Learning to play a musical instrument with a digital portfolio tool

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ABSTRACT

The body of research examining deliberate practice and self-regulation in musical instruction has grown extensively over the past decade. Compelling evidence indicates that students with higher levels of self-regulation develop superior performance skills and experience more fulfillment as musicians. But in order to develop the self-regulatory behaviours that are the hallmarks of skilled and expressive musical musicians, students need to be supported and guided as they learn to explicitly set goals and monitor and reflect on their progress. Developing these behaviours involves the incorporation of strategies that presuppose a certain level of discipline and organization on the part of the student. One way of supporting students is through digital tools, including electronic portfolios designed specifically to enhance self-regulation. The research reported in the present paper describes how a web-based electronic portfolio, called ePEARL, served to enhance the experiences of students and teachers working in music studios, and in turn, how ePEARL was then adapted to reflect music teaching and learning in a new electronic portfolio called iSCORE. The paper describes a three-phase research and development study that took place over a 22-month period. First, we used case-study methodology to examine the use of ePEARL with one teacher and student. Findings demonstrated the value of the tool in supporting student learning as well as for linking weekly lessons to include composition and school music activities. In the next phase of the study, four teachers and 15 students used ePEARL over a five-month period, when it was determined how ePEARL could be modified to more fully support both students and their studio teachers. On the basis of this second phase of research, we developed a design and development plan to create iSCORE, and then tested it with music students, teachers, and university educators. Features of iSCORE will be described and demonstrated during our presentation, featuring some of the most powerful aspects of iSCORE that support the development of self-regulation in young musicians.

INTRODUCTION

Over the past century, there have been many advances in the music industry and in educational practices. However, the field of studio music instruction has largely remained unchanged. Although hundreds of thousands of children take weekly studio lessons across Canada and the United States, many quit just as they are reaching a level of proficiency, often in the adolescent years. Later, when these former students reach adulthood, they often feel that despite their years of music instruction, they have not retained any musical skills, thus eliciting the response, "I took music lessons as a child, but I do not remember anything."

The lack of engagement in the private music lesson system is not only a problem for students. Of the thousands of independent music teachers who operate studio practices across North America, very few teachers have opportunities for meaningful professional development. For many studio teachers, their teacher education is based on their childhood learning and performance experiences and their pedagogical skills are based on "instinct, intuition, and of course imitation" (Lopinski, 2005, p. 1). Teachers who work in home-based studios have infrequent contact with other musicians. Even those studio teachers who work in a music conservatory often have schedules that are too tight to allow them to work with their conservatory colleagues. The sense of isolation experienced by studio teachers is symptomatic of a lack of infrastructure that could help teachers to learn and incorporate new pedagogical ideas and techniques. A recent survey of studio teachers indicated that an overwhelming majority of teachers feel this sense of professional isolation (Feldman, 2010).

Technological developments have played an important role in advancements in the music and education fields, and we believe that technology can help to bridge the gap for students and teachers involved in studio instruction, both in terms of how students and teachers interact with one another between weekly lessons, and in terms of enhancing student learning. Therefore, the purpose of the research described in this paper was to explore the implementation of an electronic portfolio, called ePEARL, in the music studio setting. A series of studies was designed to examine the extent to which ePEARL could be used to deepen music learning, as well as to guide the development of the tool so that it would be more suitable for the music studio context.

This paper profiles the three-phase research and software design process. We begin by framing our work with a review of literature on self-regulated learning and practicing in the studio setting and describe the electronic portfolio, ePEARL, that was used in the research. We then present each phase of the study. Phase 1 was an in-depth single case study to examine the efficacy of the tool in the studio context. Phase 2 employed a multiple case study method to examine the range of use and implementation of ePEARL in four studios, with students of varying ages, leading to design changes for ePEARL. Phase 3 involved the development of a new tool, called iSCORE, and the initial usability testing with case study participants and other music education specialists.

LITERATURE

Self-Regulated Learning and Practicing in the Studio Setting

Studio instruction refers to one-on-one instruction in home-based or conservatory settings where students take part in weekly lessons, usually between 30 and 60 minutes in duration. Between lessons, there is the expectation that students will practice, applying the ideas presented

at the lesson. During the practice sessions, students must plan, implement, and reflect on their progress, prioritizing the ideas presented at the lesson, clarifying practice goals, executing tasks and strategies to meet these goals, and then critically reflecting on their progress. While teachers often discuss practice strategies with students during these lessons, research evidence suggests that very few students apply the ideas that are discussed in their lessons (Barry & Hallam, 2002; McPherson & Renwick, 2001; Nielson, 2001). Parental supervision during practice is another strategy used to carry the momentum from one lesson through to the next. However, while parental supervision appears to be effective for younger students, it can be detrimental for older students who are seeking more independence from their parents (Barry & Hallam, 2002).

Both the amount of time spent practicing and the types of practice activities that students engage in during their independent practice sessions are predictors of success (Barry & Hallam, 2002). Hallam (1998) refers to purposeful practicing as deliberate practicing, which involves the identification of specific goals, receiving meaningful feedback, and having opportunities for mindful repetition and correction of error. In order for students to develop appropriate practice strategies, a high metacognitive level of knowledge about learning is required (Barry & Hallam, 2002). Self-regulated learning (SRL) is widely recognized as a core feature of metacognition. The extent to which a person recognizes what enhances his or her learning and how he or she consciously chooses strategies to learn more effectively marks the degree of self-regulation present in the learning process (Zimmerman, 2000). Reviews of research (Dignath, Buettner, & Langfeldt, 2008) have shown that SRL skills can be taught at both elementary and secondary levels, thus suggesting that even young children are able to develop self-regulating skills. Three cyclical phases of SRL involve both metacognitive and motivational components. The forethought phase includes task analysis, goal setting, and strategic planning. In the performance phase, task strategies are foregrounded. The third phase, self-reflection, includes self-judgment and self-reaction (Zimmerman & Tsikalas, 2005).

In studies designed to assess how students use self-regulatory practices in learning to play a musical instrument, researchers have found that self-regulation is an important component of effective instrumental practice (Austin & Berg, 2006; Bartolome, 2009). Less skilled musicians have not developed the self-regulatory habits of advanced musicians (Miksza, 2006; Nielsen, 2001; McPherson & Renwick, 2001) and may not know how to structure their practicing (Barry & Hallem, 2002). Advanced musicians are able to monitor their practice by focusing on aspects of their playing that can be improved, and by seeking help from others when facing technical difficulties (McPherson & Zimmerman, 2002). McPherson and Zimmerman (2002) name six parameters that support self-regulated learning in music: (a) students are motivated to set goals, (b) students possess methods to create strategies to support their goals, (c) students plan and manage their time, (d) performance behaviour is self-monitored and evaluated, (e) students structure physical environments for optimal learning, and (f) students use social connections to seek help.

Most evidence to date suggests that musicians feel that their training has not helped them develop metacognitive skills (Barry & Hallam, 2002). This research and software design study is predicated on the notion that having a tool that can support students in their practicing by encouraging the development of self-regulatory skills may, in turn, lead to more engaged music study. In addition, evidence suggests that computer-based tools may be beneficial for learners already experienced with information technology, and most contemporary music students are familiar with several forms of information technology (Savage, 2007). In the following section, we explore how electronic portfolios, and in particular, ePEARL can support self-regulation.

Electronic Portfolios and ePEARL

An electronic portfolio is a digital container for storing and organizing visual and auditory content, including text, images, video, and sound. Electronic portfolios may also be learning tools when they are designed to support learning processes and assessment (Abrami & Barrett, 2005). Electronic portfolios that are web-based provide remote access that encourages learning in any number of learning environments, making it easier for peers, parents, and educators to provide input and feedback in home settings as well as in music studios.

When students use portfolios, they assume more responsibility for their learning, come to understand their strengths and limitations, and learn to set goals (Avraamidou & Zembal-Saul, 2003; Montalvo & Gonzalez Torres, 2004; Riedinger, 2006; Zellers & Mudrey, 2007). Self-regulation refers to a set of mental behaviours that include monitoring, guiding, and evaluating one's learning. Students who are self-regulated actively direct their own learning (Zimmerman, 2000) and may demonstrate enhanced academic performance (Rogers & Swan, 2004). The active use of electronic portfolios may also enhance literacy and communication skills (Meyer, Abrami, Wade, Aslan, & Deault, 2010a; Meyer, Wade, Pillay, Idan, E., & Abrami, 2010b).

ePEARL (Electronic Portfolio Encouraging Active Reflective Learning) is a web-based portfolio, developed at the Centre for the Study of Learning and Performance at Concordia University. Portfolios are organized in classes, and each student receives a portfolio. The portfolios are designed to be student-centered, and as such, students design their own welcome page. There are folders in each portfolio, and within each folder, students document their work in artifacts. The structure of artifacts is reflective of the principles of self-regulated learning, that is, there are places to place, execute, and reflect on one's learning. To help students plan, there are places within the artifact for students to set goals, list strategies that they can use to achieve their goals, and indicate their motivation for completing the task. There is also space for them to display their work, by either writing text, or recording their ideas using a built-in recorder. There are also options to link to website links or upload files. Spaces for students to write/record reflections of their work are provided. The portfolios allow work to be stored for a number of years, as selected artifacts can be put in a presentation folder, or can be exported in html format. In this way, when students have finished using their portfolios, they are still able to access their completed artifacts.

The web-based format of ePEARL allows for communication with teachers and other members of the studio class. Teachers have access to portfolios of students in their class. Parents have access to their children's portfolios as well, and students may choose to share their portfolios with any or all of their classmates. Teachers, students, and parents can comment on the artifacts. Long-term studies demonstrate that ePEARL produces student gains in educational competencies and self-regulation, as well as changes in teaching practices that encourage active use of self-regulation strategies to guide student learning (Upitis, Abrami, Brook, Troop, & Catalano, 2010). This portfolio also builds community by allowing peers, and teachers to access one another's work (Upitis, Abrami, & Patteson, 2010).

ePEARL has been successfully used in classrooms in Canada, the United States, and parts of Europe to increase levels of self-regulation and achievement, primarily in language and social studies. The research reported in the present paper describes how ePEARL enhances the experiences of students and teachers working in music studios.

OVERVIEW OF THE STUDY

This three-phase study spans almost two years of work (January 2010–October 2011). The first two phases involved exploratory case studies with purposeful sampling (Yin, 2009). In Phase 1, we explored the incorporation of ePEARL in one studio (Upitis et al., 2010) for a four-month period (January-June 2010). In the second phase of the study (September 2010–February 2011), we extended the research to four music studios, soliciting feedback from studio teachers and their students about how ePEARL might be modified to more fully support both students and their studio teachers. In Phase 2, three piano studios and one voice studio were involved. In both phases, data were collected from teachers and students, as well as through an examination of the portfolios themselves (Brook, Troop, & Upitis, 2011). The third phase of the study began in January 2011 and involved the design and development of iSCORE, based on the feedback from Phase 1 and preliminary data from Phase 2. Phase 3 was completed in October 2011, with a scheduled release of iSCORE to take place in January 2012.

PHASE 1: AN IN-DEPTH CASE STUDY

Selection of the studio teacher

Based on the review of the literature, it is apparent that developing self-regulation skills is an integral part of successful music learning in the studio context. It is also clear that the pedagogical approach embedded in the ePEARL tool supports student-directed learning and the development of students' self-regulatory skills. Thus, the main criterion for selecting the studio teacher for the initial study was that she/he would be willing and able to explicitly teach SRL skills. The participating teacher also needed to be willing to learn to use the ePEARL tool and incorporate it in his/her studio practice. Because one of the universities involved in the study is located in Kingston, Ontario, Canada, we selected Kingston as the city in which the study would take place for ease of access. In addition, Kingston has an active music community: there are approximately 30 music teachers registered with the local music association. After describing the study to the Chair of the Kingston Branch, several potential participants were identified, and one teacher was selected. After obtaining consent from the teacher and parents of the students to take part in the study, the teacher began using ePEARL with her students in January 2010.

Research questions and data collection tools

In Phase 1 we explored two research questions: (a) How does a student and her music teacher use ePEARL to support music learning over a six-month period? (b) To what extent did the student become more metacognitively engaged as a result of taking part in this creative pedagogical approach?

We focused on the teacher's interactions with one of her students, Elza, and her mother. Elza was a nine-year-old girl, best described as an advanced beginner. Several sources of data were used. Most important was the portfolio itself. Portfolio data included (a) the student-teacher-parent-peer interactions on the home page and throughout the portfolio, (b) the recorded artifacts of the student's playing over a six-month period, (c) the recorded demonstrations by the studio teacher, (d) photographs and scanned documents related to the student's music-making both within the context of lessons as well as music-making at school and at home that was not

specifically related to the lessons, and (e) the student's self-declared general goals, specific strategies, reported motivational levels, and reflections contained throughout the portfolio. Semi-structured interviews were conducted with the parent and the teacher. Questions focused on the use and implementation of the tool in the lesson and in the practice sessions between lessons.

Data analysis

In examining the portfolio, we analyzed each artifact related to the music lessons themselves, as well as the artifacts relating to music that the student listened to for pleasure, her music activities at school, music she shared with peers, and her ensemble choral performances. Qualitative data were analyzed by the researchers according to established protocols. Verbatim interview transcripts were coded using Atlas.ti [5.5] (2010) where deductive and inductive qualitative analysis techniques were used.

FINDINGS

Using the electronic portfolio tool

Participants found the tool easy to use. As noted by the teacher, "I found ePEARL to be pretty straightforward to use. You need to spend a little time acquainting yourself with the features and the vocabulary, which is true of all software." ePEARL increased the communication between the teacher, the student, and the parent. It also supported Elza's ability to plan, execute and reflect on her work, largely through the use of the embedded recorder. The portfolio homepage served as an electronic dictation book, where the student or the teacher would write in the week's tasks on the homepage. There was an expectation that the student would have to complete some of these tasks prior to her lesson as the teacher would view the portfolio mid-week and offer feedback to the student at that time. In this manner, the student and teacher wrote back and forth to one another between lessons. In addition, the parent also used the homepage to communicate with both the teacher and the student. This involvement on the part of the parent was welcomed by both student and teacher, as it enabled the student to progress quickly. In the words of the teacher, "I also use the feedback feature to e-mail with Elza's mother, who is very supportive of Elza's ePEARL use. We use this feature to communicate about what has been worked on in both the lesson and at home. This is similar to a paper and pencil dictation book, but seems to be a medium that Elza's mother and I find easier to use."

The recording feature in ePEARL allowed the teacher to upload audio samples for Elza to refer to during the week. Sometimes these recordings were of an entire piece of music. At other times, the teacher simply played a phrase or passage that the student found challenging. Then, the student could listen to these demonstration segments as she practiced during the week. This recording feature, as well as the ability to upload recordings, was also used by Elza when she recorded her own playing. Through this process of recording and listening to her playing, Elza's ability to critique her performances improved, and she was able to set specific task goals that helped improve her playing. She would often practice a piece of music six or seven times before making a recording—more often than would have been the case had she not had the incentive to provide a good recording for her teacher. As the teacher noted in the interview, "Elza doesn't simply record any old thing and post it. Rather, she practices a passage until it's her best and makes sure that she has a recording that represents her best playing." Over time, Elza was able to

return to previous recordings and was able to hear how the piece had improved. Having these artifacts proved to be especially useful when she became discouraged, thinking that she was not progressing as quickly as she wished.

Elza also profiled the music that she enjoyed listening to in her portfolio. Although she rarely accessed the music that she profiled once it was uploaded to her portfolio, her peers and parents examined the pieces in the folder and commented on the music. As Elza's mother noted, "I had no idea what Elza was listening to on the radio and on YouTube. By examining her portfolio, we were able to engage in discussion about the music that she likes most—as well as talking about the appropriateness of the lyrics!"

Elza also documented special music events. For example, she added scanned concert programs and practice sheets from previous lessons. Two more active uses of the portfolio, not related to music lessons, were also employed. First, Elza was attempting to learn a piece of choral music for her school choir. She entered the lyrics for the piece into her portfolio, and then made several recordings to help her refine her singing. At one point, her mother (a singer) sang portions of the song in duet, and both mother and daughter reflected on how enjoyable the process had been, and that they would not have undertaken such a process without the support of the portfolio. The mother wrote in the portfolio, in response to her daughter's reflection, "I agree—it was VERY fun to do. And I love knowing that we can listen to you sing this again and again. You have such good pitch and clear tones, it's a real pleasure to listen to you sing solo. I like your version much better than the YouTube one that you've linked to the URL on your school music folder." Another active use of the portfolio was with the student's brother, also a musician with a portfolio of his own. One afternoon, the two siblings spent several hours creating a composition with GarageBand, and this piece was archived in both children's portfolios.

Metacognitive engagement

Perhaps the most promising finding in the Phase 1 case study was the degree to which the use of ePEARL engaged the student more deeply in the practice of learning to play an instrument. Indeed, the very act of being asked to set general goals for the term motivated the student to decide to practice for an exam on her instrument, something she had previously not been interested in attempting. It became apparent from the portfolio itself, and the observations of both the parent and the teacher, that Elza became more motivated to practice and became more adept at articulating her goals and reflecting on her performance. Elza became more willing to engage in discussions around strategies for learning to play difficult passages in her music. One of the reasons that this may have occurred was that the reflections offered by both parent and teacher offered clear directions for how to proceed, and continually supported the student in her endeavors. The student-centred nature of the portfolio also allowed Elza to explore and document types of music-making that were important to her beyond learning piano repertoire. The teacher acknowledged the potential that ePEARL had to both broaden and deepen music education. She stated:

I've always wondered how I can balance a general music education, including composition, history, and theory, with the specifics of developing piano technique. In the past, I've had students make posters about their pieces, or research a composer. I've had more difficulty working improvisation and composition into the lesson. While time and interest still remain issues, I think that ePEARL may be part of a solution. In the future, I would like to get

my students to develop an ePEARL artifact that's history based using web resources. The ePEARL artifact can provide a place where students can feature their ideas and can also share them with others in the studio. Similarly, using music software may help in the composition process and ePEARL can be the interface that supports this.

Conclusions for the Phase 1 Case Study

By using the ePEARL portfolio, the student was able to archive her work through various recording features, which in turn enabled her to listen to how her playing evolved as the term progressed, making critical reflections and changes to her playing as a result. She also used the portfolio to effectively set goals with her teacher, often during the lesson but also during the week between lessons. In addition, because the student was encouraged to bring all of her music interests to the portfolio environment, her formal piano lessons were no longer separate from the music she listened to on her hand-held devices.

Even though there was universal praise for the ways in which ePEARL enhanced music teaching and learning, the participants also indicated that enhancements to the tool could be made for the studio context. Suggested features included a more interactive chat function, a way of date-stamping or flagging new additions to the portfolio, and adding a video annotation feature to the tool. The next phase of the study was designed to further explore the types of features that needed to be added to enhance ePEARL's efficacy in the music studio context and to validate the findings from the first study with a larger and more diverse group of teachers and students.

PHASE 2: MULTIPLE CASE STUDIES

Selection of the studio teachers

We followed the same sampling method as in the previous phase, but this time, examined studios in two cities, Kingston, Ontario, Canada, and Toronto, Ontario, Canada. The criteria for selecting the studio teachers for Phase 2 were the same as the previous phase. First, teachers needed to be willing and able to explicitly teach SRL skills. Second, the participating teachers also needed to be willing to learn to use the ePEARL tool and incorporate it in their studio practices. We expanded to Toronto to include teachers affiliated with our institutional partner, The Royal Conservatory of Music. By doing this we were able to recruit studio teachers who provided instruction to a wider array of students and who taught in a broad range of studio context, including home studios, conservatories, and universities. In total there were 15 students, ranging in age from 10 to 23 years, and four music teachers involved in this study, all of whom consented to take part in the research. Three of the teachers taught piano, while the fourth teacher was a voice instructor. One teacher provided instruction in a home studio, two teachers taught in three locations; namely, a home-based studio, at students' homes, and at a university, while the fourth teacher taught at a conservatory and in her home studio. Teachers were introduced to the tool through a one-day training session where they familiarized themselves with the features of the tool, as well as with the empirical research related to self-regulated learning. Teachers then introduced the tool to their students during weekly lessons.

Data collection tools

We interviewed the teachers and the students four months after they had been using ePEARL. Questions focused on the use and implementation of the tool in the lesson and in the practice sessions. As in Phase 1, we also examined the portfolios themselves.

Data analysis

The portfolio analysis was supplemented with interview data from the teacher and students. Data were analyzed by the researchers according to protocols established in Phase 1. We coded the data guided initially by themes that emerged from the previous phase. These codes were grouped into families related to the perceptions of the tools, how the tool impacted students' learning, and what features could be added.

FINDINGS

Using the electronic portfolio tool

All participants found the tool simple to use, noting that the layout of the tool was intuitive and the buttons were easy to find and understand. Students tended to access the tool two or three times a week between lessons. When they logged on, they viewed other portfolios that had been shared with them, and then focused on their own portfolios. As in the first study, we found that the embedded recorder was the most utilized feature, as students frequently created recordings of their pieces and upload them for others to hear. Easy access to recording equipment was helpful, and the demands of producing a recording motivated students to fix various issues in their repertoire. As was explained by one young student, "[Recording] gets me to practice until it is really good" (male, age 11). The recording process also helped students develop their listening skills. Actively and critically listening to their performances encouraged students to improve aspects of their playing and singing. One participant noted: "When I play it I think it's completely fine but when I hear it, it's kind of like 'Oh, I missed that, I missed this.' So I think that [being able to record myself] really helped me" (male, age 14). This finding reinforced the need to easily access recording equipment in order to support students' learning through the recording strategy.

As was found in Phase 1, the teachers gave students feedback through ePEARL between weekly lessons. This extra feedback allowed students to progress more quickly and motivated them to make recordings for others to hear. As one 15-year-old male student noted, "It's better than waiting the whole week [for my teacher's comments]…so I still have more time to work on [my repertoire]." Interestingly, none of the teachers felt that it was an onerous task to check students' portfolios. Rather, they explained that the mid-week check-ins made the lessons more efficient as they had a better understanding of students' progress between lessons after viewing the work students displayed on ePEARL.

The ability to communicate with others was an integral aspect of the tool, but also its greatest limitation. Checking to see if someone had left a comment was the first thing many students did when they logged on to ePEARL. Students liked receiving peer comments and enjoyed sharing their musical work with other students in the studio. As one student noted, "It's nice that you can share stuff with other classmates. They can see your [portfolio], you can see

theirs" (male, age 14). In the piano studios that contained both adolescent and university students, some of the university students commented on the younger students' artifacts. This was particularly helpful for those university students who were considering becoming music teachers, as they learned how to formulate feedback through the process. The use of ePEARL also provided these aspiring music teachers with an opportunity to see how their own teachers commented on other students' work, and how the receivers of the feedback incorporated the additional ideas, methods, and strategies that were offered. As one adolescent student observed, "I've posted a lot of videos and then other students give me feedback and then tell me things that I couldn't hear and things that were good and I should keep up, so that was helpful" (female, age 14).

Some users were expecting that ePEARL would have more communication features that would allow them to exchange files and share documents with their peers and their teachers. For example, the vocal teacher established her own portfolio to distribute practice supports, such as recordings of ear training and technical exercises. The difficulty with this approach was that the tool did not allow teachers to post documents directly to students' portfolios, which meant that students could only access these additional artifacts through the teacher's portfolio. This was frustrating for the users and some stopped using the tool as a result. In addition, with no notification feature, students and teachers were not made aware when something new had been posted, which resulted in students not completing the posted exercises and teachers needing to spend valuable time searching for new additions to artifacts. All of these shortcomings of using ePEARL in the music studio context were addressed in the design of the new tool in Phase 3.

Metacognitive engagement

Using ePEARL helped students to plan and reflect on their learning. Generally, students would log in to ePEARL shortly after their lesson and used the scaffolded structure of the portfolio to set practice tasks for the week. As one 20-year-old female student noted, "I really like using [ePEARL] because it really isolates [my goals], sometimes you just feel so scattered…and you just don't know where to start." By using ePEARL, students were able to systematically organize the ideas given at their lessons and could turn this information into practice tasks.

The ePEARL format provided an appropriate structure for both younger and older students. Teachers provided their younger students with clear ideas for more effective practicing that they could record and monitor through ePEARL. The older students made critical decisions that led to an increasing sense of artistic autonomy, as illustrated by this comment: " I really like the fact that you get to choose your own goals and strategies... it's very independent-oriented…it kind of forces you to do your own work" (female, age 20). In this way, the explicit naming of planning phases (e.g., asking students to list task, and goals) was helpful in organizing their ideas, while the blank textboxes in these categories allowed them to incorporate their own ideas. The ability for students to choose and develop strategies seemed to be valued by students; however, there was no mechanism that could compile the practice strategies that students were developing in their practice. Therefore, each time they began a new artifact there was no way for them to transfer a learning process between artifacts. Features that allowed students to develop practice strategies and recall these procedures as they planned their learning would have been valuable, and were incorporated into Phase 3 of our work.

Conclusions for the Phase 2 Multiple Case Study

We found that ePEARL supported and enhanced students' self-regulatory behaviors. Students were able to articulate their goals, which helped them to focus their practice time. By using ePEARL, students had a structure to help them clarify and refine the ideas from their lessons and to develop a series of practice strategies to implement their musical plans. The tool did not tell students what to do, but rather gave them a structure to guide their thinking in an organized and systematic manner.

The embedded recording supported students' ability to reflect on their playing and singing as they attempted to achieve goals and self-evaluate the sounds that they were producing. As students continued to use the recorders, they became more adept at hearing their errors and applying appropriate strategies to remedy any shortcomings. Over time, students felt that they were becoming more autonomous in their learning and could progress with a greater sense of artistic freedom. The archival ability of the tool also helped them hear their progress over time and encouraged mastery learning. The social aspect of the tool was particularly attractive, but also the feature that was most limiting. Students wanted to interact with each other more often, both synchronously and asynchronously, but were limited by the tool's capabilities. In addition, some students found the ePEARL interfaces to be text heavy and experienced difficulty in articulating the specific tasks for learning a certain piece in a meaningful way, as they were required to type their ideas in a separate area rather than on the recordings themselves. These difficulties were also considered in the Phase 3 design process.

PHASE 3: DESIGN AND DEVELOPMENT OF ISCORE

Findings from the research in Phase 1 and Phase 2 revealed the need for the development of a web-based tool specifically for the studio context. While ePEARL had many features that students and teachers found useful, it was clear that a tool that could capture music-making more fully, and allow others to provide feedback in a meaningful and efficient manner involving written, audio, and video formats, would be even more powerful. Further, it was determined that a tool designed for the studio music context also needed communication features that could connect teachers, students, and parents allowing them to chat and email and to distribute studio-based information (e.g., rehearsal and recital dates, studio policies, instructional hand-outs). These findings resulted in the development of iSCORE, which included some of the basic features of the parent tool, ePEARL, as well as the addition of new features, which are described in the following section. iSCORE was developed at the Centre for the Study of Learning and Performance (CSLP) at Concordia University, in partnership with Queen's University and The Royal Conservatory. The design and development was funded by Canadian Heritage.

Overview of iSCORE

An iSCORE portfolio contains seven main tabs: Home, Work, Overview, Sharing, Calendar, Files, and Mailbox. The first three tabs—Home, Work, and Overview—support students as they set goals, learn new repertoire, develop self-regulatory strategies, while the other four tabs—Sharing, Calendar, Files and Mailbox—enhance communication between studio members.

Supporting Music Learning: Home, Work, and Overview

Home is the first page that students see when they open their portfolios. Students can personalize this page by uploading a picture, selecting a banner, and writing a welcome message. Students also write their overall learning goals for the year (General Goals) on the homepage and are informed of upcoming events on their calendar. This page contains the students' discussion board, Notes n' Posts, which allows others members of the studio community (peers or teachers) to leave messages or post links or documents.

Work refers to the section of the portfolio where students set goals, describe tasks and strategies, create documents and recordings, and reflect on their work. Like the parent tool, ePEARL, the work section is structured according the three phases of Zimmerman's self-regulation model: Planning, Doing, and Reflecting. In the Planning section, students outline their tasks and goals, and select appropriate strategies that will help them achieve their goals. Students' strategy selection is supported through a strategy bank. Strategies are compiled across work pages, and students can select the most appropriate one for each work project.

The Doing section is where students display their work in many different formats. In addition to a text box, and hyperlink functions, students can record work using an embedded recorder. They can also upload files and annotate their work using the embedded annotation tool. With the annotation tool, students and teachers can type or audio-record feedback directly on the video or audio recordings that have been uploaded. At the bottom of the Doing screen is a summary of students' work plan (developed in the Planning section), thus allowing students to easily access their work plan while they execute their work. In addition, there is a checklist and journal on this page so that students can immediately reflect on their work.

The Reflection section provides scaffolding to help students think about how well they were able to execute their plan. This section includes a series of questions and prompts to guide students as they think about their processes and the products that resulted. At the bottom of this screen, students can access previously recorded information about their goals, task criteria, and strategies.

The Overview tab allows students to examine their progress. In this section students see an overview of all their strategies, seeing how often each strategy is employed. Similarly, students can explore how often they are addressing aspects of their general goals through their work.

Supporting Communication: Sharing, Calendar, Files, Mailbox

The research from the first two phases of this study indicated the importance of facilitating the exchange of information and ideas between studio members. Therefore, the newly designed iSCORE includes tools that support the exchange of information related to development of students' work and studio activities. However, while iSCORE contains these enhanced communication features, students retain the ability to control what they want to share, and with whom.

Sharing: This tab serves as a gateway for students to view others' work and is also where students grant permission to others to view their portfolios. Students can allow others to see specific pieces of work, or all of their work items. In this tab, students see a list of other studio members who have granted them access to various parts of their portfolios. By clicking on these

names, students can view their peers' portfolio, examine their work, and also leave posts regarding a specific piece of work or leave a message on the Notes 'N Posts discussion board.

Calendar: An electronic calendar was designed for iSCORE. This calendar is linked to the Planning portion of the work tab, whereby students can schedule practice sessions. In addition, students and teachers can schedule rehearsals, master classes or recitals on the calendar. In this way, students can schedule events with one another, without the teacher having to mitigate communication. In addition, teachers and students can easily broadcast scheduling information to others. Information from other web-based calendars can be imported into the iSCORE calendar as well.

Files: To respond to the need for teachers and students to distribute documents, recordings, or other multi-media to students, a filing cabinet was created, where teachers and students can upload and distribute files. iSCORE help resources are also included in all filing cabinets. These help resources include a User Guide, instructions to help users set-up their portfolios, sample lesson plans, research reports about self-regulation, and pilot studies related to the tool itself.

Mailbox: iSCORE contains its own e-mail system. If two users are online at the same time, this e-mail system can become a chat feature, as users can then communicate synchronously through this feature. Users can also add attachments to the e-mails. Unlike the discussion board, Notes n' Posts, the mailbox remains private to the author and receiver of each of the messages.

Usability testing of iSCORE

A prototype of iSCORE was distributed to the pilot study teachers to use in their studio for six weeks. In addition, university professors in music education also tested the iSCORE prototype over the same six-week period. Usability testing indicated that the tool was well suited for the studio setting, with the new features supporting the music making. Of all of the new features, the annotation feature appeared to be the most powerful in terms of engaging students and supporting the development of goal setting and reflection. The enhanced communication tools also motivated users to engage with the tool, and in turn to engage in the music-making process.

CONCLUSION

The results of this three-phase study indicate that web-based electronic portfolios have the ability to increase students' motivation to practice, and in doing so, provide support to both students and teachers in the studio music context. Results also demonstrated that students develop more sophisticated self-regulation strategies as a result of using these tools, and that these strategies are applied to the learning of repertoire and other music-making activities.

Further research will be undertaken from 2012–2017 once iSCORE is released, including a three-year study of 48 studios in three major Canadian centres. This longitudinal study will compare 24 studios where iSCORE is used with 24 studios that are matched in terms of geography and student records, but where there is no parallel electronic tool in place. This long-term research will be guided by the exploratory case studies reported here. Along with the interview and analysis protocols that have been developed to date, we will also analyze changes in examination results and overall music enjoyment and achievement over time. In this way, we

expect to demonstrate how skilled studio teaching, assisted by a powerful web-based tool, can encourage students living in the digital age to continue to pursue musical studies to a level of proficiency that carries them into adulthood.

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