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## Impact of a Modified Jigsaw Method for Learning an Unfamiliar, Complex Topic

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### Abstract

**Objective:** The aim of this study was to use the jigsaw method with an unfamiliar, complex topic and to evaluate the effectiveness of the jigsaw teaching method on student learning of assigned material (“jigsaw expert”) versus non-assigned material (“jigsaw learner”).

**Innovation:** The innovation was implemented in an advanced cardiology elective. Forty students were assigned a pre-reading and one of four valvular heart disorders, a topic not previously taught in the curriculum. A pre-test and post-test evaluated overall student learning. Student performance on pre/post tests as the “jigsaw expert” and “jigsaw learner” was also compared.

**Critical Analysis:** Overall, the post-test mean score of 85.75% was significantly higher than that of the pre-test score of 56.75% ( $p < 0.05$ ). There was significant improvement in scores regardless of whether the material was assigned (“jigsaw experts” pre=58.8% and post=82.5%;  $p < 0.05$ ) or not assigned (“jigsaw learners” pre= 56.25% and post= 86.56%,  $p < 0.05$ ) for pre-study.

**Next Steps:** The use of the jigsaw method to teach unfamiliar, complex content helps students to become both teachers and active listeners, which are essential to the skills and professionalism of a health care provider. Further studies are needed to evaluate use of the jigsaw method to teach unfamiliar, complex content on long-term retention and to further examine the effects of expert vs. non-expert roles.

**Keywords:** Jigsaw, cardiology elective, active learning, complex disease state

**Conflict of Interest:** We declare no conflicts of interest or financial interests that the authors or members of their immediate families have in any product or service discussed in the manuscript, including grants (pending or received), employment, gifts, stock holdings or options, honoraria, consultancies, expert testimony, patents and royalties.

### Description of the Problem

Due to the size of pharmacy classes, lectures serve as the most efficient method to deliver information throughout the doctor of pharmacy curriculum.<sup>1</sup> As a result, incorporation of active learning is often restricted. However, active learning strategies promote face-to-face interaction, individual accountability, social skills, and group processing. Strategies also aid in development of higher-level thinking and long-term retention. The 2016 Standards from the Accreditation Council of Pharmacy Education promote active engagement of learners, self-directed learning, and collaborative learning.<sup>2</sup> The jigsaw method may aid in accomplishing all of this.<sup>3</sup>

### Statement of the Innovation

Previous studies have used the jigsaw method to enhance drug information skills or expand/build on concepts previously taught in the curriculum.<sup>4-6</sup> In using the jigsaw method to teach valvular disorders, the students’ ability to move from a

dependent to independent learner is exercised. However, their ability to integrate and apply concepts from self-taught material for an unfamiliar disease state can also be explored. Evaluating the impact of this approach may encourage pharmacy faculty looking to expand active learning methods, especially in core or required courses where they may have not felt comfortable assigning new, unfamiliar topics for self-learning. Furthermore, this initiative examined the effectiveness of the jigsaw teaching based on the students’ assigned role as “jigsaw expert” (i.e. responsible for studying the assigned material) or “jigsaw learner” (i.e. responsible for learning from the ‘jigsaw expert’).

### Description of the Innovation

Advanced Cardiology is a two-credit hour elective offered to pharmacy students in the third professional year at Midwestern University Chicago College of Pharmacy. Enrollment requires students to have successfully passed a required Pharmacotherapeutics course focused on cardiovascular disease state management in their second professional year. New topics are introduced, and students are expected to have a baseline understanding of cardiovascular topics. Course enrollment is capped at 40 to allow for a variety of active learning strategies to be employed throughout the course.

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Valvular heart disease is a topic that is not routinely incorporated into required pharmacy curricula. In past years at the Chicago College of Pharmacy, valvular heart disease was taught through a traditional didactic lecture format in the Advanced Cardiology elective course. During the lecture, the following four valvular disorders are covered in-depth: aortic stenosis, aortic regurgitation, mitral stenosis, and mitral regurgitation. The causes, prognosis, symptoms, monitoring, and treatment of each disorder are discussed for each of the disorders. In the fall quarter of 2015, the jigsaw method was utilized to teach these concepts.

The jigsaw method was chosen because it would require students to self-learn hemodynamics, physiology, diagnostic testing, physical assessment, and medication management for a complex disease state not previously discussed in the core curriculum. To briefly summarize the basic concepts of the jigsaw method, learning material is divided into segments.<sup>3</sup> Students are assigned one segment to learn as the “expert” and given adequate time to become familiar with their assignment. During class, students form “expert” groups with other students who were assigned the same material. The expert group discusses and teaches each other the main points of their assigned material before assembling into jigsaw groups. In the jigsaw groups, each student represents a different segment and teaches their fellow group members. Students are encouraged to ask questions for clarifications. Facilitators are strongly encouraged to observe the groups and assist only when necessary. Figure 1 illustrates the formation of expert and jigsaw groups used in this study. Following use of the jigsaw, a test was administered to assess student learning.

In order to maximize the two hour classroom time, a mandatory reading and each student’s assigned valvular disorder was posted to the course Blackboard site (Blackboard, Inc., Washington, DC) two weeks prior to class. The reading assignment was an in-depth primer to clinical pharmacists about valvular heart disease.<sup>7</sup> This was provided to the students, because many pharmacotherapy-themed textbooks do not have chapters devoted to valvular heart disease. The primer began with an overview of hemodynamics and diagnostic methods and findings that are typical of the various valvular disorders. The primer also described each of the four valvular disorders discussed previously and provided detail on: etiology, symptoms, prognosis, monitoring, and treatment. Students were instructed to review and understand the latter concepts related to their assigned valvular disorder prior to class. The primer concluded with a review of the various replacement valves, antithrombotic therapy recommendations, and infective endocarditis prophylaxis.

Students were randomly assigned one of the four valvular disorders (e.g., aortic stenosis, aortic regurgitation, etc.) for which they were the “jigsaw expert.” On the day of

instruction, a ten-question pre-test was conducted during the first 10 minutes of class. All the questions were knowledge-based and focused on the causes, prognosis, symptoms, monitoring, and treatment of each disorder. This was followed by a 10-minute introduction to valvular heart disease and review of valve location, pathophysiology, and diagnostics, taught by one of the investigators. This step is a modification from the jigsaw method, and was done to orient students to the disease state. They did not know the orientation would occur. Most of the information presented had been taught previously in other courses and/or students may have had exposure to the points in the primer. Students were then instructed to form their “expert” groups with four other students. The expert groups were given 20 minutes to collaborate on defining their disorder in a simple manner, and each group reviewed causes, prognosis, symptoms, monitoring and treatment of their respective disorder. Two facilitators were on hand to answer questions and keep students on track in terms of time.

The students were then rearranged into their jigsaw groups, which were also randomly assigned. Every jigsaw group was composed of four students, each representing one of the four valvular disorders. Over the course of 40 minutes, each “expert” taught their assigned valvular disorder to the other three students in their group (“jigsaw learner”). All students were provided with a one page, hardcopy handout, which was organized by valvular disorder. This guide allowed them to handwrite information taught to them by each expert in their group (Figure 2). Remaining class time was spent discussing anticoagulation strategies for the various valve replacements and criteria for infective endocarditis prophylaxis, followed by a ten-question test near the end of class. Questions were the same in both versions, however the order of questions and answers were scrambled to minimize recall of answers or memorization. Eight questions covered the valvular disorders that were discussed in the jigsaw groups, and were related to etiology, symptoms, monitoring, and treatment. The remaining two questions were related to anticoagulation in the setting of replacement valves, which was taught by the instructor and were not included in the data.

In order to examine student learning, the difference between pre- and post-test mean scores were evaluated to assess immediate concept retention. Pre/post test scores were further analyzed by comparing the performance on items based on “jigsaw expert” and “jigsaw learner.” Data analysis was performed using IBM® SPSS® Statistics Version 22.0 (IBM Corporation, Armonk, NY). Data were analyzed using the paired student t-test for continuous variables. This study was approved by the Midwestern University Institutional Review Board.

## Critical Analysis

### Key Findings

The pre/post test was completed by all 40 students enrolled in the course (100% response rate). Overall, the post-test mean score of 85.75% was significantly higher than that of the pre-test score of 56.75% ( $p < 0.05$ ). On the pre-test, students scored 2.55 percentage points higher on questions related to their pre-assigned valvular disorder, than they did on the remainder of the test. Test scores improved regardless if the material was assigned ("jigsaw experts" pre=58.8% and post=82.5%;  $p < 0.05$ ) or un-assigned ("jigsaw learners" pre= 56.25% and post= 86.56%,  $p < 0.05$ ).

### Reflection

Utilizing the jigsaw method to teach complex topics should be planned carefully. Instructors should ensure that relevant and appropriate-level pre-reading material and learning objectives are assigned. This eliminates a layer of difficulty for the students to identify resources on their own for an unfamiliar topic. Pre-assigning expert groups also allows for the students to take ownership of their material and not become overwhelmed with the entirety of learning a new complex disease state. As seen by the scores, regardless of whether a student was assigned material or learned material during the jigsaw exercise, their understanding of the material improved. Self-teaching is a complicated endeavor and can be daunting to a student, but the jigsaw method allowed the student the chance to review their own learning of assigned material with their expert groups first to better master the material and build their confidence prior to teaching their peers. This should also give the instructor confidence in employing use of the jigsaw method to learn unfamiliar, complex content since test scores improved regardless of role played (i.e. "jigsaw expert" versus the "jigsaw learner").

The jigsaw method also makes students accountable for their own material and to their peers. Students were aware that the post-test grade would be used as assessment points for the lecture week and make up approximately 5% of their course grade. If students had not been informed of this, some may not have prepared adequately and/or provided insufficient information to their peers.

The jigsaw method helps students to become both teachers and active listeners, which are both essential to the skills and professionalism of a health care provider. These points on accountability, communication, and professionalism are particularly important since they can be aligned with the CAPE outcomes regarding approach to practice and care (Domain 3) and personal and professional development (Domain 4) and statements from the ACPE Standards as previously discussed.<sup>2,8</sup> The jigsaw method also provides an excellent opportunity for students to interact with peers that they normally would not encounter and may assist in maintaining attention.<sup>9</sup>

## Next Steps

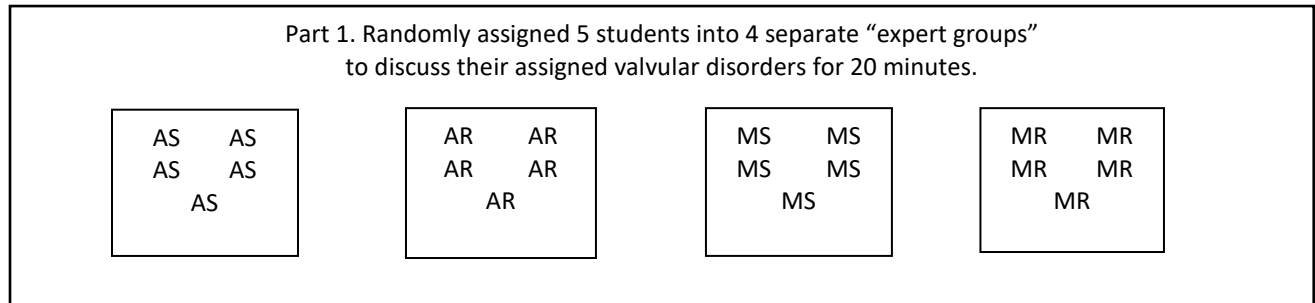
Based on the positive results of the initial implementation, the instructors used the jigsaw method to teach valvular disorders the following year. As a result of feedback from students in the prior year indicating that they felt rushed, emphasis was placed on the importance of time, when students were working in their expert and jigsaw groups. Although this was not implemented yet in our use of the jigsaw due to time constraints, faculty facilitators should consider a final wrap-up session of key points. This is not a required step in the jigsaw method, but it allows the instructor to clarify student questions and summarize key concepts.

Further investigation is necessary to evaluate the efficacy of using the jigsaw method to teach unfamiliar content. Evaluating performance on questions related to "jigsaw expert" versus "jigsaw learner" content is needed for long-term retention to provide further evidence that the learning experience is effective. Use of the jigsaw method should also be explored in courses with a larger class size as it may be challenging to extrapolate our findings to courses that enroll a large number of students from a functionality standpoint.

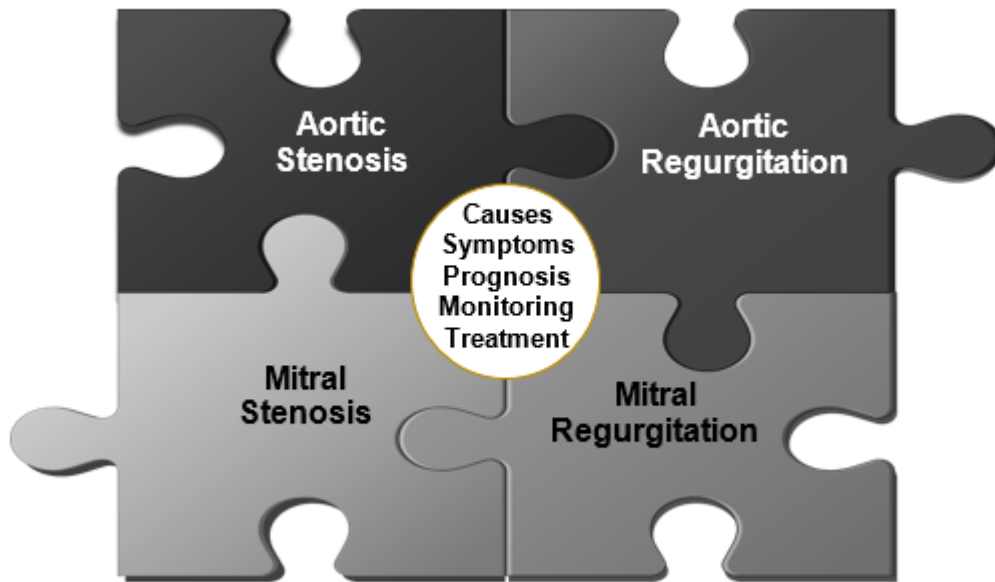
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**Figure 1: Formation of Expert Groups and Jigsaw Learner Groups to Teach Concepts of Valvular Heart Disease**



Part 2. Re-arranged students into jigsaw groups where each "expert" learner was expected to teach peers in their group their assigned valvular disorder over the course of 40 minutes.



AS= aortic stenosis; AR= aortic regurgitation; MS= mitral stenosis; MR= mitral regurgitation

Figure 2: Jigsaw Worksheet Used in Class to Facilitate Peer-Teaching

## VALVULAR HEART DISORDERS- WORKSHEET

	AORTIC STENOSIS	AORTIC REGURGITATION	MITRAL STENOSIS	MITRAL REGURGITATION
<b>SIMPLE DEFINITION</b> (How you would explain to a patient or someone not in health care.)				
<b>COMMON CAUSES</b>				
<b>PROGNOSIS</b> (Is there a difference between mild-moderate vs. severe classes?)				
<b>SYMPTOMS</b>				
<b>TREATMENT</b> (May be either medications and/or surgery)				
<b>MONITORING</b> (What type of test? How often should it be done?)				