**Title: Solving ill-structured problems: Role of scaffolding and feedback**


## Abstract

One key challenge tertiary educators face is to help undergraduates develop higher-order thinking skills that go beyond the ability to regurgitate content knowledge. The ability to apply content knowledge in a rational and relevant manner to solve authentic problems is an important attribute that graduates should possess for them to contribute productively to society. Real world problems are often ill-structured problems that have ambiguous information and no standard solutions. University students therefore need opportunities to develop problem-solving skills. However, solving ill-structured problems is not an intuitive process and students who are novices at solving such problems can benefit from having a framework to help them conceptualise the problem-solving process and develop problem solving skills. Students could also gain from feedback provided during problem-solving that might help refine their skills. Hence, scaffolds and feedback could be incorporated in undergraduate modules to improve students' problem-solving skills.

In a third-year Molecular Basis of Human Diseases module at NUS, ill-structured problems were introduced in previous semesters to understand how students solved problems. Students worked on a problem collaboratively in groups of three using asynchronous online discussion forums (AODFs). Analysis of students' posts at AODFs revealed that they were unable to properly define the problem space. This consequently affected students' ability to solve problems effectively. However, students responded well to summative feedback provided and were able to improve their solution.

Given the gap in students' solving ill-structured problems, we aim to provide scaffolds and feedback to students to improve their problem-solving skills. In our proposed study to be conducted in the same module, we will first illustrate the problem-solving process by introducing a problem-solving framework. In Phase 1 of the study, in addition to merely providing summative feedback, scaffolds such as question prompts or message labels will be used separately in two different problem-solving assignments. The goal is to evaluate which type of scaffold would improve students' performance at solving ill-structured problems. Based on the results of Phase 1, the appropriate scaffold will be used for students in Phase 2 of the study. Here two different modes of feedback, summative and formative will be tested in two consecutive problem-solving assignments. The objective is to assess which mode of feedback is more effective for students.

We will use thematic analysis of students' posts at the AODFs to evaluate the effectiveness of our intervention on students' problem-solving skills. Different steps in students' problem-solving process will be coded and descriptive statistics will be generated for further analysis. The data will be compared to historical data from the preliminary study. An ill-structured problem will be incorporated in the end-of-semester summative assessment to assess if students are able to solve the problem on an individual basis. Students' interviews will be conducted at the end of the semester to evaluate if they retain the ability to solve ill-structured problems. From the data in our proposed study, we hope to introduce appropriate scaffolding and feedback in the future to improve students' problem-solving skills.

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