**Engaging deeply with Cognitive Science in a Conservatory of Music: Using student-centred learning to enhance learning outcomes in music students**

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## Abstract

Concepts from cognitive science (CS), including music psychology and performance science, are rarely taught to conservatory students, even though these topics are likely useful for their practice and performance of music. This study examines the effectiveness of student-centered learning (SCL) and project-based learning (PBL) methods for teaching CS to undergraduate conservatory students in a module on The Psychology of Music Performance. The results gleaned from student assignments and feedback show that the module activities, especially the SCL and PBL components, were largely successful in deeply engaging the students, resulting in knowledge acquisition as well as critical thinking. The findings suggest that a well-balanced teaching approach incorporating elements of SCL and PBL is capable of instilling both breadth and depth of learning of relevant CS findings in the music conservatory context.

**Keywords:** Student-centered learning (SCL), project-based learning (PBL), interdisciplinary pedagogy, psychology, music performance, learning outcomes

## Introduction

Cognitive Science (CS) has informed best practice in a range of applied areas such as sports and pilot training (e.g., Williams & Leffingwell, 2002), but comparatively little CS research has informed the practice and performance of music. Although some studies do explicitly connect CS and music performance (e.g., Thompson et al., 2006), there is relatively little

awareness and engagement from music students with this knowledge. At the same time, teaching CS to conservatory students may prove challenging, as most music students are not familiar with this discipline or its analytic, scientific approach. This paper explores a new module taught by the first author on 'The Psychology of Music Performance', which was offered at an internationally-acclaimed conservatory of music. The module covered topics such as memorization techniques, empirically-informed practice strategies, and music performance anxiety. In terms of the teaching approach, the module aimed to leverage student-centered learning (SCL), and project-based learning (PBL) more specifically, to enhance student motivation, engagement, and learning outcomes.

SCL is an instructional approach that tailors classroom activities and assessments to the students. PBL is a type of SCL in which students are presented with a hands-on opportunity to solve real problems by conducting a project (Blumenfeld et al., 1991; Krajcik & Shin, 2014). In a PBL classroom, students are responsible for their own learning by designing, executing and reflecting on their projects (English & Kitsantas, 2013). This approach allows students to explore topics that they find genuinely important, which tends to foster higher engagement and deeper understanding (English & Kitsantas, 2013), and can even help students achieve better learning outcomes compared to traditional methods (Kokotsaki et al., 2016; Bell, 2010).

In music education, student projects have a long tradition (Tobias et al., 2015), with examples of PBL found in music education training (Cayari, 2015; Lasauskienea & Rauduvaiteb, 2015) and in general music education classrooms (Bamberger, 1999). To our knowledge, however, PBL has not been applied to help university music students internalise scientific concepts, such as those from CS, in order to improve their performance practice, even though PBL is likely an ideal approach for this goal (Tobias et al., 2015).

Given the strengths of SCL and PBL, we aim to evaluate the effectiveness of these approaches in teaching cognitive and performance science to conservatory music students, focusing on a new module that incorporates interactive teaching and learning (T&L) methods. We analyzed the impact of these methods on the module's learning outcomes by evaluating students' assignments and module feedback (see Table 1).

[Insert Table 1 here]

The three learning outcomes used to gauge the module's effectiveness are 1) factual learning and conceptual knowledge, 2) critical thinking and reflection, and 3) engagement. These outcomes are broadly based on the revised Bloom's taxonomy as applied to music education (Hanna, 2007). Bloom's taxonomy revolves around the tenet that applying knowledge is more important than simply acquiring knowledge (Bloom et al., 1956), which is highly compatible with our goals for the SCL and PBL approaches.

The first learning outcome broadly maps to the lower two levels of the Bloom's taxonomy, and refers to students' ability to recognize, recall, and understand the concepts taught. To define critical thinking (L02), we drew inspiration from the upper two levels of Bloom's taxonomy (e.g., analyze, evaluate, create), which have been shown to be a suitable gauge of critical thinking (DeWaelsche, 2015). This view emphasizes that critical thinking involves higher-order thinking skills such as analysis, reflection, and metacognition. The third learning outcome (engagement) refers to the degree of involvement and effort that students expend towards classroom activities and assignments, and whether they applied what they learned outside of the classroom. We adopted a cognitive and behavioural approach towards assessing engagement (see Wang et al., 2014), which encompasses meaningful processing of information, strategy use, participation/effort, and observable displays of motivation in students.

## Study Methods and Module Information

### Participants

13 out of 21 students enrolled in *The Psychology of Music Performance* module volunteered to participate in this study (participation refers to allowing the research team access to their de-identified module materials for analysis). All but one of the participants were music performance majors enrolled in [conservatory name]; the remaining student is a serious musician who plays in the [university name] symphony orchestra. All student data were coded using participant numbers (P1-P13) before analysis.

### Module Overview

Lessons in the 13-week module were comprised of lectures (with accompanied readings), in-class discussions, and activities such as "game show questions" and demonstrations. The module activities, and how they were analyzed for this research, are briefly outlined below.

#### *Blogs*

Students were asked to write a blog post every week to reflect on how the weekly topic (such as "techniques for combating performance anxiety") relates to their practice and performance of music, and to later comment on their peers' posts. The blog posts were assessed in terms of evidence of Recall, Application, and Evaluation.

#### *Individual Research Project*

The module's main assessment activity was an individual research project, conducted throughout the second half of term, in which students implemented and empirically tested a strategy of their choice from those taught in class, examining the strategy's effect on their practice of music. Of the topics discussed, deliberate practice was the most popular among the

students, followed by music performance anxiety. Before starting their projects, students had to submit a research plan for their proposed research project. After receiving at least one round of feedback and submitting a revised plan, they carried out their projects for four weeks. Finally, they submitted a written report, and gave a brief presentation to the class.

The students' reports were analyzed through a deductive process of identification, summarization, and analysis of patterns (recurring ideas across students) to assess the impact of the module on the three intended learning outcomes.

***Focus group discussion***

Semi-structured focus group discussions (FGDs), facilitated by the teaching assistant, were held online at the end of the module. These groups consisted of 6-7 students, and each FGD lasted approximately 90 minutes.

The discussions were transcribed from audio recordings and proofread to ensure accuracy. The data were then coded according to whether the students' utterances corresponded to learning outcome LO1, LO2, or LO3 (column 2 of Table 1), and classified based on the teaching and learning (T&L) method (column 1 of Table 1). Trends from the FGD were then identified, distilled into key points, and assimilated with the trends identified from the research projects in an iterative process. Our findings from this process are described below for each of the modul e's LOs.

## Results and Discussion

We analyze below the ways in which the various T&L methods helped students achieve the stipulated learning outcomes.

**LO 1. Factual and Conceptual Knowledge**

Overall, students were able to effectively grasp the majority of concepts taught in the module, although expectedly, the extent of understanding varied across students and topics. Although evidence of LO1 was found across all T&L components, the classroom activities, especially lectures and readings, provided the basis for most factual and conceptual learning. The FGDs revealed that the readings were seen as difficult. The majority of students found the lectures significantly more accessible, and helpful in clarifying the readings.

In terms of the SCL/PBL components, analysis of students' blogs confirmed that the majority of students demonstrated *recall* and *application* in their weekly blog posts. Evaluation and self-evaluation were less consistently present in their responses, and seemed to depend heavily on the blog prompt. Overall, however, the blog posts demonstrated that students were able to recall and discuss factual and conceptual information they had learned. In addition, all students successfully managed to execute their individual projects, and motivate their projects by citing appropriate literature, which demonstrates sound understanding of the materials. Students reflected in the FGDs that the blogs and research project encouraged them to review the class materials regularly, which several students described as helpful in deepening their learning. In other words, classroom activities facilitated the majority of factual and conceptual learning, and SCL/PBL activities promoted greater interaction with this knowledge.

In terms of the facts/concepts learned, students made various comments in the FGDs about how the module (in general) introduced them to concepts that were beneficial for their music practice and "being able to perform at a better level" (P7, FGD1). All students indicated that they aim to take forward at least one strategy they learned in the future, and many mentioned that they will refer to this module when confronted with future musical challenges. According to the FGDs and project reports, students found the most helpful facts/concepts learned in the

module to be deliberate practice techniques (e.g., interleaved practice strategies), mental rehearsal, and strategies for combating performance anxiety.

In terms of T&L challenges relevant to LO1, a difficulty in teaching this module is that some topics and strategies are more relevant for certain instruments/individuals than others. Whereas some students were able to, e.g., generalize instrument-specific strategies for their instruments, others found this challenging, especially when asked to write and reflect about these topics in their blogs. For this reason, a few students remarked that traditional assessment options, such as quizzes, would be a good alternative to blogs to test their factual/conceptual knowledge.

In summary, students were able to gain a solid factual and conceptual understanding of the course material, with the foundation of their knowledge acquired through classroom activities (primarily lectures and readings), and a deeper understanding, review, and application of the concepts stemming from the SCL/PBL components (blog posts and individual projects).

**LO 2. Critical Thinking and Reflection**

A theme that emerged across the projects and FGDs is that the module helped students be more intentional and analytical during their practice sessions. Students commented that while it can be difficult to ascertain whether a strategy would work well for them based on the lectures and readings alone, the project allowed them to test and personalize strategies. Students acknowledged that it was not until they had applied concepts/strategies in projects and in-class demos that they realized that some of their previous mindsets and behaviours were counterproductive, such as practicing “in auto-pilot mode”, having self-defeating thoughts, or failing to set practice goals. For example, one student reflected, “During the data collection, I proved that my practice sessions in the past were very mindless!” (P13, research project). After

recognizing these patterns, students evaluated how the strategies they learned could help solve their problems.

During PBL, students often expressed that their solutions involved thinking more critically when approaching practice and performance. Some students even made detailed evaluations o f how and why the strategies they tried worked, or did not work, for them. This process facilitate d reflection and self-discovery:

> After pondering upon the data, I came to the conclusion that the results make sense. Though I was more confident in playing when I was implementing Strategy A, as the color coding helped build a solid system and memory in my head, I was totally discarding the musical aspect of the music. I was very much just playing it through. But for Strategy B, when I listened to recordings before performances, I often feel more inspired and expressive in my execution. (P5, project report)

In terms of SCL, students remarked that writing and reading their peers' blog entries also helped them analyze which strategies work for them, reflect on their practice, and ultimately understand themselves better (e.g., in their approach to certain musical activities), and. For many students, (self-)reflection gradually became an ingrained feature of their practice. For example, one student recounted, "if I start to like, split a note or maybe switch a note, I would, instead of continu[ing] to practice it mindlessly, I would ponder, 'why did I miss the note?'." (P6, FGD1)

Further, several students were able to go beyond the facts they learned by personalizing strategies or connecting disparate topics. For instance, one student's project involved using

deliberate practice strategies to tackle performance anxiety, while another student tailored the existing memorization strategies according to her needs. This ability to generate new approaches from existing materials embodies the pinnacle of Bloom's Taxonomy (i.e., "creat e"). An example of this is below, which also highlights the prevalence of critical thinking in students' projects:

> If, [P10] said that we're going to a clothes store and all the [class] material are the clothes, then for me, it's not only like they look good by themselves, but when I try them, I need to kind of adjust something… for me, I also need to, kind of change the material a little bit by myself… for example, I use the memory map. But I find out that for me, [I] would prefer to like… create a story line when I… memorize a piece instead of just analyze the score… Yeah, so …[the] individual project helps me, and this really gave me a lot of like my style. (P9, FGD2)

Lastly, several students also expressed in the FGD that they are more open to analytical thinking and adopting a psychological approach to practice and performance after taking the module. This change in mindset shows that a SCL/PBL approach has the potential to shift fundamental perspectives. While the blogs, in-class discussions and demonstrations prompted students to critically examine and reflect on what they had learned in lectures/readings, the greatest evidence of LO2 stemmed from students' individual projects.

**LO 3. Engagement**

Students displayed many signs of being engaged (i.e., motivation to learn and apply knowledge) by the interactive components the module (SCL, PBL, and in-class discussions/games/ demonstrations), but found the readings comparatively less engaging. A

recurring theme throughout the FGDs was on the benefits of *applying* strategies to their music practice (as required for their blogs, projects, and demonstrations). As one student aptly summarized, "when we learn, it's a different thing from applying it" (P1, FGD1). Students mentioned that the benefits of applying their knowledge included: knowing that the strategies works for them personally, having a more in-depth understanding of the topics, and providing motivation to attempt/persist with the strategies. Some students particularly appreciated how the project and blogs motivated them to implement strategies and reflect on them regularly through structured assignments.

> When you read [the strategies] in the reading it's like, okay, this this this happens, so we must do A-B-C, and then… it will magically fall into place. But most of the time that's not the case. Had it not been for the project right, I would have probably given up after a couple days.... But I think it was thanks to the project which… kind of in that sense "forced" me to keep at it, and it was only after a certain period of time, did [my playing]… improve. (P7, FGD1)

The projects promoted active involvement and positive engagement from all students. Views on the other main SCL component (blogs), however, were mixed. Some showed little engagement, especially when they did not believe the blog's topic applied to themselves. Others thought blogging was the best part of the module, seeing it as a way to interact with other students, reflect on their own struggles, and find friends tackling similar issues. Writing blogs fuelled engagement in most students by encouraging regular reflection on concepts/strategies, and through interaction with peers: "I think for me, it was mostly the blog post that I found very helpful… not only for self-reflection, but… I thought it was really important for fellow musicians to share experiences…" (P12, FGD2).

Students also found the classroom activities to generally be engaging. In the FGDs, many students remarked that the lectures (including slides and entertaining videos) were engaging, as well as the in-class discussions and activities, especially the educational games and live demonstrations, which helped bring factual information alive.

Lastly, a few students mentioned spending time outside of class to do further research on the topics that they found interesting, or to practice new strategies. This shows a deep level of engagement and commitment to the material. Overall, students found the readings the least engaging, lectures, classroom activities, and blogs to be quite engaging, and live-demos and projects to be extremely engaging.

## Conclusions and implications for music education

We have examined the impact of the T&L methods on the three target learning outcomes in this module on 'The Psychology of Music Performance.' The interactive SCL/PBL approaches were found to be particularly successful in enhancing conservatory students' engagement and ability to apply concepts from cognitive science towards their practice and performance of music.

Naturally, the T&L methods each had their relative strengths and weaknesses for achieving the three LOs. While classroom activities facilitated the greatest factual/conceptual knowledge, they did not produce the greatest reflection or engagement. In comparison, the individual projects bolstered critical thinking, reflection, and engagement, but they necessarily focused on one topic of the student's choice, rather than allowing for a broad selection of concepts to be learned, as was possible through the classroom activities and blogs. Arguably, it was the *breadth* of traditional classroom activities and blogging, combined with the *depth* of the

individual projects, that facilitated learning, critical thinking, and engagement in the module. As a result, we suggest that an effective teaching approach for helping students learn and apply CS concepts to their practice of music involves balancing traditional teaching methods with SCL/PBL approaches.

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Table 1. An overview of the teaching methods, intended learning outcomes, and data sources used in this research.

| **Teaching/Learning Methods** | **Learning Outcomes** | **Data sources** |
|---|---|---|
| • Classroom activities (lectures, assigned readings, demos, educational games)<br>• Student blog posts (SCL)<br>• Individual research project (PBL) | • LO1: Factual learning and conceptual knowledge<br>• LO2: Critical thinking and reflection<br>• LO3: Engagement | • Blog<br>• Research project<br>• Focus group discussions |