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Research

Comparison of an interactive e-learning preparatory tool and a conventional downloadable handout used within a flipped neurologic pharmacotherapy lecture

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Abstract

Background: In recent years, a growing number of educators have explored the use of instructional technology to improve student outcomes. However, the efficacy of highly interactive class preparatory tools has been poorly evaluated for neurologic pharmacotherapy courses.

Purpose: The purpose of this study was to examine student performance, engagement, and perception of an interactive online preparatory tool used in a flipped neurologic pharmacotherapy course and compare outcomes between the tool and the conventional downloadable paper handout.

Basic procedures: Participants were randomized to the online tool ($n = 57$) or the conventional handout ($n = 59$) for class preparation. Dedicated class time was identical for both groups. Scores for a readiness assurance assignment, in-class quiz, and final exam were collected and metrics of engagement were tracked online.

Main findings: Students using the online tool scored significantly higher on the final exam ($P = 0.04$). The number of distinct days used to access the online tool exhibited moderate positive relationships with the quiz ($r_p = 0.35$) and exam ($r_p = 0.38$). The time of first access exhibited a strong positive relationship with exam performance ($r_p = 0.48$).

Conclusions: The results from this study suggest that engagement with a highly interactive online preparatory tool is positively related to student learning in neurologic pharmacotherapy.

Keywords: Flipped classroom; Neurology; Pharmacotherapy; Seizure; e-Learning

Introduction

In recent years, a growing number of educators have explored the use of instructional technology to improve student outcomes. Ongoing advancements in instructional technology have fostered "blended" learning environments, that combine the use of online learning with traditional classroom-based learning.[1] The flipped classroom is one type of blended learning approach in which foundational content is offloaded for students to learn on their own prior to class, allowing the instructor to engage students in active learning exercises during class time.[2] This approach shifts the emphasis from teaching and teacher-centeredness to learning and student-centeredness, promoting self-regulated learning and intrinsic motivation along with efficient transfer of knowledge.[2–5] Although instructors identify relevant

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concepts and organize offloaded content, students ultimately control the learning environment by proceeding through content at their own pace, guiding themselves to additional resources, and assessing their own learning gains. Furthermore, students have the opportunity to fully prepare for class time that is focused on higher-order thinking,[6] problem solving, and critical analysis rather than transmission of content.[2]

The efficacy of the flipped classroom has been reported by researchers in various disciplines using a wide range of approaches to offloading content, including animated e-books,[7] captured video,[4,8] podcasting,[9,10] and computer-based cases with interactive elements.[11] In pharmacy, for example, McLaughlin et al.[4] reported improved exam performance and increased engagement in a flipped pharmaceutics course using captured video, while Pierce and Fox[8] found enhanced performance and perceptions in a flipped renal pharmacotherapy module. Improved student outcomes associated with blended learning have also been widely reported in dentistry,[12] nursing,[13] and medicine.[14] As evidenced by the literature, a broad variety of modalities, tools, and strategies can be employed, and with the assistance of learning management systems and other online platforms, students can access a variety of course materials and resources electronically well in advance of scheduled class time. Research suggests that, in addition to enhancing student learning and problem solving skills,[12,15,16] blended learning and the flipped classroom can also promote student commitment and motivation to learn.[4,17,18]

Improved student outcomes associated with offloaded content within the context of the flipped classroom can be explained in part by "connectivism," a digital-age learning theory that emphasizes the process of connecting information sources, maintaining continual and current knowledge acquisition and developing decision-making skills that enable learners to understand new information in the lens of shifting realities.[19] Connectivism advocates learner autonomy by recognizing the need to support learners as they become personal knowledge managers amid exponentially growing amounts of accessible information.[19] By offloading content for students to learn at their own pace and engaging students in active learning that integrates and applies that content, students develop the ability to identify connections between different sources and recognize meaningful patterns. Furthermore, using digital technology to engage students in learning prior to class enables them to quickly and efficiently navigate various information sources and further identify new sources among distributed sets of information.

While a growing body of literature in various disciplines supports the use of offloaded content to improve student outcomes,[4,20,21] the efficacy of offloaded preparatory tools has been poorly evaluated for neurologic pharmacotherapy courses. Neurologic pharmacotherapy is often difficult for the learner because the overall paucity of data and treatment guidelines require learners to utilize higher-order thinking skills[6] to solve complex cases and problems amid rapidly changing information and drug treatments. This type of content lends itself to connectivism because it relies on one's ability to acquire and interpret new information among rapidly changing realities.

Given the complex evolution of neurology knowledge and the ability of re-engineered pre-class content to prepare students for active learning in the classroom, the authors hypothesize that using highly interactive offloaded content will significantly improve outcomes for pharmacy students in a neurologic pharmacotherapy course. The purposes of this study were to (1) compare the impact of two different types of offloaded preparatory course content delivery within a flipped neurologic pharmacotherapy classroom: a traditional downloadable paper handout and an enhanced online e-learning tool and (2) examine patterns of student engagement with offloaded preparatory content. This study will serve as a pilot for informing future course redesign.

Methods

Course description

The University of North Carolina (UNC) Eshelman School of Pharmacy professional program is a four-year program requiring six semesters of coursework in the classroom and ten months of experiential practice. The school consists of approximately 620 Doctor of Pharmacy students housed on three campuses. Pharmacotherapy 5 Neurology/Psychiatry is a two-credit hour course required for Doctor of Pharmacy students during the spring semester of their second year in the curriculum. This five-week course, totaling 28 hours of contact time, integrates the pathophysiology of 17 different psychiatric and neurological diseases and applied therapeutics, emphasizing pharmacology, pharmacokinetic properties, and adverse effects of medications along with considerations of optimal agent selection.

The data for this study were collected from the seizure portion of the Pharmacotherapy 5 course. At the time of this study, the seizure portion of the course was the only topic that used the flipped format. However, the students enrolled in this course previously completed at least one semester-long flipped course at the School. In the spring semester of the first year, pre-class preparatory work for Basic Pharmaceutics II consisted primarily of video lectures and required readings.[4]

The instructor for the seizure module was new to the school, having previously taught the same material for 16 years at Wayne State University Eugene Applebaum College of Pharmacy & Health Sciences. As illustrated in Figure 1, three hours of class time were dedicated to the seizure material. All foundational content was offloaded for students to access prior to class so that class time could be dedicated to active learning exercises. For the first 15 minutes of class, students completed a graded quiz