Cadenza: The Evolution of a Digital Music Education Tool

Rena Upitis[1] and Philip C. Abrami[2]
[1]*Faculty of Education, Queen's University, Kingston, Ontario, Canada*
[2]*Centre for the Study of Learning and Performance, Concordia University, Montreal, Québec, Canada*

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Abstract: This paper describes the evolution of Cadenza, a digital music tool designed to inspire and assist students with practising between music lessons. Cadenza was developed using an evidence-based research and design model, supported by funding for both the research and software design. The focus of the present case study is on how Cadenza has continued to thrive after the research funding period ended, through a community-based not-for-profit organizational structure housed within the auspices of the host research institution. In an era where technology transfer has become a goal for many post-secondary institutions, this case study illuminates both the advantages and pitfalls of creating a start-up enterprise under the umbrella of an established university.

1 INTRODUCTION

Digital tools for music teaching and learning can enrich and even transform students' musical worlds. There is extraordinary potential for music technology to engage students in their musical practice, link them to their teachers and musician peers, and help them develop the kinds of habits they need to make music for the duration of their lives (Gouzouasis and Bakan, 2011; Ruthmann and Mantie, 2017). Further, digital tools and online communities have the potential to help teachers form collaborative professional networks (Burnard, 2007; Savage, 2017) which is of considerable importance in a profession that is largely unregulated and has been identified as being marked by professional isolation (Feldman, 2010).

But using digital tools, especially where the aim is to develop self-regulated musicians, is not without challenges. The tools themselves need to be powerful and appealing in a sustained way—they need to do much more than engage the students initially, only to be dropped for the next tool or app that comes along. The teachers using the tools also need to have technological and pedagogical savvy, or at least the willingness to learn, in order for such tools to be effective. And the tools also need to continue to evolve and develop, in a sustained manner, in order to continually improve the teaching and learning environments in which they are used.

With these considerations in mind, in this paper we describe a digital tool that was expressly designed for the independent music studio. The evolution of the development of this tool, based on an evidence-based research approach and the self-regulation learning theory, is also described. Next, we discuss how this iterative evolution, based on research findings, was transitioned to a new university-based organizational structure, allowing for the continual evolution of the technologies once the formal funding for research and development ended.

2 LITERATURE

In many countries, world-wide, where the Western musical canon prevails, millions of young people take weekly music lessons from independent or studio music teachers, often in addition to their school music instruction. In Canada alone, it is estimated that over 2 million students are involved in this particular form of music education annually (Upitis and Smithrim, 2002). Increasingly, these students are using digital music technologies to support their music teaching and learning, some of which have been designed with the explicit aim of developing independent self-regulating lifelong musicians (Upitis et al., 2013).

2.1 Developing Self-regulated Learners

A vast array of studies has demonstrated that learning is more enduring and effective when students take control over their learning through processes of self-

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regulation (Dignath et al., 2008; Zimmerman, 2011). Zimmerman's self-regulated learning model defines self-regulated learning (SRL) as an incremental process, where self-generated thoughts, feelings, and actions are planned and adapted to achieve personal learning goals. At the beginning, novice learners require a considerable amount of scaffolding and social support to emulate expert learners. Over time, learners develop forms of scaffolded self-control, and ultimately, self-regulation. Zimmerman (2011) claimed that fully self-regulated learners continually engage in an iterative three-phase cyclical process comprised of *forethought*, *performance/volitional control*, and *self-reflection*. These phases are interactive and comprise a wide array of cognitive, social, and motivational variables.

2.1.1 Forethought

The self-regulatory cycle begins with the *forethought* phase (Zimmerman, 2011), which involves task analysis and self-motivational beliefs. Goal setting and strategic planning are part of task analysis, while self-motivational beliefs encompass self-efficacy beliefs, expectations in terms of outcomes, and the intrinsic value placed on the learning. Goal setting and strategic planning often take place in music lessons with the teacher's guidance (McPherson et al., 2012).

2.1.2 Performance

Performance/volitional control refers to the activities that learners undertake to describe and reach their goals (Zimmerman, 2011). These processes might include self-instruction, imagery, attention focusing, and various specific task strategies to help ensure that music practice sessions, between lessons, are efficient and effective.

2.1.3 Self-reflection

In the third phase, learners engage in a process of *self-reflection*, made up of self-judgment and self-reaction (Zimmerman, 2011). Self-judgment involves an evaluation of the learning activities and causal attribution, where learners ascribe reasons for their successes or failures, as well as factors that they can address in the next phase of their learning (McPherson and Renwick, 2011). The process of self-reaction includes affective responses to the learning, which can be adaptive or otherwise, thus influencing the student's development, both as a musician and as a self-regulated learner.

2.2 Self-regulation, Music Learning, and Digital Tools

Intense commitment is required to learn an instrument, and it can be extraordinarily difficult to sustain such commitment over extended periods of time. Self-regulation holds promise as a way of ensuring that learners develop the processes persist with music study over many years (McPherson et al., 2012; Varela et al., 2016).

Self-regulation is of particular importance during the time between music lessons. While the lesson setting consists primarily of the teacher responding to and directing the singing or playing of the student, the practice setting involves the student managing and responding to his or her own singing or playing. Students who become long-term and independent musicians do so as a result of developing effective habits of self-regulation (McPherson and Zimmerman, 2011) including deliberate and effective practice strategies (Hallam et al., 2018). Deliberate practising involves the identification of goals, receiving meaningful feedback through a supportive social network, and having opportunities for mindful repetition (Hallam et al., 2018). This kind of deliberate practising does not come easily for many students, and teachers use a variety of methods to support their students between lessons (Pike, 2017; Upitis et al., 2015).

Further, as the student implements what has been learned at the lesson, he or she must be able to assess whether the practising is leading to the desired outcomes (Pike, 2017; Hallam et al., 2018). This type of critical reflection can be difficult, as students are required to simultaneously produce sounds *and* reflect on the sounds that they produce. Consequently, students may rely on parental oversight, along with practice aids developed by their teachers (Upitis et al., 2013; Upitis et al., 2015). Students may also use digital resources to ensure that their practice sessions are enjoyable and productive (Partii, 2014; Savage, 2017).

2.2.1 Cadenza

Cadenza is a web-based practice tool designed on the model of self-regulated learning. It was designed to motivate and guide students to take responsibility for their practising and overall music learning. In accordance with self-regulated learning theory, Cadenza provides the scaffolding required for students to become self-regulated musicians by providing features that support forethought, volitional control, and self-reflection—the three pillars that

mark the self-regulated learning cycle (Zimmerman, 2011). There is a teacher version of Cadenza as well, which enables teachers to streamline their record-keeping, by quickly accessing information on particular students or locating past lessons. The teacher can also create group lessons, so that tasks that are common to several students can be easily shared, without needing to re-invent or re-type those common tasks.

Students are encouraged to set goals, with the guidance of their teacher(s), and during the lesson, the teacher records the strategies that students can use to achieve those goals. These strategies are contained both in the task descriptions as well as in a nuanced check-list feature, where teachers and students together negotiate the volitional stage of their learning. Using this sophisticated check-list feature, the teacher can specify, for example, the total number of repetitions for a given task, the number of correct repetitions, or the length of time to devote to a task for each practice session. The student then refers to the lesson plan during the practice sessions, recalling the directions given by the teacher during the lesson. Cadenza tracks targets and goals as the week progresses, and the teacher can see student progress and check on particular aspects of practice sessions when notified by the student.

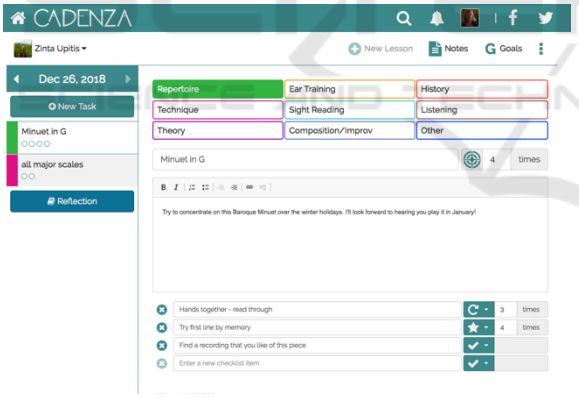

Figure 1: Cadenza Lesson Student View.

Students and teachers can create, archive, and display work by writing text, or uploading text, audio, video, links, and images on either the teacher or student version of Cadenza. Finally, students are invited to reflect on their work to assist them in planning for the next learning cycle. The reflection features also enable teachers to comment on student work in dynamic ways. One of the sharing features is a video annotation tool, where students can upload a sample of their playing and receive feedback from their teacher before the following lesson. Online teaching materials support teachers using Cadenza, and workshops and webinars are conducted regularly to help teachers use Cadenza effectively in their studios. Cadenza also supports communication between teachers and students during the week, so that teachers are aware of the work that students have completed between lessons, and students can seek help as required.

2.2.2 Developing Cadenza

Cadenza is one of four digital music tools developed by the Music Tool Suite project, a multi-institutional partnership that was first established in 2010. The partnership was initially comprised of a Canadian team of researchers, studio teachers, curriculum developers, and software designers from Queen's University, the Centre for the Study of Learning and Performance (CSLP) at Concordia University, and The Royal Conservatory of Music (until February 2017). In 2017 two new institutions joined the partnership, the Canadian Coalition for Music Education, a national advocacy and education group, as well as the UK based Curious Piano Teachers, an online professional development organization supporting piano pedagogy.

Cadenza was created over many years using an evidence-based approach to software design and development, an approach that was consonant with our university-based project. Since the development of Cadenza was supported by several substantial research grants, including a Canadian Social Sciences and Humanities Research Council Partnership Grant, the development of Cadenza and other related tools benefited from considerable research in its evolution. This meant that the research and development took place in a more measured way than the fast-paced development that characterizes the protocol of continuous software engineering that takes place outside of the academy (Avila et al., 2017; Fitzgerald and Stol, 2017). However, in 2018, an outside developer was also hired to continue development of Cadenza, leading to the most recent release (V. 3) in October of 2018, and thus, Cadenza, while initially developed using an evidence-based university led research model, is now evolving through an agile industry approach as it transitions from its research base to a not-for-profit organizational structure.

Cadenza was first released in April 2016 and was made available without charge. Another tool in the Music Tool Suite is Notemaker, an iOS app first released in December 2015. It is an effective tool for making real-time comments on video and audio recordings, sharing the same type of functionality as the video annotator in Cadenza. A third tool in the

suite, DREAM (Digital Resource Exchange About Music) was initially released in September 2014 and was designed to provide teachers easy access to digital resources related to music education. DREAM is no longer supported, as the project does not have the resources to continue to curate the site. Finally, iSCORE, a web-based practice and communication tool, was released in 2012 and re-released in 2013. It continues to available in both English and French and has a limited number of users in Canada and Europe. All of these tools are supported by instructional videos to help teachers, parents, and students implement them effectively at home and in the music studio. Videos can be accessed through our website (www.musictoolsuite.ca) or on our YouTube channel.

2.3 Post-development: What Next?

It is not uncommon for academic research projects to wind down completely when the funding period ends. As a result, a number of universities have recently developed structures to increase the likelihood of the commercialization of research activity through the spinoff of new companies (Fitzgerald and Stol, 2017; O'Shea et al., 2007). The host institution for the Music Tool Suite project, Queen's University, is one of many universities that is now learning to adopt this approach, devoting both financial and human resources to knowledge mobilization and technology transfer, as well as embedding supporting structures into the university itself. The central purpose of this paper is to describe the initial phases of the post-development journey of the Cadenza tool.

3 METHODOLOGY

A case study methodology was used to characterize the evolution of Cadenza from a university research project to a social entrepreneurship start-up community organization (Yin, 2017). The case study was bounded by a 20-month time frame, beginning in March of 2017. The organizations involved included the founding universities (Concordia and Queen's), the newly acquired industry developer (Troon Technologies), and the two new partnering organizations (Canadian Coalition for Music Education and Curious Piano Teachers). The research was carried out in accordance with the Canadian Tri-Council Policy Statement governing research with human participants (Canadian Tri-Council Policy Statement 2, 2010). Data sources included interviews with key informants, reflective field notes of the first author, meeting notes involving the various partners and staff involved in the Cadenza transition, and electronic surveys of teachers using Cadenza. Data were coded according to standard protocols for analysing qualitative data (Yin, 2017), and results were grouped into six overarching themes, as described in the section that follows.

4 RESULTS

The transition from a university research-based project to a self-sustaining business enterprise has resulted in a number of challenges as well as new opportunities that were not previously available to the project team. These challenges and opportunities are delineated below under six major categories, including a set of false starts which ultimately led to the structure that has been adapted for Cadenza. These include (a) identifying a suitable structure, (b) legal documentation and operational logistics, (c) finding an industry partner, (d) hiring a Project Manager within the university structure, (e) negotiating with senior university administration, and (f) marketing and communications.

4.1 Organizational Structure

The first conceptual task in moving to a self-sustaining enterprise was the identification of an organizational and governance structure. To this end, several avenues and approaches were explored without success. These included but were not limited to: (a) making pitches to start-up local companies, (b) attempting to merge with another company that created digital tools for music education, (c) partnering with software and book publishers, (d) identifying higher education music partners, such as conservatories, to mobilize the software, (e) licensing Cadenza to organizations in China (e.g., the Shanghai Symphony Orchestra, based on an initiative spearheaded and financed by the senior administration of Concordia University), (f) creating an open source structure, and (g) forming a new company.

For various reasons, these routes were abandoned, as it became clear after meetings and negotiations that the fit was not ideal for promoting Cadenza. Ultimately, at the suggestion of the Office of Innovation, the founding partners along with the two new partners determined that creating an open community structure, housed as a not-for-profit within the university, was the most likely avenue to success. By housing what is essentially a small

business within the university, located at the Faculty of Education where the research project was also hosted, the Cadenza Community Project could take advantage of university resources at a time when the university was also interested in promoting this kind of knowledge mobilization—a form of technology transfer involving a type of social entrepreneurship.

4.2 Legal Documentation

Once the governance structure was determined, namely, a self-governing Steering Committee made up of the founding institutions as well as community partners, the process of developing the legal documentation began. Here we were aided by being part of a university system, as the host university took on the task of creating both the governance structure as well as the contributor agreements, necessary to acknowledge the past contributors of Cadenza and to release any future claims on the tool. In addition, a Research Amendment agreement needed to be formulated between the two universities, in order to move forward from the research-based structure to the independent Cadenza Community Project. These documents were first drafted in May of 2017. At the time of writing the present paper, the documents had not yet been signed by the two institutions but were in the final stages of negotiation. Legal documentation not only considered the issues associated with intellectual property, but also any future licensing arrangements that might be undertaken, outside of the scope of the Community Project itself.

In addition to the development of the legal documents, there were a number of logistical issues encountered on the financial side in terms of a revenue-generating enterprise within the University that was not part of an existing structure (e.g., tuition for courses). Several issues were encountered and resolved, including the integration of a payment system for Cadenza that would involve credit card payments, the creation of a tracking system for banking, and the negotiation of a tax on revenue. The University's policy of a 40% tax on external revenue was re-negotiated to 4% for the purposes of the Cadenza Community Project.

4.3 Industry Partner

Early in the evolution of the Cadenza Community Project, it became crucial to identify a new software developer, outside of the university context. We were aided by the Director of Partnerships and Innovation at Queen's University in identifying such a partner. Troon Technologies began working on Cadenza in April 2018, and delivered two new versions, the most recent of which was released in October 2018. The new versions feature a contemporary homepage and login, replacing the functional but less appealing university design (see Figure 2), as well as several new types of functionality, including a feature to allow the creation of group lessons and the addition of the video annotation tool to the teacher view. These changes, among others, have been embraced by our student and teacher users.

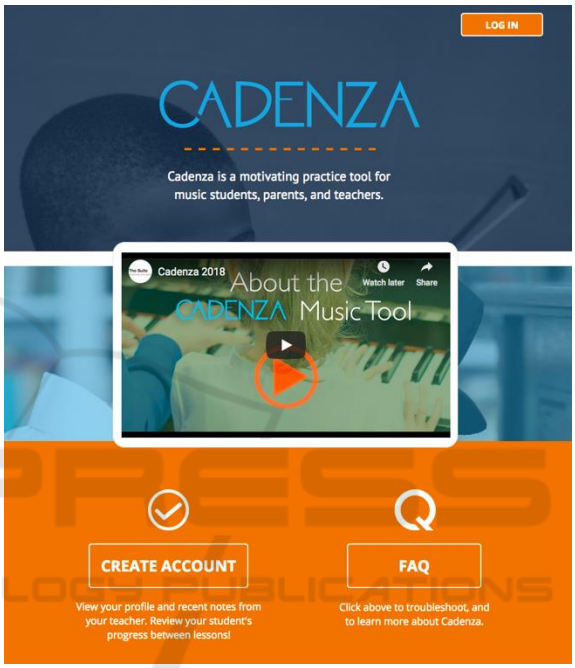

Figure 2: Cadenza homepage.

The research literature suggests that industry software development often from a lack of integration of planning, development and implementation (Fitzgerald and Stol, 2017). Researchers claim that what can be a lack of integration in industry is further complicated by problems in coordinating testing timing of releases. These types of problems were not encountered in our transition to Troon Technologies, as we have not experienced any discontinuities between development and deployment. That said, there were several striking differences between working with an industry partner and a university partner in software development. For example, in our experience, the university-based software development excelled at the integration of planning, development, and integration, but with the consequence that releases were infrequent, an often a year apart. Also, the ways in which the two organizations approached needs assessment and

design, as well as debugging the penultimate versions prior to release differed considerably. That said, the combination of the two approaches has led to a version of Cadenza that our users have embraced wholeheartedly, as indicated by post-release survey responses, the growth of new users, and the decrease in user queries regarding technical and pedagogical concerns.

4.4 Project Manager

The identification of a suitable Project Manager was a relatively easy task, as one of the teacher advisors who had been part of the Music Tool Suite since its inception was both capable and willing to take on the task. She was an ideal candidate, as she was already extremely familiar with the tool, having helped guide its development, and her large music studio practice made her an ideal person to interface with the users of Cadenza. In addition, as a music studio teacher, she had considerable expertise in running a small business, and this background has been essential to the start-up of the Cadenza Community Project. At the time of writing, the Project Manager had just finished her fourth month in the position.

It proved to be more difficult to hire such a person within the university staffing structure. Our Project Manager, in fact, has assumed the duties of an Executive Director, and would be named as such were this organization to be housed outside of the confines of the University. However, the moniker of Executive Director has specialized meaning within the University and could not be used in the present situation. It remains to be seen whether the title of Project Manager is properly understood outside of the university context.

4.5 Senior University Administration

Several layers of university administration were involved in the establishment of the Cadenza Community Project. At the central level of administration, there was both support and encouragement in establishing the organization. Senior staff from the Office of the Vice-Principal (Research) devoted countless hours consulting with the research team in order to make the transition. In addition, the Dean of the Faculty of Education made many tangible commitments to the project, including the provision of office space as well as agreeing to underwrite the project until August 31, 2021. This agreement gave the Cadenza Community Project a three-year window to show a profit and to begin to create a reserve fund.

4.6 Marketing and Communications

An effective marketing plan will be essential to the ultimate fate of the Cadenza Community Project. We were able to identify an independent marketer to help with the initial phases of the Cadenza Community Project. The first six-week campaign was successful by industry standards, as measured by organic growth in terms of Facebook posts, the list of teachers subscribing to the Cadenza mailing list, and the open rates and click rates for newsletter items. In terms of the latter, the open rates for our newsletters averaged 40% (industry standard 15.8%) and click rates averaged 3.5% (industry standard 1.5%).

The organic Facebook reach is depicted in Figure 3. Analysis of Facebook users showed that audience members who engaged with two or more posts a week were most engaged by those posts that promised to teach them something about their profession—music education—for free. So, for example, posts about how to set up a lesson using Cadenza were particularly effective. Looking deeper at the posts, the posts that showed images of the tool, used "how to" language, and explained how the tool would help teachers and students, resulted in the highest engagement rates. The analysis of the campaign also showed that diversity in post topics was crucial, as well as the approach of addressing "pain points," that is, aspects of the profession that teachers found to be particularly challenging.

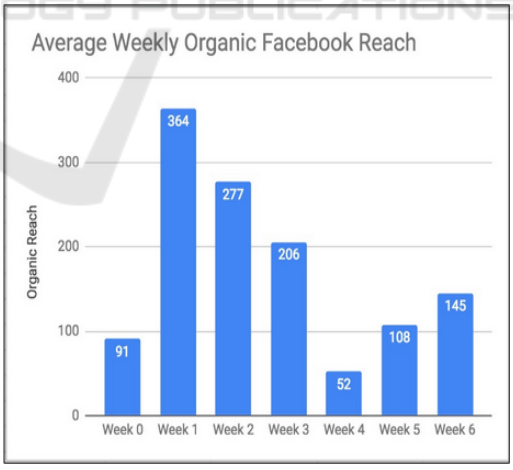

Figure 3: Facebook Reach.

From the analysis of the first six-week marketing campaign, it is predicted that the growth will be slow, but consistent, with 300 teachers joining in the next academic year on a base of 3,500 users. This growth should be more than ample in terms of meeting our revenue projections, where we require 50 subscribers

in the first year for a break-even scenario. As with the development of the Cadenza tool itself, we will monitor the effectiveness of the marketing campaign and make iterative adjustments accordingly.

5 CONCLUSIONS

The initial challenges involved in moving Cadenza from a university research-based setting to a stand-alone enterprise have been considerable. The difficulties have been compounded by being the first social entrepreneurship project in the Faculty of Education: we expect that, if we are successful, future groups will encounter fewer logistical difficulties, given that the way will have been paved, at least in part, by the Cadenza Community Project. There are also the challenges associated with any start-up, namely, learning to operate so that the enterprise breaks even and continues to evolve so that further developments to the initial products can be made and new products can be developed. Given that at the time of writing the Community Project was still in its infancy, it is difficult to say whether the project will take root and flourish. However, even the documentation to date is of academic interest at the very least: case studies such as this one can be fruitful for business schools interested in analysing this evolution of university-based entrepreneurship enterprises. Ultimately, in the spirit of honouring the research that went into the development of Cadenza, attempting to make this new structure work feels like a moral imperative, to honour not only the research investment, but also, the dedication of the students, parents, and teachers who invested so much in the development of Cadenza.

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