

Full Length Research

Adoption of Continual Curricular Review Examinations to Increase Retention in the Health Sciences.

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Accepted 20th October, 2017

Performance in high attrition rate pre-requisite courses are known to be strong indicators of success and development of novel teaching strategies often focus on these courses, without addressing the continuance of knowledge within a curriculum. As Anatomy and Physiology (AandP) courses have some of the highest failure rates and are a requirement for most nursing programs, this study aimed to identify deficiencies in the transference of AandP knowledge through an examination and content review in Pathopharmacology courses. The results of the examination demonstrated a significant lack of AandP knowledge retention (average scores were 41.6% and 47.3%). Following the intervention, performance on HESI subject courses significantly improved ($p=0.0007$ and $p = 0.0084$). Review of pre-requisite material for courses with high attrition rates can have a significant impact on student success. This methodology addresses the transfer of knowledge between courses within a curriculum, and allows for student-managed learning. .

Keywords: Anatomy and Physiology, attrition rates, module development, review examination.

INTRODUCTION

Background

High proportion of students in gateway courses in the sciences receive non-passing grades or drop the course (DFW rate). Several factors, such as socioeconomic status, college preparedness, learning styles, and instructional styles have been investigated to understand the low level of student success in these courses. Data suggests that numerical and analytical skills, general mathematics skills, and reasoning skills are strong indicators for academic success in the biological sciences, with a significant correlation between the average pre-requisite science course grades and mean grade in advanced science courses in nursing programs (Newman, 1957).

While numerous studies have examined the inherent factors of students that lead to their success in gateway courses, it is necessary to apply this knowledge

in the execution of teaching strategies in order to directly improve student success. For pre-nursing studies, introductory AandP courses are common gateway courses with some of the highest rates of failure and withdrawal of all courses at the undergraduate level (Gilmore, 2008; Hooper, 2011). Successful completion of AandP classes is a strong indicator of success in nursing courses, as well as eventual completion of the nursing program (Jefferys, 2007; Schutte, 2016; Wang and Stiles, 2016). Due to this finding, significant research has focused on learning why attrition rates are so high and developing new teaching strategies to increase student success in these courses (Blanc, DeBuhr, and Martin, 1983; Harris, Hannu, and Gupta, 2004; Hull, Wilson, Hopp, Schaefer, and Jackson, 2016). However, the focus should not be aimed at increasing student

success in a single class, but increasing success in a program. Empirical evidence in the pre-nursing program at Purdue University North Central suggested that while students were passing AandP, retention of the course material and application to future nursing courses, such as Pathopharmacology, was lacking, leading to high DFW in nursing courses.

Research suggests that students benefit when courses are designed as a continuum, especially in the application of knowledge from prerequisite courses (Hailikari, Katajavuori, and Lindblom-Ylänne, 2008). In order to emphasize the importance of the transference of knowledge between courses in the nursing program, a review exam was constructed that tested the retention of material from AandP. This intervention was done in the Pathopharmacology I and II courses, as they are the first courses in the nursing curriculum following entrance into the program. Upon failure of the exam, students were encouraged to review the prerequisite material, re-exposing the students to the AandP concepts, before moving onto the current Pathopharmacology course material. This was designed to reinforce the transference and application of knowledge necessary to be successful in the course.

Construction of review learning modules in each particular subject area could be incorporated into this intervention. Following failure in a particular subject area on the review exam, students would be required to complete online review modules, followed by a subject specific quiz. However, students with a perception that instructional outcomes are a result of their own behavior have been shown to be more motivated to learn (Hailikari et al., 2008). Therefore, instead of a requirement, and to set a baseline for self-motivation in this intervention, students were encouraged to review deficient AandP material on their own accord. This allowed for self-managed learning, which can result in the development of their own effective learning strategies and increased student engagement (Newman, 1957).

METHODOLOGY

An intervention was designed to specifically address the deficiency in students' retention of pre-requisite material. To assess student deficiencies in particular subject areas, review exams were constructed from AandP exam questions that pertained to content specific to the Pathopharmacology I or Pathopharmacology II courses. Students enrolled in the courses were required to take the review exam in the first week of the semester. The exam was administered on Blackboard, an electronic learning system, and students were not notified of the exam prior the

intervention date. This was done to get an accurate representation of base-knowledge retention from the pre-requisite AandP course.

The students were then informed of their overall grade, as well as their performance in the content areas that showed particular deficiencies. Before each subject area in the Pathopharmacology course, students were encouraged to review the particular AandP content identified as a deficiency in the exam.

To assess whether the review exam and independent learning improved student success, performance on the Health and Environmental Sciences Institute (HESI) exam was collected. The HESI exams are designed to test student knowledge in specific content areas in the nursing curriculum and are administered following completion of a course to assess a student's readiness for the National Counsel Licensure Examination (NCLEX) examination. Several types of HESI exams exist, including national exams, and customizable exams based on the curriculum. The Pathopharmacology I HESI exam at XX was a customizable exam, while the Pathopharmacology II HESI exam was the national, standardized exam. Students' performance from this intervention was compared to previous cohorts that did not have the review material to assess the impact the intervention had on the retention of course knowledge. Significance was calculated using students t-test.

This work was approved by the Purdue University North Central Internal Research Board (IRB). Only the course instructor and research personnel had access to the students' information and were kept confidential.

RESULTS

Students enrolled in the Pathopharmacology courses (I and II) were required to take the review exam without prior notification. The average of the exams were 41.6% and 47.3% respectively (Figure 1). These results show retention of AandP material from previous semesters be to very poor. The lecturer observed that students were discouraged after the exam results were reported. Additionally, the lecturer reported increased student organization of study groups and request for review material. Throughout the semester, this organization and motivation persisted.

Following completion of the Pathopharmacology I or II course, students were required to take a Custom HESI for Pathopharmacology I or a National HESI Pathopharmacology exam in Pathopharmacology II. The average converted scores were collected for each cohort. These results were compared to previous semesters in which students did not take the review

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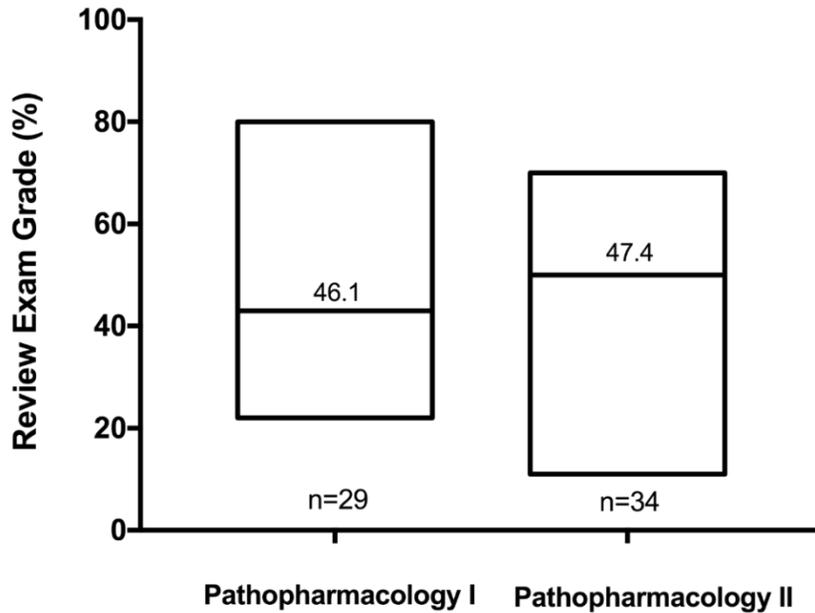


Figure 1: Results of Anatomy and Physiology Review Exam by Pathopharmacology Students. Average and range of percentage correct on review exams for Pathopharmacology I and Pathopharmacology II courses. The n values indicate the number of students for each cohort. Significance was calculated using student t-test

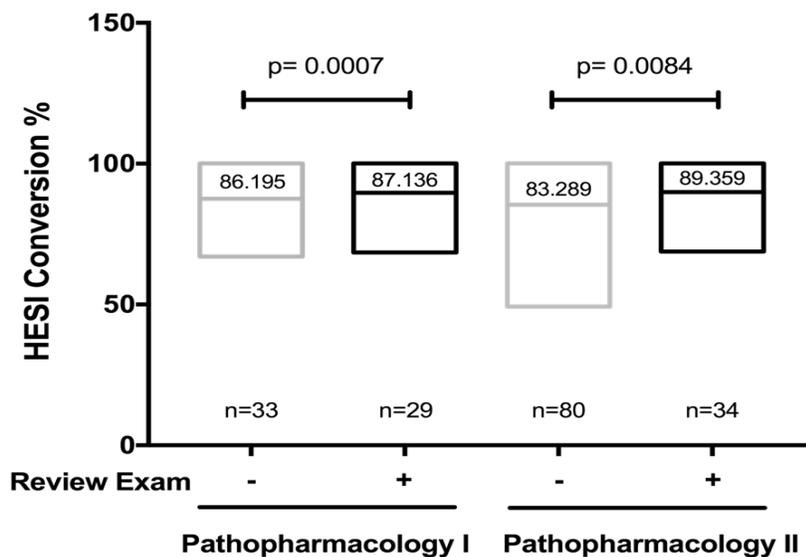


Figure 2: Influence of Review Exam on Student HESI Exam Performance. Percentage conversion score, or the weighted score based on difficulty of the exam, on the HESI Pathopharmacology I and II exams, for students who took the review exam (black bars), and those did not have access to the review exam (grey bars). The n values indicate the number of students for each cohort. Significance was calculated using student t-test.

exam. The results show a significant improvement (1.10% and 7.28%), in the HESI exam scores for those students that had the review exam in both

Pathopharmacology I and Pathopharmacology II compared to students who did not have the review exam (Figure 2). These results suggest that identification of

pre-requisite deficiencies lead to increased review of material, and ultimately better performance in the nursing course and retention of information.

DISCUSSION

Observation of student activity and response to the review exam empirically demonstrated that negative feedback lead to increased student preparation and studying. The majority of students expressed concern following the results of the review exam, which prompted the organization of student-lead study groups for course and pre-requisite content. This is similar to previous reports of alterations in learners' behavior following negative feedback (Kluger and DeNisis, 1998; Hattie and Timerpley, 2007).

The empirical and quantitative results suggest that an increase in student performance on evaluative exams may be attributed to two variables; a change in student study habits, or alterations in the delivery of course content by the instructor. Identification of deficiencies is thought to have increased student engagement and student-driven control over review material. Students have been known to develop their own effective learning strategies given an increase in student-control (Hattie and Timerpley, 2007; Newman, 1957). Changes in learning strategies can lead to increased motivation and engagement, ultimately affecting the final grade and retention of material. Alternatively, this intervention allows the instructor to focus on course content and not review pre-requisite material, increasing student exposure to valuable course concepts, deepening understanding and retention of material.

The results of the review exam provides evidence that there is a significant lack of retention of material from pre-requisite courses. Instructors may be proceeding with a false assumption that students have the pre-requisite knowledge to apply to the course content. This causes students to be behind in material in the course, which leads to more anxiety and less motivation, leading to a decrease in performance on evaluative exams, such as the HESI, as well as future courses. Research has seen a high positive correlation between the average pre-requisite science course and the mean Pathopharmacology grade (Potolski, Cohen, and Coleen, 2003). Therefore, some strong students may not have been influenced by the review exam due to a positive grade and better retention of AandP material.

One limitation to this learning technique is student engagement and motivation. The review module technique gives the students the opportunity to assess their deficiencies and address them, but only if they are

active participants. Students with higher levels of self-efficacy demonstrate higher levels of academic performance and are more likely to participate in activities to improve their grade (Potolski et al., 2003). Interactive instructional systems make it possible to provide students with control over the depth of study, range of content covered, and time spent on learning. This student-control has been shown to directly influence both motivation and achievement due to a sense of responsibility of their experience (Harter and Connell 1984). The rationale of the proposed intervention method is to give students instructional control, adding to the student's sense of competence and self-efficacy, and ultimately increasing their motivation in course and in reviewing pre-requisite material. Previous studies have shown that students given control over the time and depth of study on coursework lead to greater perceptions of self-responsibility and completed a significantly higher proportion of the assignments (Hailikari et al., 2008). Based on the results of this study, students were significantly impacted by the results of the review exam, which lead to student-control and managed review of pre-requisite material.

Future studies will address the role of instructor-controlled modules, through a required module-based learning on the Blackboard course website, in order to assess student-motivation. This strategy will shift some of the student-control to a more instructor-controlled environment. Following failure of a particular subject area on the review exam, students would be required to complete a series of review modules constructed by the instructor. Before continuing on, students would be required to pass a quiz, which contains questions previously missed on the review exam and whose subject matter was addressed in the review module. This type of instructor--control could increase student performance, as it allows students to have some student-control in the time and method of studying but also supplies a guide for particular subject matter and resources that need to be reviewed. While this takes away from total student-control of their education, it is expected that the self-guided module system will retain the increased motivation outcomes seen in this study.

The implications of these findings suggest that review-module teaching methods will have a significant impact on student performance. This intervention method requires little additional preparation by the instructor throughout the semester, with significant returns in terms of increased student study habits and exam scores. The review-module teaching method allows students to evaluate their own learning and take an active role in diagnosing their learning needs. Students are given the opportunity to assess their retention of necessary course material from a pre-requisite course, identify any deficiencies, and review

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the material before continuing. This is expected to increase student performance in not only Pathopharmacology, but could be applied for nearly any type of advanced course. This a student-tailored learning technique that enables students to become independent learners and take responsibility for their own learning.

ACKNOWLEDGEMENTS

This project was funded by an instructional improvement grant from the Office of Academic Affairs at Purdue University-Northwest. The authors would like to acknowledge Karen Klosinski for her assistance in this project.

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