Using Technology in Teaching: Not a Silver Bullet

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While there has been much hype about how technology can significantly improve teaching (Ministry of Education, 2008) and revolutionise learning (Siegler, 2010), we believe that teaching is fundamentally the business of people—and that technology is no silver bullet.

That said, we describe in this paper some of our experiences in applying technology in the teaching of Computer Science at the School of Computing, National University of Singapore. In particular, we describe how technology has been employed to enhance the delivery of content and to better engage our students. We also briefly discuss the challenges faced and explain what went well and what did not. Finally, we conclude with some reflections on our experiments and experiences.

Enhancing Traditional Delivery

The most common use of technology in teaching is perhaps the use of online presentation tools like PowerPoint. While common, PowerPoint has a tendency to encourage its users to be lazy. While it is quite easy to create a set of slides, it is more difficult to craft a good lecture. Powerpoint's default "death-by-bullet-point" style is perhaps not the most effective way to make presentations (Gallo, 2009).

Animations and pictures are often useful for engaging students but they must be appropriate and chosen carefully. The challenge is that it is often difficult to find appropriate pictures. While there are many free resources on the Internet today, finding the right video clips or pictures when we need them can be a time-consuming task.

Webcast

We have found webcast to a useful learning resource for students. While it might be true that providing webcasts might encourage some students to skip lectures, our experiences seem to suggest that the impact is not significant. We have been recording webcasts for CS1101S "Programming Methodology (Scheme)" for the past 5 years, and lecture attendance has hovered consistently between 80% and 90%. Our view is that students need to be responsible for their own learning and therefore should be allowed to choose how they want to learn. If some of them learn better by staying at home and watching a screen, why should it bother us? Another advantage of webcast is that it allows students to learn at their own pace. Students can put the recording on pause to play it back and even rewind it if they want to replay certain parts. Also, students sometimes fall sick or have to miss lessons for one reason or another. The provision of webcast will allow these students to catch up on the lectures they missed at their own convenience.

The key drawback of webcast is that without visual feedback from the class, it might sometimes be hard to pace a lecture. However, as long as the attendance is reasonably good, this should not be a major concern. The webcast recording is also helpful to the lecturer in providing him with feedback on his presentation delivery. That said, watching oneself in a recording can often be quite painful.

YouTube

YouTube presents educators with a unique resource with its huge repository of interesting video clips. Because it is often hard to find the right clips when we need them, we have found it a better idea to compile a list of interesting video clips, as and when we come across such clips. Short and entertaining clips can be shown in the middle of a 2-hour lecture to break the monotony of the class. Students who are not interested in the clips can take the opportunity to go to the bathroom. One warning about YouTube clips is that they are not typically persistent; clips have been removed from time to time. If a YouTube clip from the previous year is to be used again for a course, it is important to check before the lecture that the clip has not been removed.

There are a number of motivational YouTube clips that are quite interesting and inspirational. While it is common for courses in the humanities to have assigned readings, assigned "watchings" are probably quite uncommon. For CS3216 "Software Development on Evolving Platforms", the students are asked to watch two video clips before the first lesson: (i) The Last Lecture (Pausch, 2007) by the late Randy Pausch; and (ii) Stanford Commencement Speech 2005: Stay Hungry. Stay Foolish (Jobs, 2005) by Steve Jobs. These clips are useful because they help to set the tone for the class right at the start of the semester.

IVLE Chat Room

In CS1101S, the lecturer and tutors hold weekly office hours and invite students to come for consultations. The attendance at these office hours varies widely and can be quite low. We tried holding online consultations using the IVLE Chat Room tool for two years. The rationale for this was to allow students to ask questions from the comfort of their rooms. The first time we tried it, these sessions seemed moderately successful. However, attendance for the second set of sessions was very low and it was not as effective. We postulate that this was because the students were already able to contact their tutors online with an instant messenger (IM) so there was no need to go online to ask questions during a predetermined time. We believe that there is some potential in using a real-time chat facility for teaching and/or consultation, but one has to be aware that the process can get quite chaotic as different students might ask different questions simultaneously. It might be helpful to come up with a

protocol on how the interactions in the chat room should be conducted and have it communicated clearly to the students.

Engaging Students

We believe that teaching is about psychology, and not about technology. Effective teaching goes beyond the transmission of information and knowledge to the students. Instead, we should attempt to inspire and motivate students to want to learn and to develop the right attitudes towards learning. To do so, it is often necessary to "connect" with the students. While communication with students was previously limited to interactions within the classroom, modern technologies now offer us the opportunity to do much more.

IVLE Forum

While forums have been a common feature on the Internet, they can also be used as convenient medium to engage students and to allow them to ask questions. We have successfully used the IVLE Forum tool in our classes to allow students to put up "reflections" on the lectures they attended as well as to ask questions about the assignments. The students were rewarded with a small amount of continual assessment (CA) marks for their participation. Whether the forum works well depends to a large extent on the temperament of the class. If the students are extroverts, the forum tends to be more active and effective; if the students are not so outspoken, it does not work as well.

Instant Messenger (IM)

Students today are increasingly plugged in and IM tools are increasingly pervasive. Many students use MSN and those who use Gmail have access to GChat. Facebook also supports an online messaging tool. Our students have found it helpful to be able to ask their instructors questions directly using IM. However, we do not think that it is necessarily a good idea because it might be very disruptive for the instructors. Those who want to adopt IM in their modules must be mindful that students have a tendency to pop random questions to them at all times of the day.

Social Media

While email has long been a medium through which educators can reach out to the students, social media presents us with more options. Emails are still useful as a means to reach a large number of students for important announcements. However, it is often helpful to forward articles and posts for students to read, and students might not appreciate having their mailboxes spammed by their instructors.

It turns out that Facebook feeds can be very useful for this purpose. Facebook allows links to be posted and after reading the posts, the instructor can proceed to engage the students in a discussion. In Figure 1, we provide anecdotal evidence that students find such feeds helpful. An interesting observation about using such feeds to engage students is that it allows us to not only engage our current students, but former students as well.

Figure 1. Anecdotal evidence that Facebook feeds are appreciated by students and are useful as a means to engage them online.

Blogging

Blogs have become relatively commonplace in recent years. Many students also maintain personal blogs. For some classes, the IVLE Forum might not work so well and we have tried using blogs as an alternative means to engage students. Blogs can typically be used in two ways: (i) the lecturer writes and maintains a blog to communicate his ideas and/or the key points about the class (Leong, 2009) or (ii) have students submit their assignments in the form of blog entries.

Our experience with blogging in CS3216 has been quite positive. Given that we are working mostly with Computer Science majors, the students are not particularly enthralled with writing in general, so the results might have been ever better when we apply this strategy to engage humanities majors. All in all, the public nature of the blogs encourages students to think harder about what they want to say before they write and post their entries. Also, the comment feature in blogs allows the instructor

to engage in an online discussion with the students in a natural way. In fact, the students often end up having discussions with one another. Once in a while, they might get a little carried away and end up in a "flame war" and there might be a need for the instructor to step in to keep things civil.

Applying Game Mechanics

Jane McGonigal, in her TED Talk "Gaming can make a better world" (McGonigal, 2009), highlighted that people around the world invest some 3 billion hours weekly playing online games, making online gaming a significant activity in their lives. Together with the World Bank Institute, she developed a social networking game called Urgent Evoke (http://www.urgentevoke.com), where players work together to solve a real life crisis. This inspired us to think about whether the same could be incorporated into our teaching.

Figure 2. Screenshot of JFDI Academy, the online games system devised for CS1101 assignments.

In CS1101S, we successfully converted the assignments into an online game (JFDI Academy, 2010). In previous years, students were typically expected to complete seven problem sets over the course of a semester, or an average of one problem set every two weeks. These problem sets were relatively large assignments that can take up to 20 hours to complete. A problem that we observed was that students tended to procrastinate and do their assignments very close to the deadline. Because the problem sets are relatively large, many students often fail to complete their assignments on time. To convert the assignments into an online game, we broke up the seven problem sets into 22 smaller "missions". With smaller assignments to submit more frequently, students are "forced" to be more consistent in their work. As students completed their missions, they would be awarded "experience points" and in doing so, gradually "levelled up" in the game.

Figure 3. Achievements and badges reflected in the JFDI Academy.

Another key feature of the new game system is self-paced learning. While there are still deadlines to meet, the students are encouraged to complete the assignments at their own pace. All submitted assignments are graded by the tutors within 24 hours. By submitting the assignments, they "unlock" new missions and can proceed to more advanced missions. The game system also includes other game mechanics like achievements, a leader board and a storyline with supporting comics. Screenshots of the system and the "unlockable" achievements are shown in Figures 2 and 3 respectively. Anecdotal feedback from the students indicate that the system makes the assignments more interesting, but the competitive nature of the "levelling" system and leader board also makes it somewhat stressful.

The preliminary feedback for the system has been overwhelmingly positive. About 86% of the students said that the e-learning system has helped them to learn better as compared to a traditional lecture-tutorial system. 73% of the students found that the e-learning system motivated them to learn faster. Most importantly, about 75% of the students surveyed find that the system had a positive impact on their interaction with their tutors, allowing them to learn better throughout the course. This was likely a result of the feed-like "wall" in the game system that the students could use to discuss the grading of their assignments with their tutors. A more comprehensive study of the effectiveness of this game system is currently underway.

Beware the Hidden Cost

While the above examples might seem to suggest that technology is the best thing since sliced bread for engaging students, the reality is that technology is only part of the story. The use of technology is likely to require even more time and effort in teaching, not less. Those who are looking towards technology as a means to make teaching more efficient, and hence are hoping to spend less time on it, are likely to be disappointed. That said, this should not be entirely surprising if we remember that engaging students is really a human activity. Technology merely facilitates the process.

For example, when we encourage students to post their questions in the Forum page, they expect to get prompt responses. This means that additional effort will have to be put into checking the forum on a daily basis and responding to those questions. If the questions remain unanswered, one of two consequences, or perhaps both, is likely to happen: (i) students stop coming to the forum and posting questions, since they think that it is pointless to do so, or (ii) the instructor will be reminded in the end-of-semester teaching feedback exercise that he should have responded more promptly. In the latter, the employment of technology has not only added no value whatsoever to the class, it would have hurt the instructor's teaching feedback rating.

Similarly, interacting with students over IM can soak up a lot of time and leave the instructor with little time to do anything else. Fortunately, most IM tools allow its users to "become invisible" or sign off, which can provide some reprieve. Likewise, blogging and engaging students on the blogs takes up time. The new game system we introduced for CS1101S, while seemingly effective, takes a significant amount of manpower and effort to run and maintain. Instructors who are thinking of introducing new technologies in their classes should think hard about how much time and resources they have to devote to the endeavour, and should only take the plunge if they are convinced that they are willing to pay the price. In short, there is no such thing as a free lunch.

Technology is no Silver Bullet

Because of all the good that technology can potentially bring to teaching, there is often a misconception that technology necessarily improves teaching. This thinking and mindset is absolutely fallacious. On the other hand, there are also people who consider teachers who do not employ technology in their teaching to be poor educators. This too is necessarily false, because there are a number of brilliant teachers who are remarkably effective when they teach with nothing more than a good old-fashioned chalkboard.

We feel that an appropriate analogy for teaching is the act of singing. In this context, e-learning technologies are analogous to sound systems. If a singer has a terrible voice and cannot hold a tune, even the most expensive and advanced sound system can do very little. However, a good sound system can possibly help the singer project her voice further and more clearly. In the same way, technology is not a recipe for good teaching. The teacher or singer is really the one who determines the result. Just as there are singers with naturally powerful voices who do not need the sound system, there are also teachers who can teach "unplugged".

If educators are misled into thinking that e-learning is a silver bullet and that the mere application of technology can improve learning outcomes, they are likely to be sorely disappointed and may produce collateral damage instead of good outcomes.

Conclusion

Confucius said more than two thousand years ago that we should teach according to the ability of the student. Every student is different. As educators, we probably first want to decide what we want to teach and understand who we are trying to teach, before deciding how we want to do it (with technology or otherwise). Where appropriate, we should fully exploit technology to achieve our goals, but we should also be mindful that the problem must come first. It is only when we understand the problem we are hoping to solve do we have a hope of applying technology to actually make a positive difference.

Technology does not work for everyone, and technology may not work every time. Educators who want to employ technology in their teaching need to be willing to

take risks, and be willing to experiment and to fail. We can take comfort in the fact that despite the dangers of technology, no students are likely to die and no animals are likely to be maimed even if our experiments do not work out. If anything, every time we fail, we will get a little smarter

To conclude, teaching is a complex endeavour. Technology is only helpful if it is viewed in the right context and as a means to an end. At the end of the day, what really matters is the outcome, or to ask the question, "What did our students learn today?"

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