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The Interdisciplinary Journal of Problem-based Learning

SPECIAL ISSUE: UNPACKING THE ROLE OF ASSESSMENT IN PROBLEM- AND PROJECT-BASED LEARNING

The Role of Using Formative Assessments in Problem-based Learning: A Health Sciences Education Perspective

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ABSTRACT

Practitioners in the field of pharmacy are often confronted with ill-structured problems. Specifically, pharmacists are tasked with making patient-specific recommendations that are both safe and effective, which requires combining knowledge from the biomedical, behavioral, and pharmaceutical sciences. Given the dynamic nature of pharmacy as a profession, the field has begun to explore learning strategies that go beyond mere content coverage to strategies that better support higher-order learning outcomes. One of these approaches is problem-based learning (PBL). While studies have focused on how to support PBL to improve learning outcomes, the role of assessment is often overlooked. Further exploration is thus needed since assessment plays a pivotal role in teaching and learning. This Voices paper will explore this idea within a larger context; we will also share the experience of how a subject matter expert (SME) worked with a team of instructional designers (IDs) to revise an existing course to more explicitly employ PBL and thus adopt an inquiry-based mindset needed for complex clinical decision making. Given the inherent challenges of assessment in PBL, further discussion will be focused on how to (a) design ill-structured problems, (b) align assessments to the PBL curriculum, and (c) how to hold students accountable in cases where a traditional grade is not attached.

Keywords: pharmacy, problem-based learning, assessment, ill-structured problems

Introduction and Background

Practitioners in the field of pharmacy are often confronted with ill-structured problems in their daily practice. Specifically, pharmacists are tasked with making patient-specific recommendations that are both safe and effective, which requires combining knowledge from the biomedical, behavioral, and pharmaceutical sciences. For example, the pharmacists' care plan for patients with the same disease entails consideration of comorbidities or patient-specific factors, such as the ability to afford care. Furthermore, guidelines change based on new drug discoveries and research, resulting in complex clinical decision making that involves multiple possible solutions.

Given the dynamic nature of pharmacy as a profession, the field has begun to explore learning strategies that go beyond mere content coverage, to strategies that better support higher-order learning outcomes. One approach includes problem-based learning (PBL), which is a student-centered instructional approach whereby students learn both content and reasoning skills when presented with representative domain problems. To date, PBL has a rich literature base, especially in the health sciences domain. PBL was first used at McMaster University in the 1960s in response to an increase in student dissatisfaction with traditional methods of teaching and learning in medical education (Bate, Hommes, Duvivier, & Taylor, 2014). In recent years, many health professional schools have redesigned their curricula

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to meet the educational needs of students and to more closely align with accrediting bodies. In particular, there is an increased aim to educate health professional students to become self-regulated and lifelong learners, which align with the tenets of PBL (Accreditation Council for Pharmacy Education, 2018; Liaison Committee on Medical Education, 2018). The core characteristics of PBL include students in small groups, students guided by tutors, students given problems to activate their prior knowledge, and students participating in self-study. Where traditional health sciences education focuses primarily on passive rote memorization, PBL goes beyond this and nurtures clinical reasoning.

Given the emphasis on contextualized problem-solving, PBL is a prime example of situated learning in health sciences education (Berkhout, Helmich, Teunissen, van der Vleuten, & Jaarsma, 2018). This instructional strategy suggests that learners engage in self-directed learning with their peers as they solve representative problems that practitioners face. Studies also show that preclinical medical students and pre-advanced pharmacy practice experience (APPE) students become better self-regulated learners due to their active participation in these settings (Strohfeldt & Khutoryanskaya, 2015; Lucieer et al., 2016). Theorists argue that as learners are exposed to the types of problems that practitioners face, they will be more likely to learn the concepts (Jonassen, 1997), and they will be better prepared for their future careers (Hartling, Spooner, Tjosvold, & Oswald, 2010). When compared with the didactic approach that emphasizes rote memorization, the ill-structured nature of the problem also allows learners to engage in higher-order learning skills, such as information-seeking, questioning (Graesser et al., 2018), hypothesis generation, argumentation (Ju & Choi, 2017), and decision-making (Wilder, 2015). They garner additional skills in terms of flexible knowledge, collaborative problem-solving (Hmelo-Silver & DeSimone, 2013), and an increased motivation (Schmidt, Rotgans, & Yew, 2011).

Despite the purported benefits of PBL, this instructional strategy presents unique challenges to the learner and instructor. For example, students who are more familiar with traditional, passive learning sometimes find dissatisfaction with this type of learning where their active participation is key. This can be attributed to increased reliance on preparation and participation among students during PBL activities (Walling, et al., 2017; Rovers, Clarebout, Savelberg, & van Merrienboer, 2018). The self-directed approach of the PBL model also suggests changes on the part of the instructor from primary disseminator of knowledge, to facilitators of learners' self-directed learning and peer collaboration (Salinitri, Wilhelm, & Crabtree, 2015). Teachers are especially instrumental in scaffolding learning during PBL. Students' reflections on failures and misunderstandings are an important aspect of this process. Expert facilitators in PBL are also responsive to students as they direct students to areas of the problem space that they may otherwise overlook (Hmelo-Silver & Barrows, 2006; Watson, Koehler, Ertmer, Kim, & Rico, 2018).

Assessment in PBL is another important area of instruction because "learning and assessment are mutually dependent because both students and teachers tend to pay greater attention to learning objectives that are assessed" (van Aalst, 2013, p. 280). Indeed, a recurring challenge involves instructors espousing a student-centered approach to finding solutions for ill-structured problems where no prescribed 'right' answer exists. Studies find that assessment is a recurring challenge of PBL (Tamim & Grant, 2013; Wijnen, Loyens, Smeets, Kroeze, & van der Molen, 2017); when no specific outcome exists, it can be difficult to determine how to properly direct student learning (Graesser et al., 2018). In addition, other studies find that the iterative nature of problem-solving requires the instructor to provide students with regular feedback to assess their achievement of learning objectives (Chan, 2016; Grob, Holmeier, & Labudde, 2017). This creates a workload challenge in PBL, in particular when compared with well-structured problems that have a predefined answer.

This issue requires further exploration because evaluation plays a central role in how students engage in inquiry, curriculum design, standard alignment, accreditation, and other teaching and learning aspects. To address this gap in the literature, this Voices manuscript will focus on the challenges of aligning the open-ended nature of ill-structured problems and potential impacts on formative assessment. We will also share the experience of how a subject matter expert (SME) worked with a team of instructional designers (IDs) to revise an existing course to more explicitly employ PBL, and thus adopt an inquiry-based mindset needed for complex clinical decision making. Given the inherent challenges of assessment in PBL, further discussion will be focused on how to (a) design ill-structured problems, (b) align assessments to the PBL curriculum, and (c) how to hold students accountable in cases where a traditional grade is not attached.

Description of Practice

Initial Implementation

Ten years ago, a traditional four-year pharmacy school underwent a significant curriculum redesign for the Doctor of Pharmacy program. Prior to the redesign, the curriculum primarily consisted of lectures based on some small group discussions in the third year, which were inconsistently incorporated into the therapeutics courses. Professional electives at that time included those in pharmacy practice or in non-pharmacy focused coursework and which inconsistently

incorporated active learning. The catalyst for the redesign was also motivated by a mix of external and internal factors. Regarding the former, external accreditation bodies mandated changes to requirements and the delivery of materials. Internal factors consisted of the school's intent to increase engagement with the students through the content and to prepare students to enter a variety of pharmacy practice settings.

As a result of this redesign, all therapeutics courses in the third year were changed to employ a PBL approach, requiring that students take four hours of practice-related elective courses during their third year. In particular, a two-hour elective class entitled Metabolic Syndrome was offered as a complement to the core curriculum in the third year. This elective introduced concepts related to obesity and built on previously learned concepts from the core curriculum, which focused on diabetes, dyslipidemia, and hypertension. The elective was case-based and fostered discussion of the constraints, perspectives, and parametrics governing pharmacotherapy decision making. Additional course requirements included 3 formal group presentations (journal club presentation, patient presentation, and patient education presentation) as well as 3 individual quizzes administered periodically throughout the course. While the instructor noticed some benefits, including students being more likely to respond to case-specific questions, she noted that she was still the primary one driving the case-based discussions, as students were hesitant to respond to open-ended questions. This was challenging for the instructor, as the intended student-centered learning outcome was not fully achieved, and students were still struggling with not having a single right answer.

Redesign of PBL Curriculum

Two years ago, the course instructor partnered with instructional designers (IDs) to restructure the case-based class sessions, focusing on how to make learning more student-centered and how to integrate meaningful formative assessments with feedback. From the core pharmacy curriculum, it was evident that there were benefits to a PBL approach. However, in the core curriculum the PBL approach was based on guiding students to find a single correct answer. This approach was good as a first step to helping learners develop accurate clinical decision-making skills. That said, an elevated level of clinical decision making was needed to ensure that students could deal with the problems they may encounter during rotations and in practice that can have multiple correct responses. Thus, at the forefront of our decision making was the need to scaffold students in being comfortable with not having a single right answer. The redesign was iterative and involved several debriefing meetings during and after implementation. One way to think about the iterative design process we undertook is to view it through the lens of the learning organization framework put forth by New Tech Network (2016). This framework is used to support school improvement and is based on the premise that change occurs when a specific aspect of student learning is identified for improvement. The framework has 3 elements, "a specific focus, tight cycles of inquiry [data, analysis, and strategy], and elements of an organization that tend to support or impede learning [structure, leadership, and culture]" (New Tech Network, 2016, 00:23 - 00:33). Through ongoing discussions, we were able to identify the specific focus on formative assessment. The instructor provided data from her previous experience for the ID team to make an analysis. This would inform the strategies that were proposed and implemented. In thinking about strategies, the ID team was cognizant of the factors that could impede or enable any proposed changes, such as the structure of the course. In the following sections, we provide details of how we focused on formative assessments and go through the cycle of inquiry.

First, the instructor and IDs discussed ways to generate student engagement and student ownership, as well as implement formative assessments. Secondly, we wanted the changes to fit easily with the current course structure to avoid giving both the students and the instructor too much extra work. This aspect was challenging because the existing course used a progressive case sequence, but did not include a way to scaffold learners through the problem-solving phases from planning/problem representation to solution generation. One of the issues that emerged during this process focused on the role of assessment. Through these discussions, we found that not having a structure in place prevented the instructor from fully identifying the student's understanding of the problem space and providing the necessary feedback. As this was an elective course that the instructor felt was already full of assignments that were tied to curricular ability-based outcomes, she was concerned that adding additional required assessments would overburden the students. However, she was encouraged in the discussion with IDs that using a structured approach to guide the students through the cases would result in increasing student engagement, meaningful assessment of students' learning, and more opportunities for just-in-time feedback. Upon discussion, the instructor and the IDs determined that group work would remove the burden from students for additional out-of-class work. The instructor was also concerned that not assigning a grade to the work student groups were submitting in class would deter them from being fully engaged. However, the IDs reminded her that her verbal feedback on group responses/solutions would provide the class with feedback in a safe, nonjudgmental environment.

In order to scaffold students through the problem-solving phases, we developed and implemented a structured approach to strategically (a) guide and (b) provide

assessments to the students through the eight cases (each of the four disease states had two progressive cases). The structured approach had two components: The first was to document their thought processes as they worked collaboratively to produce solutions, and the second was to give students an opportunity to reflect individually on their personal problem-solving processes based on the assessment. The eight progressive cases enabled students to experience ill-defined, authentic scenarios with similarly complex variables they would encounter in practice. The structured response to cases supported students to effectively go through problem representation and solution generation in a systematic and metacognitive way. For example, in the first case on obesity, students had to make a decision between recommending lifestyle modifications versus pharmacologic options. The second case on obesity required students to consider recommendations for the management of medications and nutritional deficiencies after a patient had bariatric surgery, which built on the intervention recommendations to assist with weight loss discussed within the first case. In one of the hypertension cases, students had to determine whether a first-line or second-line pharmacologic option was most pragmatic. In the second hypertension case, students had to consider the role of first and second-line pharmacologic therapies in the management of hypertension in an older adult who was opposed to taking pharmacotherapy and preferred an herbal option. Students had to incorporate guideline recommendations for preferred therapy, consider how therapy recommendations could differ for an older adult, and determine how to address the use of herbal options that may not have evidence to support their use to manage hypertension. Please see Table 1 for additional examples of cases and their focus.

Structured scaffolding of problem-solving included questions such as, "What is the primary problem?" and "What do you see as the secondary problem?" In addition to scaffolding, including these types of questions was important because we used them to provide students with just-in-time assessments during their collaboration. Student groups were required to not only identify the primary and secondary problems they identified in the cases, but also identify what they perceived as the most important points (variables/factors/constraints) to consider as they developed their solution to the patient's problems. They were also asked to recommend a solution plan and justify their recommendation, including the resources they used to support their solution. At the end of the allotted time given for groups to work on the cases in class, each group was required to post their response in a discussion board forum on the learning management system (LMS).

Formative Assessments Through Group Discussions

For each case, the instructor reviewed all group responses and led a whole class discussion of similarities and differences as a way to provide verbal, formative feedback. In addition, this time was used to articulate her expert reasoning and to model professional problem-solving thinking skills. Although no grade was associated with group responses, the process of documenting their responses to each case and including the instructor's feedback encouraged accountability among the learners. The instructor felt that if the answers to each case were ungraded and formative, the students would be encouraged to become more comfortable with not having just one correct answer. The intention behind having the case responses as formative assessments was to establish a safe discussion time for students so that they were not as focused on having the correct answer, but focused on the process of obtaining a justified solution. This experience mirrors existing literature that shows that students, both at the individual and team levels, have a tendency to not carefully read feedback and, in order for feedback to be effective, students have to read, interpret, and act on the feedback. The act of responding to feedback also needs prompting in order for the feedback to influence future performance (Gabelica, Van den Bossche, De Maeyer, Segers, & Gijselaers, 2014; Schinske and Tanner, 2014). In this situation, the instructor's workload was not increased, and students were able to receive meaningful just-in-time feedback in an interactive way, thus increasing the likelihood the feedback would impact future performance at both the group and individual level.

Formative Assessments Through Individual Reflection

After each set of two cases, students were required to individually reflect on the process, allowing for engagement with the problem-solving process. The students' individual reflections provided the instructor important insights about the overall course structure, as well as provided her a means to assess the newly implemented case discussion process. The students' reflections allowed the instructor to see how the students felt about the process of responding to cases since it was new for the instructor and the students. Additionally, the students' individual reflections provided an opportunity for them to explore their problem-solving processes compared to their peers, as well as how they utilized knowledge from one case to another. Examples of reflection prompts included, "For the selected topic, how did your experience in case 1 help with your approach to case 2? Include any knowledge that you incorporated as well as problem solving processes." The instructor had worked with the IDs to develop these reflection prompts. The intent was for the instructor

Table 1. Topic areas and assessment methods. *Cases for 2017–2018**

Week in Semester	**Disease states**	**Cases focused on:**	**Assessment methods (responded as groups - class had five groups):**	
			Formative	Graded
2, 3, 4	Obesity (4 hours)	1. Lifestyle recommendations and pharmacologic options (prescription, OTC, and herbal) for weight loss 2. Types of weight loss surgeries/qualifications 3. Community Pharmacy--s/p Roux-en-Y gastric bypass and meds	All groups provided a structured response to two cases—one on week three and one on week four	
4, 6, 7	Hypertension (3 hours)	1. Resistant hypertension and second-line pharmacologic options 2. Community Pharmacy—Older adults, non-compliance, and herbal products	All groups provided a structured response to two cases—one on week 6 and one on week 7	Weeks 5-6: Groups assigned a journal article for presentation
9	Type 2 Diabetes (2 hours)	1. Lifestyle recommendations and pharmacologic options (prescription and herbal) 2. Pharmacologic options and specific considerations in older adults	All groups provided a structured response to two cases—both on week 9	Weeks 8-9: Groups assigned a patient presentation
11, 12	Dyslipidemia (3 hours)	1. Management of high TG and considerations for using non-statin therapies 2. Management of LDL with a statin, non-statin combination therapy, and considerations if statin intolerant	All groups provided a structured response to two cases—one on week 11 and one on week 12	Weeks 11,13: Presentation to the class as if they were patients

to be able to review individual student responses and gain insight into whether the students were carrying forth knowledge between the two cases and recognizing that the cases were building on each other. Futhermore, the instructor hoped that if the student reflections indicated misconceptions or gaps in knowledge, she could provide those insights to the class during the debriefing time for that case prior to the students submitting a summative assignment. Though not formally graded, the reflections also helped to meet part of the students' professionalism and participation part of their course grade, since both the formative and summative assignments were completed as a group.

The instructor noted that initially the self-reflections indicated discomfort from the students about not having one *right* answer, but the tone of their reflections changed over the semester as students became more comfortable with the process and recognized that there could be multiple right answers. Students also noted that the structured process helped them to grasp the course material more easily. Reflections also provided another avenue for students to get meaningful feedback without any extra burden on the instructor. After students submitted reflections, the instructor would scan a percentage and take note of any trends or concerns. She would address these in the following class.

Summative Assessments. Although the case discussions were formative and ungraded, they were aligned with three summative assessments (see Table 1) which already existed in the course. In the summative group assessments that were formal presentations, student groups were expected to evaluate medical literature, guidelines, and drug information sources, and provide an appropriate response based on the therapeutic assessment they were undertaking. The summative assessments involving presentations were as follows:

1. A formal journal club presentation that required students to analyze medical literature and recommend how the findings could be applied to patient care.
2. A formal patient presentation that required students to develop an assessment and plan for managing the assigned case's problems and apply medical literature and guidelines.
3. A formal patient education session that required students to educate the class as if they were patients. This required them to provide sound recommendation for self-care based on medical literature and guidelines.

In addition, the student groups also completed three patient care notes (SOAP: subjective, objective, assessment, and plan) over the course of the semester. The structure of the formative case-based discussions with ambiguous solutions to problems helped to prepare the students for the summative assessments. The summative assessments had specific rubrics that were reviewed with students, along with the specific requirements for each presentation type. This was done approximately three weeks prior to the various group presentations. Each summative assessment required students to justify their recommendations because there was not always one right answer, which was similar to the case-based discussions utilized in the course. Since one of the intentions of this elective course was to prepare students for their fourth professional year, the instructor elected to use existing fourth year rubrics for the group assignments. This helped mirror the skills and knowledge students were expected to portray during their rotations. The related course objectives for each type of assignment communicated to students the types of situations/problems they will encounter in clinical practice settings. Accounting for multiple correct answers was challenging. To overcome this challenge, the rubric used focused on the appropriateness of the rationale as well as the actual solution.

Over the years, the instructor realized that there are some key sections that students need detailed feedback on that is not accounted for in the rubric. For example, she recognized that the feedback on the groups' review of key points, application of the information presented, and their ability to answer questions are key areas of which to provide feedback for future growth. With regard to the student groups' written responses in the form of SOAP notes, the instructor recognized that comments on their solution and justification to their patient case is important in helping the groups refine their responses to be clinically appropriate for communication with other healthcare providers.

Interpretation and Lessons Learned

To date, a rich body of literature exists about teachers' perceptions (Wijnen, Loyens, Smeets, Kroeze, & Van der Mollen, 2017), students' perceptions (Henry, Tawfik, Jonassen, Winholtz, & Khanna, 2012), and technologies that scaffold student learning (Kim, Belland, & Walker, 2017). While other studies have focused on how to support PBL to improve learning outcomes (Ge, Law, & Huang, 2016), the challenges of assessment by the instructor are often overlooked (Grob, Holmeier, & Labudde, 2017; Graesser et al., 2017). Indeed, early literature on PBL implementation noted that this was a possible challenge (Ertmer & Simmon, 2006) and additional studies suggest that this is a persistent problem in a variety of learning contexts, including K–12 (deChambeau & Ramlo, 2017; Tamim & Grant, 2013), higher education (Wijnen, Loyens, Smeets, Kroeze, & Van

der Moellen, 2017), and medical education (Azer, McLean, Onishi, Tagawa, & Scherpbier, 2013). Given this remaining challenge, this experience highlights the importance of formative assessments in preparation for summative assessments, especially when dealing with problem-solving learning experiences. That is, how to overcome the tensions between giving learners a safe space to be wrong when solving ill-structured problems, while meeting the requirements of often stringent assessment systems.

This experience also highlighted the burdens that multiple assessments place on instructors and how to navigate those challenges. In particular, the instructor saw the value of multifaceted formative assessments in terms of discussion of cases with multiple viable answers, encouragement of student collaboration across the class, and student reflection on the process. As highlighted by this experience, discussion of cases with multiple right answers is important because the majority of health sciences education focuses on students selecting one right answer, when in the real world there can be many possible solutions. In addition, student collaboration is important because of the interprofessional collaboration that pharmacy students, and all health science students, will be faced with in practice. The instructor further noted that having the formative assessment structure remain the same throughout the semester through the utilization of the case-based discussion was helpful for the students to become comfortable with the process and the concept of multiple right answers. The instructor saw that this allowed the students to perform well on the related summative assessments that were utilized throughout the semester.

Lessons learned include that integrating formative assessment requires advance planning but can be done with small tweaks to an existing course and without increasing instructor workload. Flexibility is very important, as tweaks may be needed after implementation. For example, we experienced challenges with low reflection response rates during the first part of implementation (only 33% of the class completed their reflections after the first two cases), despite reflection counting toward a course participation grade. We brainstormed this problem in one of our debriefing meetings and determined that since this was a new process, it was important for the instructor to have an open discussion with the class regarding the purpose and importance of the reflections. The instructor used this first debriefing as a time to summarize the comments that she had gleaned from the first group of reflections. Additionally, the students that had completed this first reflection were given bonus professionalism/participation points. For future reflections, the instructor adjusted class plans to provide 10–15 minutes at the end of designated classes for students to complete their reflections. While this did not always occur due to other class activities, the intent was to show the students that the instructor valued the reflections, as they were beneficial to both students and the instructor. Over the two years this process has been used, greater than 90% of students completed their reflections by the designated deadlines and received their full professionalism/participation points. The reflections were a key part of this process because they allowed the instructor to see their thoughts on the case structure, sequencing, and responses in real-time rather than having to wait until the end of the semester for course evaluations, which often have a low response rate and do not give insights into students' problem-solving processes.

The organized approach to cases provided structure for students' responses and facilitated more meaningful instructor feedback and engagement among learners. While the instructor was concerned about incorporating extra requirements without having a grade attached, students actively participated, and their individual reflections indicated they found the process valuable. Prior to implementing this structure for case-based discussion in class, the instructor noted that students did not necessarily seem to connect what was being discussed in class with the presentations they were being asked to complete as part of their group assignments. In addition, the instructor had eliminated individual quizzes that were simply intended to hold the students individually accountable for applying the information discussed in the course. There was some indication, simply based on group presentation assignment grades and individual quiz scores, that the students were retaining information (i.e., the grades were generally As/Bs). However, students would have an A on a group presentation, and then their responses on an individual quiz would show they could not justify why they would recommend a particular pharmacotherapy or lifestyle change. As such, the problem-solving piece and application of the information to future clinical situations seemed to be lacking. Since the implementation of the structured case-based discussion and responses, the instructor has noted that that the quality of students' work on the graded summative course assessments improved. Even though the summative assessments were three different types of presentations (journal club presentation, patient presentation, and patient education presentation) and three patient care notes, the students' abilities to prioritize problems, make recommendations, and justify their recommendations were seen throughout each artifact. This observation is in line with previous studies (Schinske and Tanner, 2014) that found that descriptive feedback without a grade on formative problem-solving assessments contributed to students' improved performances on similar follow-up assessments. This highlights the importance of balancing assessment for learning and assessment of learning in a PBL environment.

The entire process was invigorating for the instructor, as she observed the students willingly participating in case discussions each week and increased engagement over the course of the semester. She also observed the students becoming more comfortable with the process, collaborating with each other, respecting differing opinions, and recognizing there can be multiple right answers to managing patients. Overall, the instructor noted that utilizing a structured case discussion process with reflection provided a foundation for students to become more comfortable with solving problems that were ambiguous, which mirrors what they will encounter in practice. This resulted in increased confidence in the students' abilities and improved learning outcomes evidenced in their formative and summative assessments.

Key Considerations and Next Steps

Key considerations for educators who want to incorporate formative assessments as part of a structured approach to solving open-ended, ill-structured problems include timing of the assessments, as well as how students will be held accountable and given credit for completing the assessments. Based on this instructor's experience over two iterations of this format, the most appropriate timing of the assessment is determined by whether it is a group assessment (group response to class case) or whether it is an individual assessment (reflection). In both instances, students seemed to do better when given time in class to complete these assessments. Therefore, educators should account for this in the class lesson plan. The amount of time needed will be determined by two factors: First, the complexity of the case and the expected response in the group assessment. Second, the level of details students will be required to include in their reflections. This instructor found that students needed at least 30 minutes to formulate their group assessments and about 15 minutes to compose their individual reflections. It is also important to note that although students may not be as alert or engaged after a full class session, individual reflection works best after the group assessments have been submitted. Additionally, some students seemed to be more reflective when given time outside of class to reflect. Regarding allocation of points or grades for completing assessments, the instructor found that having a mechanism to hold students accountable, as well as explicit plans to acknowledge and address student responses, were vital to the success regardless of points awarded. If an educator decided to grade the formative aspects for accuracy, this could add another level of formal feedback to the students, as well as time commitment for the educator. A scale/rubric for awarding points may be needed to ensure that the metrics of success are clear to the students. In this case, we chose to make the formative aspects complete/incomplete as part of the student's participation grade to allow students to learn from the structured formative assessments.

The structured formative assessment process was utilized in this elective course for two iterations. The instructor feels the balance between graded/ungraded and formative/summative assessments is the right approach for achieving the desired problem solving and clinical reasoning learning outcomes. However, the instructor notes that the students continued to struggle with the entire process at the beginning of the semester. While initial challenges emerged, the importance of maintaining an open line of communication about the intent of the formative assessments became clear over the course of two iterations. Students need to be made aware that the course is intentionally designed for them to become comfortable with ambiguity and having multiple possible solutions, as this is what they will encounter in practice. In future iterations, the purpose of the approach will be included in the syllabus, and class time will be scheduled throughout to have discussions as needed on the rationale behind the teaching, learning, and assessment approach.

The instructor will also continue to allot time for the students to discuss cases, develop and post their responses, and review the answers with the entire class so that all students receive the benefit of a diversity of answers and instructor/expert feedback. In addition, the instructor intends to purposefully designate time at the end of the pre-specified classes for students to work on their individual reflections. The school is currently undergoing another curricular revision referred to as the Practice-Ready curriculum, and this elective will be divided into two offerings across two academic years. The instructor intends to utilize this case-based reasoning process, reflection, and assessment as she restructures the elective into two separate six-week offerings.

This project was focused on assessment and allowed us to intentionally design assessment and learning activities to progress students from a single answer mindset toward thinking about multiple possible solutions and rationale for decision making. As proposed in the Learning Organization Framework (New Tech Network, 2016), focusing on a specific student's learning outcome is important for improvement and change through an inquiry cycle of data collection, analysis, and strategy.

The individual reflections and group responses provided unique insight into how students learned in this class, as well as the importance of formative assessments in PBL. This allowed us to further examine the tension that exists between having an accountable grading system and providing a safe space for students to use assessments for their learning before using assessments purely for evaluation of

performance. When we analyze the artifacts from students' formative assessments and the class discussions and performance on the summative, it is evident that it is possible to scaffold students in problem-solving without attaching a grade and without overloading the instructors. These findings will be used to implement this strategy on a larger scale in the core curriculum with a larger cohort. The findings also add to the discourse surrounding the assumption that if it is not graded, students will not engage and thus will not learn. The elements in the exterior triangle of the learning organization framework, leadership, culture, and structure, become apparent in addressing this tension, as these can enable or act as a barrier to improving student learning outcomes.

At the school level, the structure and culture of the core Practice-Ready curriculum support this type of assessment, which will make large-scale adoption easier. One of the characteristics of the Practice-Ready curriculum is critical thinking whereby learners form judgments, evaluate options, solve problems, and develop solutions. Additionally, the leadership provides support via dedicated resources for collaboratively achieving the shared goal of developing critical thinkers. At the classroom level, the external triangle required is important, as we have found that having the right structure in the learning design facilitated learning from formative assessment. It was important for the infrastructure to create a classroom culture where students felt comfortable not having the *right answer,* and where diversity in thinking was respected. This allowed the instructor to provide the leadership through modeling.

Health sciences educational institutions are held accountable by additional accrediting bodies and the pressure to ensure students are competitive for various post-graduate opportunities. These regulations and postgraduate opportunities often use grades as a criterion for selection and determining success. Only focusing on grades can result in educators losing sight of what is needed to produce graduates that have the core competencies required to enter their professions. This experience focused on formative assessment as one way to balance scaffolding students, while still employing rigor to determine a grade. In the future, the qualitative data collected from this implementation can be analyzed to identify themes and garner additional teaching and learning. Finally, further data analysis could be done to see if there are any significant correlations between student performance in the course and their performance on the fourth professional year rotations.

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