Board 21: Work In Progress: Jigsaws as an Effective Approach for Developing Analytical and Collaboration Skills in Healthcare Systems and Process Design Courses

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Why Jigsaws?

A Jigsaw is an active-learning method which expedites learning, collaborative problem-solving, and teamwork skills development [1-2]. Jigsaws have been used effectively in classrooms ranging from K-12 to those in advanced engineering courses [3]. A Jigsaw implementation is a team-of-teams activity in which students work in an *expert group* to develop competence on a topic. Each expert group studies a different topic in depth. Then, as *jigsaw "home" teams*—comprised of a member from each expert group—students work collaboratively to teach each other what they have learned as they put together and map out the complete activity. The jigsaw configuration enables students to make connections between the course material and real-world scenarios through collaboration and mutual teaching and learning.

Motivation

Medical Informatics and Telemedicine is an elective course for Junior and Senior level Biomedical Engineering (BME) students at Wentworth Institute of Technology. The course is offered twice each academic year, with an enrollment of around 15 students per offering. The course focuses on applications of health information technologies (HIT), delivered in the form of lectures, labs, and workshops, where students, individually, and in groups, explore different aspects of health informatics. Active learning interventions used by the instructor build off real-world scenarios such as design of electronic health record systems (EHR), implementation of clinical decision support rules, evaluation of system interoperability, and health information exchanges. Jigsaws are particularly well suited for analysis of scenarios which involve clinical processes and workflows, such as those implemented on EHRs.

Jigsaw Implementation Example

Scenario Description

A fictional but realistic scenario, adapted from the influential Shortliffe Health Informatics textbook, is used to illustrate the design, operation, and interoperability of an EHR [4]. In the scenario, James, a patient with diabetes, progresses through the following four distinct episodes:

1. *James learns to control his diabetes, is able to independently check his blood sugar, self-dispense insulin, and manage his nutrition.*
2. *James has difficulty controlling his diabetes and requires consultations, interventions, and coaching.*
3. *James has serious complications goes to ER, is hospitalized, stabilized, and discharged.*
4. *James returns home. He receives support from clinicians, family members, and other resources. His anonymized data is fed into population health databases via health information exchanges (HIE).*

Jigsaw Configuration

The class is divided into groups of four students. These constitute the jigsaw "home" teams. Within each team, every member is assigned to become an "expert" on one of the four episodes of the scenario. Students analyze the episodes and collaboratively create "end-to-end" diagrams and maps of the "patient and data journeys." They identify and describe software modules and features, evaluate interoperability, clinical-decision-support, telehealth consultations, and clinical

outcomes. At the start of the activity, each member of the jigsaw home team is exposed to only their assigned part. By the end of the activity, through mutual teaching and learning, all members of the home jigsaw team are familiar with all four episodes of the complete scenario. The entire activity is typically covered in three fifty-minute sessions.

Jigsaw Activity Roadmap

James' scenario is analyzed as a jigsaw activity and implemented following the roadmap shown in Table 1, which indicates the tasks and duration of each of the steps of the jigsaw activity.

Table 1. Description and duration of activities conducted within the *home* and *expert* jigsaw teams

<table>
<tr><td>Step 1:
Home Team meets
(15 min)</td><td>Tasks
● Assign team leader.
● Team receives a description of each of the four episodes. Each team member is assigned a different episode to analyze.
● Each team member becomes the "expert" on their assigned episode</td></tr>
<tr><td>Step 2:
Expert Group meets
(45 min)</td><td>● Experts for each episode meet to discuss and analyze their part with fellow experts
● Experts prepare documents and presentations to describe their episode to the other members of their jigsaw home group.</td></tr>
<tr><td colspan="2">Expert Group Deliverables
● Identify and describe the "characters" in their episode and their roles.
● Indicate the type and content of communications/consultations between characters.
● Illustrate data interoperability by creating "data-journey" diagrams, which identify data elements collected, the flow of data, formats, handoffs, and other relevant elements.
● Indicate what software and systems were used and which tests/measurements/diagnostics were performed.</td></tr>
<tr><td>Step 3: Jigsaw Home Team Reunites: (60 min) Followed by class discussion (30 min)</td><td>Deliverables: Home team puts together composite flowcharts and diagrams for the entire scenario. Students create reports with graphics of relevant inputs/outputs from the EHR. Particular focus on data "handoffs" and transitions of care between episodes.</td></tr>
</table>

Thematic Analysis Methodology

The impact of jigsaws on analytical and collaboration skills development is evaluated with a thematic analysis approach following established methods, with themes identified solely based on collected data without pre-existing code sets from previous research. Thematic analysis provides a way to systematically analyze qualitative data. The thematic analysis approach is implemented in a five-step process: data acclimation and familiarity; line-by-line coding; initial theme identification; further theme expression; review of themes based on the complete data set. Themes were named and aggregated by number of mentions for a preliminary analysis and comparison by both authors [5-6].

Data Source

The initial data elements for analysis come from end of semester course evaluations. Student responses can help assess understanding of subject matter, how content is applied, and in evaluating growth in teamwork and collaboration skills. Sample questions include the following:

- *List the 3 most important skills you learned in this jigsaw activity.*
- *Describe the 3 most challenging aspects of this jigsaw activity.*
- *How did you overcome these challenges?*
- *Explain three ways in which you might apply the concepts from this jigsaw activity in other courses and in the workplace.*

Preliminary Results and Discussion

Data for preliminary analysis comes from end-of-term, university-administered course surveys from the fall 2021 semester. Seven of the thirteen students enrolled responded. From preliminary analysis of data, the three most popular themes were selected from aggregate statistics of responses and are summarized in Table 2.

Table 2: Thematic analysis codes identified from preliminary analysis.

Theme	Description
Theme 1: ***Teamwork***	***Students appreciated the value of teamwork and collaboration***
Theme 2: ***Communication skills***	***Students noticed improvement in their communication skills, in a low stake setting***
Theme 3: ***Process mapping skills***	***Students were able to apply skills learned in class successfully***

Of the three themes, students appeared to identify the benefit of process mapping skills most strongly in their responses – one of the course learning objectives. While these observations are not definitive, they seem to indicate that jigsaws may play an important role in helping develop communication and teamwork skills. We found it interesting that of the primary themes among the student responses, two were *soft skills*. Students expressed more of a sense of appreciation for the teamwork and communication skills development of the course and used less specific language in this domain (Ex. “My skills... increased”). Student perception of soft skills has not been a focus of this research, and it may be considered in future work.

Conclusions and Future Work

In this paper, we have described how Jigsaws were implemented in a health informatics course, where system design and process mapping are essential components. Jigsaws can add context for students to apply their learning and increase their ability to perform in teams to analyze complex scenarios involving technology and the people who use it. Preliminary data analysis of student responses to end of semester course evaluations seems to indicate that jigsaws can be an effective active learning intervention, which bolsters analytical and collaboration skills particularly in courses involving systems and process design. The next stage of analysis would include coding more data sets and addition of other methods, such as a *photovoice* protocol to analyze students’ graphical reports and documents collected [7].

References

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