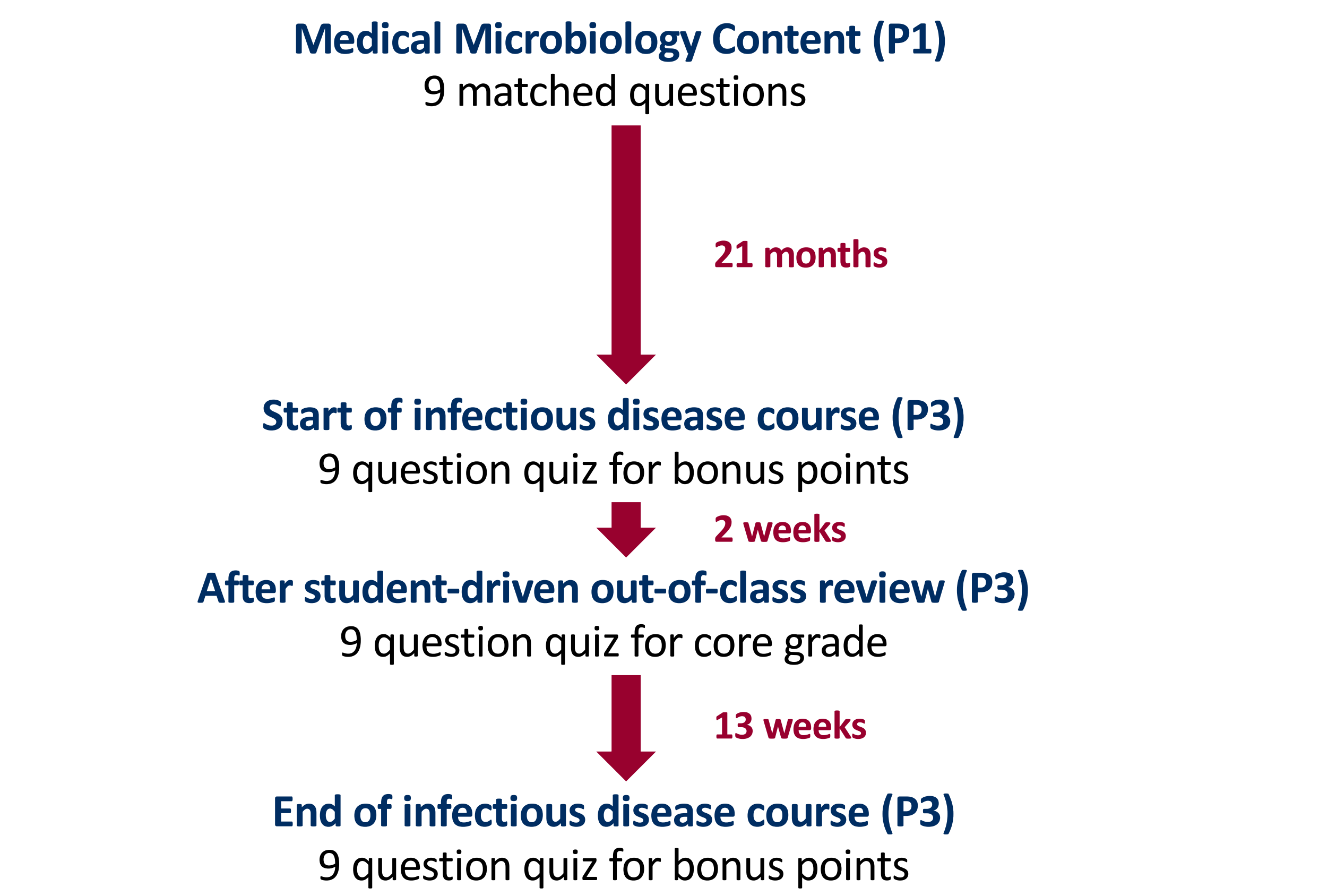


FIGURE 1. Flow chart of assessments and timing

RESULTS

	n	Range	Mean	Standard Deviation	95% Confidence Interval	Median	Average Absolute Deviation from Median
P3 - Start of course “bonus pre-quiz”	66	1.20-8.00	4.49	1.60	4.18-4.81	4.50	1.32
P3 - After review “graded quiz”	67	3.93-9.00	7.44	1.31	7.13-7.75	7.67	1.03
P3 - End of course “bonus post-quiz”	55	4.27-9.00	7.36	1.27	7.02-7.71	7.60	1.06
P1 - exam questions	75	3.00-9.00	7.60	0.94	7.30-7.89	8.00	0.51

TABLE 1. Descriptive statistics from four assessments on foundational medical microbiology knowledge. A one-way ANOVA was performed to compare student performance on these four assessments.

P3 - Start of course “bonus pre-quiz” = 9 question quiz on first day of class for bonus points
P3 - After review “graded quiz” = 9 question quiz contributing to course grade
P3 - End of course “bonus post-quiz” = 9 question quiz on last day of class for bonus points
P1 - exam questions = 9 similar questions from the exam these students took in their first professional year

There as a significant effect of effect of the timing of exposure to foundational medical microbiology material on student performance at the $p < 0.05$ level for the four conditions $[F(3,259) = 88.30, p < 0.0001]$.

Compared to		difference	95% Confidence Interval	t	df	Standard Error of Difference	P value
P3 “bonus pre-quiz”	P1 exam questions	-3.07	-3.45 – -2.67	15.78	65	0.19	$p < 0.0001$
	P3 “graded quiz”	-2.98	-3.43 – -2.53	13.26	65	0.23	$p < 0.0001$
	P3 “bonus post-quiz”	-2.82	-3.35 – -2.29	10.66	54	0.26	$p < 0.0001$
P3 “graded quiz”	P1 exam questions	-0.12	-0.53 – 0.28	0.61	66	0.20	0.54
	P3 “bonus post-quiz”	0.15	-0.39 – 0.69	0.56	54	0.27	0.58
P3 “bonus post-quiz”	P1 exam questions	-0.16	-0.59 – 0.27	0.77	54	0.21	0.45

TABLE 2. Post hoc analysis of assessment performance utilizing paired t-tests. In order to identify the differences identified by the one-way ANOVA, paired t-tests were performed between each of the results of the four assessments.

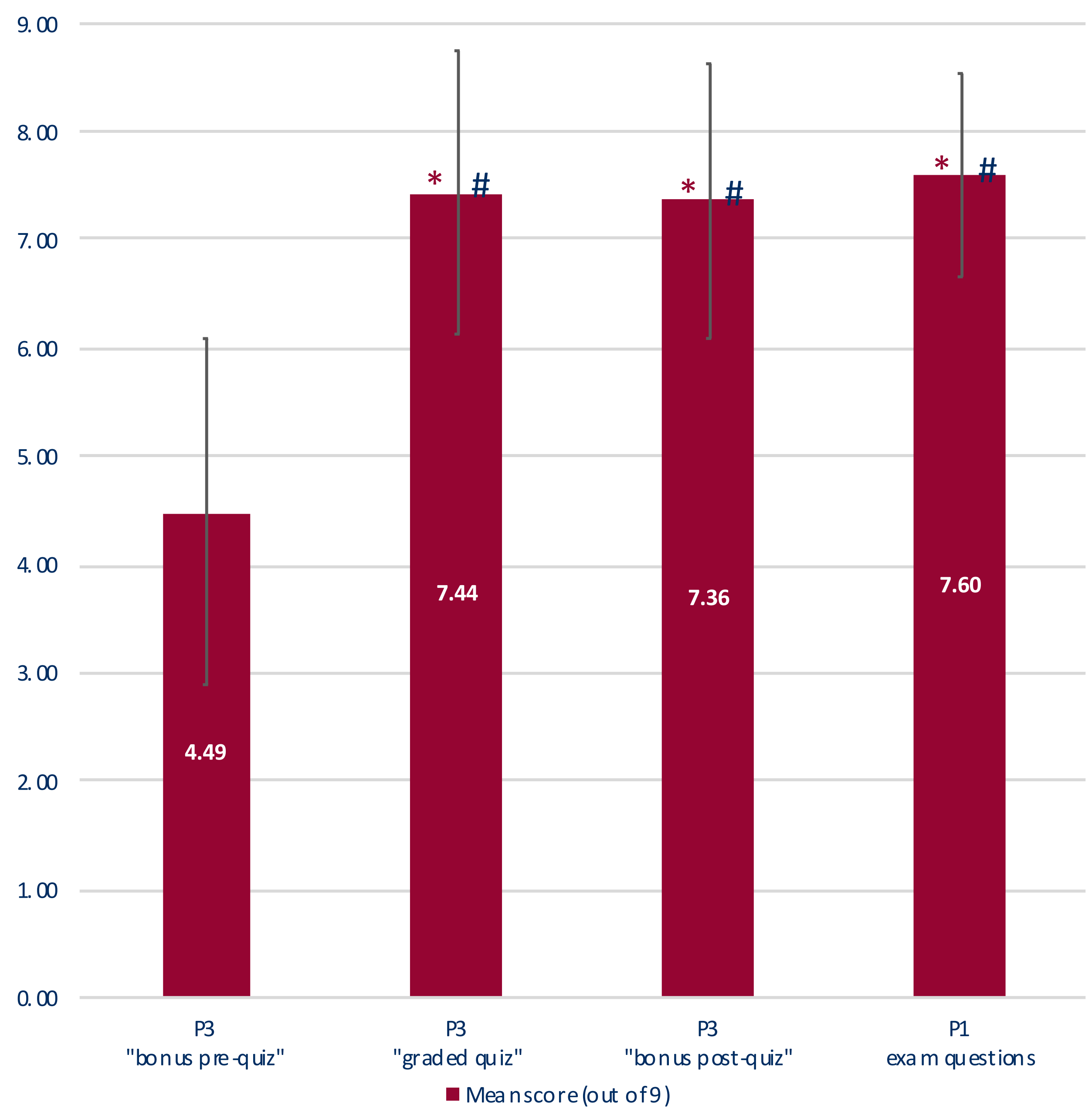


FIGURE 2. Mean scores and standard deviations for each of the assessments. * = significantly different from P3 pre-quiz. # = not significantly different from each other.

There was a significant difference between students’ performance on the pre-quiz at the start of the P3 infectious disease course compared to their performance on similar questions from the P1 year ($p < 0.0001$), after reviewing the material ($p < 0.0001$), and at the end of the course ($p < 0.0001$).

There was no significant difference between students’ performance after reviewing the material in the third year from either their performance in their P1 year ($p = 0.54$) or at the end of the course ($p = 0.58$). Similarly there was no significant difference between their knowledge at the end of the third year infectious disease course and on the medical microbiology exam from the P1 year ($p = 0.45$).

LIMITATIONS

- Fourteen students on an alternate academic plan are included in the first year data but not in the third year data.
- Four students on an alternate academic plan did not participate in the first year course, but did participate in the third year course.
- One student did not take the pre-quiz.
- Twelve students did not take the post-quiz.
- The same quiz questions were used on each P3 assessment; students may have “memorized” answers.

CONCLUSIONS

In depth foundations early in the curriculum coupled with focused, student driven content review at the time of application was an effective way to hold students accountable for foundational knowledge without using classroom time later in the curriculum to reteach the material.

- Students did not maintain foundational knowledge from their P1 year to the start of their P3 year.
- Students reactivated foundational knowledge from their P1 year with abridged review material over a two-week period of independent study.
- Students retained reactivated foundational knowledge through the end of the infectious disease course.
 - This is consistent with research⁶, demonstrating reactivation of foundational knowledge through repeat quizzing helps students retain knowledge.
- Reactivation and retention of foundational knowledge in the P3 year was to the same level of mastery as students demonstrated in their P1 year.

FUTURE DIRECTIONS

- Examine student performance on specific types of quiz questions (recall vs application on the different infectious disease course assessments).
- Examine student performance on infectious disease exam questions under two different curriculum structures (with and without extensive P1 year medical microbiology).
- Examine overall student performance in the infectious disease course to identify successful aspects⁷ of the reactivation strategy and aspects that need refinement.

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