Collaboration, Technology and Affordances

Kay Greene
Music Director
Drama Instructor
Horton High School
Wolfville, NS
kgreene@gnspes.ca

At Horton High School, there are approximately 150 music students and 80 Grade 10 drama students. I teach all these students, in bands, choirs, orchestras, classes, and small ensembles. It is my hope that, before leaving my department, these students all understand the importance of collaboration and creative problem solving and therefore I strive to find for them every opportunity to hone their collaboration skills, and to be creative, collaborative problem solvers. I do this because I firmly believe that if they can creatively problem-solve, within a productive, collaborative group, then they can succeed at whatever they wish. I also know that collaborative work encourages critical thinking (King, 2008; Gokhale, 2008; Vygotsky et al., 2004). Rather than simply relying on the natural tendency for musical groups to be collaborative, I assign work that puts students in a position to collaborate. With the integration of technology into education, I have been able to use collaboration in new and exciting ways. Google Apps for Education (GAfE) has supplied many free and accessible ways to allow both synchronous and asynchronous collaboration between and among students. This work can be done face-to-face, or over a distance; there are more options available than I have ever experienced before. Faced with the prospects of an exciting new frontier, I find I must keep my enthusiasm in check and pace the introductions of new technology to my students. After having presented the classes with a few of the new possibilities, I noticed some students shutting down, or getting overly frustrated, or becoming very stressed and anxious. Does the integration of technology create too steep a learning curve for some students? Can I continue to share collaborative opportunities with my students using our newly implemented technology, without causing undo stress and anxiety? With the right pacing, a thorough understanding of the learning curve associated with technology integration, and knowledge of how the user interface and platform effect the perception of affordances, I believe that specific collaboration projects can continue in my program, with the inclusion of technological integration.

The process of creating an artefact together with other students provides learners with unique opportunities; they can reflect on common practice, and can adapt their own practice in response. Since we learn through observing, modelling and speaking with others, collaborative learning is, therefore, a socio-cognitive model (Robinson, 2012). And through this discussion, clarification of ideas, and evaluation of others' ideas, the development of critical thinking is fostered (Gokhale, 1995; Snyder, 2105). In her doctoral thesis, Godat (2012) also points to the benefits of collaborative work, such as the reduction of constraints that impede learning, simply by spreading these impedances over the entire group. In her 2010 Australian study, Snyder found that collaborative work led to gains in critical thinking. There are some downsides to collaborative work, especially in elementary and secondary schools. Robinson (2012) points out that group work can be a source of conflict, identifying frustration and fear as negative emotions experienced when participating in group work, especially when using online technologies in this group work. Although there are benefits working asynchronously within a group setting,time to reflect and adapt practise and to compose a response, for instance, there are also many sources of negative emotions such as unequal distribution of tasks, delayed response time, and frustration with the technology (Robinson, 2012). In a 2008 study, Bachlour, Kaplan, and Dillenbourg

suggest that, although collaborative learning can be more effective than individual learning that may not always be the case. In some cases, perceived status and popularity can negatively affect collaboration. These authors also state that there is a risk when one participant holds critical information and is unable to effectively share the information with the other group members. This is a situation familiar to many of my students.

"And ***this*** is why I hate technology!" As educators, many of us may have heard that line before. In the past two months, I have heard it more than usual. This increased frustration runs parallel to our school's introduction of a one-to-one device policy, providing all students with an Acer 720 Chromebook. The response by students to this initiative was mixed, with some students self-identifying as "technologically stupid". Or, stating, "Technology hates me", or claiming "I don't understand how to use this thing...not one bit." The students speaking this way are a group of so-called 'digital natives", using the descriptor coined by Marc Prensky in 2001 (Prensky, 2001). Prensky's analogy has been dissected and discussed and refuted by many (Thomas, 2011), and even though it is common sense to accept that there is no magic date separating people who 'know' and those who do not, the digital native/immigrant analogy sticks. And not all of my digital natives claim the title.

Integration of technology into education is much more than giving 900 students each a Chromebook. When technology was an infant in the classroom, it was implemented in a very passive manner. Instead of overhead transparency projectors, we used LCD projectors connected to our desktop computers. We showed videos. We showed digital images instead of paper images. Technology was just a delivery tool. This is no longer good enough. Technology is not just a delivery tool, but a piece of the distributed learning package (Olson, 2010; Lahlou, 2009). There are many different avenues available that integrate technology and group work, for instance, collaboration within Google Docs, using social media, working together to make podcasts or other media productions, participating in discussion forums, and collaborating on group projects. According to Olson (2010), these methods all encourage collaboration, they incorporate interdisciplinary learning, and they attract non-traditional learners.

As an instruction model, Distributed Learning is vastly different from the similarly-named Distance Learning, which I have been familiar with since the 1990's. Although there are many different, but related definitions of the term Distributed Learning, the vast majority of these definitions point to the importance of instruction and learning occurring independently of time and place. A simplified definition focuses on the fact that with this model, learners and instructors can be situated in different places and can work asynchronously, as well as integrating face to face and online work. In this way, Distributed Learning is considered in much the same way as distance education. A more thorough definition declares that cognition and knowledge are not situated solely with the learner, but are distributed - across objects/artefacts, people/learners, and tools. Technology is one of these tools, and the development of understanding through this technology produces a stronger foundation of distributed cognition. Edwin Hutchins (2000) postulates that there are at least three types of distribution within the cognitive process: cognitive distribution among and between members of the social group, distribution over material and environmental structures, and distribution through time. Hutchins goes on to explain that when cognition is distributed over time, current knowledge and prior knowledge interact to become modified. The cognitive system, then, includes all the learners, all the artefacts and all the tools, in an almost symbiotic relationship, over time, and the outcome of the work benefits the entire system, not just the learner. If, as Lahlou (2009) states, technology is a central pieces of the distributed learning system, then as educators we must become part of this and comfortable with and in this distributed learning environment.

According to Kim and Reeves (2004), distributed learning, or cognition, implies that students can think deeply and critically about their work, and create meaningful artefacts that represent that thinking. This is all done through working with cognitive tools. The concept of cognitive tools was defined in the early 1990's and are described as mental and computation devices that extend the cognition of learners. Jonasson (n.d.) declares that these tools, including databases, spreadsheets, semantic networks, expert systems, multimedia/hypermedia construction, computer conferencing, collaborative knowledge construction environments, and computer programming, cannot be effectively used by students without a deep understanding of the topic being studied. He goes on to state that the cognitive tools facilitates that deep learning, as well. This cyclical process is the learner interacting with his/her environment, which in turn creates a new, deeper learning experience. As our classrooms become augmented with new technology tools, the impact of affordances increases, as the environment takes on the role of an intelligent and cooperative partner (Lahlou, 2009).

Regardless of which platform or interface is used when integrating technology into the classroom, it is an accepted belief that the design protocols are an important consideration (Lahlou, 2009; Kim & Reeves, 2007; McGrenere & Ho, 2000). In the simplest of equations, good design makes good practice easy. If good practice is difficult, either for the student or the teacher, then the end cognitive goal will be lost. When introduced to a new tool, if the design does not afford simple, intuitive use, then the user will tend to revert to their old, possibly ineffective methods (Kim & Reeves, 2004). This idea of affordance is well established in literature, both educational and otherwise (Lahlou, 2009; Kim & Reeves, 2004; Hsu, 2012; Lakkala, Lallima, & Hakkarainen, 2005; McGrenere & Ho, 2000). In some circles, the idea of 'affordances' is very simple; a door without a handle, but simply equipped a flat plate indicates it is a 'push door'. The location of the metal plate and the absence of a handle allows the user to understand methodology with very little instruction. This is the principal design concept of affordances - to allow people to do as much as they can with as little training as possible. McGrenere and Ho (2000) outlined two principal definitions of 'affordances' as they exist in the world of human-computer interactions: Donald Norman claims that affordances are design aspects of an object which suggest how the object should be used, and James Gibson contents that an affordance is an "action possibility" available in an object, regardless of whether or not the user can identify that possibility (McGrenere & Ho, 2000).

Along with the physical affordances that tools and objects provide, there are also social affordances, which are properties of an object or tool that permit and promote social action. Some examples of that social action are interactive learning, collaborative learning, sustained critical discourse, and the social construction of knowledge (Kreijns & Kirschner, 2001). In their study on the social affordances of the internet, Wellman et al. (2006) point out that not all social affordances are positive. For instance, the internet, with its rapid growth since the early 1990's, is causing changes in society, from groups to networked individualism. Rather than tightly knit groups, society is moving towards loosely bound networks (Wellman et al., 2006). If the internet can decrease, transform, and supplement society, as Wellman et al. (2006) state, then certainly it can do the same in our classrooms. Social affordances, like those described above with the internet in society, can also be associated with environments. For instance, a classroom with desks placed singularly in rows presents a different social affordance than does desks in groups of four, with chairs around them. A couch in a drama studio is a social affordance, as is a cafeteria equipped with many small table instead of a few long tables.

With regard to technology, social affordances are "properties of CSCL (Computer-Supported Collaborative Learning) environments which act as social-contextual facilitators relevant for the learner's social interactions" (Kreijns & Kirschner, p.14). When considering this in the context of my classroom,

the easily identifiable 'Share' button on every Google application is a social affordance. Many apps also have a large, noticeable '+' sign next to a user's profile picture/icon, which affords asking someone to join, virtually speaking, in your work. Although Dillenbourg (2008) has stated that fewer computers encourage more social interaction, since four students working around one desktop must interact and collaborate with each other since 2008, there have been many advances in the ability of students to synchronously collaborate online. Many of the Google Apps that are being introduced, for instance, have built-in collaborative capabilities, meaning I can offer my students opportunities to collaborate online today, which were not available six months ago. I believe that, as educator's demand these tools, developers will seek to supply that market.

I will take the time to describe an incident that happened in my grade 9 music class recently. Since the students at Horton High School all received chromebooks in October, they have been working to become comfortable with them ever since. Some seem naturally adept at navigating the technology, while others struggle. The first assignment I gave them, in groups of four, included researching an endangered species (this connected with a piece of music we were learning), discovering some simple facts about that species, and composing and notating a short piece of music that was meant to represent that animal. The students used an application called 'Flat' to write their composition, and 'shared' the composition with each other while they were creating it. This activity was fraught with technical difficulties, sharing problems, confusion with permissions and ownership of the documents and compositions, and struggles with handing it in. Even with these problems, the students agreed that they learned something from their peers through the activity. Some learned about how to write music, some learned about their endangered species, and some learned about how to use the technology. The cognition was indeed distributed. Just a few days ago, I gave the students another assignment. They were to use the application 'Versal' (www.versal.com) to create a lesson for a peer. The lesson is to be about major scales, and they have a rubric outlining the basic requirements and the opportunities for expansion. They are to work individually or with a partner, whichever they wish. Next week, after I have vetted the lessons, they will give their lesson to a peer to complete. I was a little reticent to send the students to a new application, fearing that the learning curve would turn them off. However, my fears were unwarranted. The very first thing my students wanted to know after they were given a cursory introduction to Versal, was how they could 'share' their partner. After a brief moment of disappointment, when they thought they could not collaborate online, a student spoke out, telling his classmates how to invite collaborators, and giving them instructions. The feelings of being technologically overwhelmed that I expected, or at least feared, did not happen.

As we continue to strive towards establishing effective collaboration in our classrooms, all the while incorporating technology, teachers run into a new struggle: the learning-effort curve. In an otherwise difficult paper to read, Hsu (2012) discussed a very interesting concept called learning effort curve. This construct combined learner effort, efficacy, efficiency, style and performance. I have attempted to illustrate the inter-relationship between these factors in the figure below:

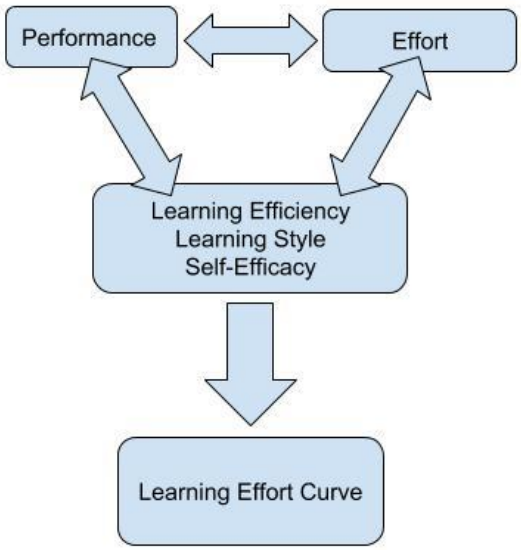

Figure 1. Learning Effort Curve

As educators, if we are working with a student who has low self-efficacy, or cannot be efficient with their time, or their learning style does not match those of their peers, it may make for low performance and/or low effort, which will all translate to a learning effort curve that is burdensome.

Although the affordances of the technology may exist, these affordances cannot be seen at the onset of the user/tool relationship (Kim & Reeves, 2004). This falls in line with Gibson's definition of an affordance, where the affordance is a potential for action built into an object, whether or not the user can identify that potential. The concept of a learning curve was first introduced in the world of industry, when assessing the cost-effective nature of repetitive work. The more a worker is exposed to a specific task, the more quickly that worker can complete a task, and with fewer mistakes (Argote, 2013). When considering this same concept in the classroom using new technology, the basic ideas are the same. According to Kim and Reeves (2004), with a new tool, the extraneous load is increased at the onset of work. Higher level thinking is not possible until the tool is a full partner. Hsu (2012) pointed out that an increased learning effort results in lowering the learner efficiency. He also confirmed, in his study done in Taiwan at the university level, that self-efficacy and learner characteristics were important elements to consider with introducing e-learning opportunities.

There are definitely obvious disadvantages to introducing new tools in the classroom, as pointed out above. However, the benefits are numerous, considering the established advantages to collaborative work. Oliveira, Tinoca, and Pereira, in their 2011 study, state that virtual worlds and learning environments provide students with the possibility of gaining knowledge and developing competencies through explorations and experimentation. These virtual environments also can put students in groups that offer diverse learning settings. Although this study was also done at the university, some of these concepts, I believe, hold true in high school. If one were to accept the findings of Sugata Mitra, in his well-known research using unsupervised internet-connected computers, children, even those children from small isolated villages in rural India, can learn how to use a new technological tool. The learning curve is not an issue in these studies (Mitra, 2014). Although Mitra's research is highly contested by some (Clark, 2013; Arora, 2012), Mitra unequivocally stated that allowing students to group

themselves, ultimately in groups of four, and work independent of direct instruction, will result in deep and critical thinking by the young students. While these results are far from indisputable, the process gives thought to the idea that perhaps students and technology can accomplish much together.

Given that there has been established benefits to collaborative learning and to e-learning, it seems to make sense that the benefits of collaborative e-learning will overcome the drawbacks of the learning effort curve, even if that curve is at times significant. As with many new concepts, tools, or ideas, the user must 'buy into' the idea that the new is better than the established. A strong and effective relationship between the user and the tool becomes apparent as the learner becomes more familiar with the tool and its' capabilities. At that point, the learner begins to benefit *more* from those capabilities. The interface between the user and the tool becomes less and less obvious, with the final goal of the interaction being directly between the two. As the interface of the cognitive tool becomes less visible and apparent to the learners, then the learners see more of the affordances possible in the tool (Kim & Reeves, 2004). This is the beginning of a true partnership between the user and technology.

The learning curve and extraneous cognitive load placed on students when attempting to integrate new technology in the classroom is, based on the research done in this paper, a worthwhile struggle. Having students work collaboratively with and through these new technological tools can even mitigate some of this effort. Students can benefit from the strengths of their peers. Anecdotally, I have witnessed my students learn both about a new topic, and about a new online application, by working collaboratively with and through technology. It seems that every week, a new application is being introduced. At the beginning of this school year, for example, I had to use a separate speech-to-text application to speak my notes. Now, Google Doc offers that tool. The interface between the students' thoughts and the written word is becoming almost non-existent.

When Stephen Hawking needed a new method to communicate, because his cheek muscle that he was using to type was deteriorating, the inventors at Intel understood the significance of the learning curve, and so created something appropriate. Explaining their reason behind the tool they created for him, they explained to him that his current tool was "very dated, but you're very used to using it…" (Medeiros, 2015). It took many tries to integrate a new language interface for Mr. Hawking, with a steep learning curve, even with the engineers trying to avoid one. In their words, "The new system is much faster and efficient, but we had to train Stephen to use it. In the beginning he was complaining about it, and only later I realized why: He already knew which words his previous systems would predict. He was used to predicting his own word predictor." (Medeiros, 2015). It is interesting to note that, although the original interface was cumbersome, Hawking had become familiar with it to the point that they were in partnership with each other. As we read about the struggle that the smartest person on the planet had with integrating new technology, perhaps we can accept that students will absolutely have to wrestle at times to overcome the learning curve associated with the integration of new technology. That being said, it may very well be that this desire to eliminate the cognitive strain that comes with navigating through the interface that propels our students to be the computer engineers of the future, who create the perfect oblivious-interface - one that is there, and ubiquitous, but not obvious at all.

For my junior students to have written a composition reflecting the properties of the African Black Hippo, they would have needed weeks, if not months, of instruction on how to notate the musical thoughts in their heads. Even then, they would not have known what their written composition really sounded like, since they would have played what was in their heads, not what was on the paper; errors would not be recognised. By implementing the technology at their disposal, they were able to creatively represent, in musical form, how they felt about an endangered species. They needed to have critical

knowledge of how specific musical elements can be used to represent specific physical traits or characteristics. With the technology, the computer played the music back to them, confirming or denying their thoughts on their own compositions. The project would not have happened without the cognitive tools afforded by our school's technology initiatives. Hopefully, moving forward, I will hear fewer proclamations of “I hate technology!”

References

Argote, L. (2013). Organizational Learning Curves: An Overview. In *Organizational learning creating, retaining and transferring knowledge*. Heidelberg: Springer.

Arora, P. (2010). Hope-in-the-Wall? A digital promise for free learning. *British Journal of Educational Technology, 41*(5), 689-702. doi:10.1111/j.1467-8535.2010.01078.x

Chandler, D., & Munday, R. (2011). *A dictionary of media and communication*. Oxford: Oxford University Press.

Cheung, R., & Vogel, D. (2011). Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. *Computers & Education, 63*, 160-175. doi:10.1016/j.compedu.2012.12.003

Clark, D. (2013, March 4). Sugata Mitra: Slum chic? 7 reasons for doubt. Retrieved November 29, 2015, from http://donaldclarkplanb.blogspot.co.uk/2013/03/sugata-mitra-slum-chic-7-reasons-for.html

Dillenbourg, P. (2013, November 28). *Classroom orchestration: Why do some tools sometimes work well?* Lecture presented at EAPRIL Conference in EAPRIL Conference,, Biel/Bienne Switzerland.

Gokhale, A. (1995). Collaborative Learning Enhances Critical Thinking (M. Sanders, Ed.). *Journal of Technology Education, 7*(1). Retrieved November 12, 2015, from http://scholar.lib.vt.edu/ejournals/JTE/v7n1/gokhale.jte-v7n1.html?ref=Sawos.Org#about author

Hsu, P. (2012). Learner Characteristic Based Learning Effort Curve Mode: The Core Mechanism on Developing Personalized Adaptive E-Learning Platform. *Turkish Online Journal of Educational Technology*, *11*(4), 210–220.

Hutchins, E. (2010, May 18). Distributed Cognition. Retrieved November 28, 2015, from http://comphacker.org/pdfs/631/DistributedCognition.pdf

Jonassen, D. (n.d.). Technology as Cognitive Tools: Learners as Designers. Retrieved November 28, 2015, from http://itforum.coe.uga.edu/AECT_ITF_PDFS/paper1.pdf

Kim, B., & Reeves, T. (2007). Reframing research on learning with technology: In search of the meaning of cognitive tools. *Instructional Science, 35*(3), 207-256. doi:doi.org/10.1007/s11251-006-9005-2

King, A. (2008). Collaborative learning in the music studio. *Music Education Research, 10*(3), 423-438. doi:10.1080/14613800802280167

Kreijns, K., & Kirschner, P. (2001). The social affordances of computer-supported collaborative learning environments. *Frontiers in Education Conference, 2001. 31st Annual, 1*, T1F-12.

Lahlou, S. (2009). Supporting Collaboration with Augmented Environments Design and Dissemination Issues. In P. Dillenbourg, J. Huang, & M. Cherubini (Eds.), *Interactive Artifacts and Furniture Supporting Collaborative Work and Learning*. Boston, MA: Springer Science Business Media, LLC.

Lakkala, M., Lallimo, J., & Hakkarainen, K. (2005). Teachers' pedagogical designs for technology-supported collective inquiry: A national case study. *Computers & Education,* 337-356. doi:10.1016/j.compedu.2005.04.010

McGrenere, J., & Ho, W. (2000). Affordances: Clarifying and evolving a concept. In Graphics Interface (Vol. 2000, pp. 179–186). Retrieved from http://teaching.polishedsolid.com/spring2006/iti/read/affordances.pdf

Medeiros, J. (2015, January 13). How Intel Gave Stephen Hawking a Voice. Retrieved November 29, 2015, from http://www.wired.com/2015/01/intel-gave-stephen-hawking-voice/

Olson, C. A. (2010). Making the tech connection. *Teaching Music, 17*(5), 30-35. Retrieved from http://search.proquest.com/docview/753587891?accountid=12378

Prensky, M. (2001). Digital Natives, Digital Immigrants. *On the Horizon, 9*(5), 1-6.

Prieto, L., Asensio-Pérez, J., Muñoz-Cristóbal, J., Jorrín-Abellán, I., Dimitriadis, Y., & Gómez-Sánchez, E. (2014). Supporting orchestration of CSCL scenarios in web-based Distributed Learning Environments. *Computers & Education, 43*, 9-25. doi:10.1016/j.compedu.2013.12.008

Wellman, B., Quan-Haase, A., Boase, J., Chen, W., Hampton, K., Díaz, I., & Miyata, K. (2006). The Social Affordances of the Internet for Networked Individualism. *Journal of Computer-Mediated Communication, 8*(3). doi:10.1111/j.1083-6101.2003.tb00216.x