



## Teaching Programming Online

Wendy Wang

[wendy\\_phoenix@hotmail.com](mailto:wendy_phoenix@hotmail.com)

Trident University International Cypress (USA)

### Abstract

*Online education provides opportunities to people who traditionally do not have access to universities. However, we need more empirical studies to gain better understanding on how to deliver quality online education. Comparing to subjects such as history, philosophy, math, and literature, online programming course faces unique challenges: the content of the IT courses needs to be updated much more frequently to stay current, and learning to program is a complicated process. Students, especially beginners, would need constant guidance. In an online environment, students would not have the benefits of getting instant feedback from instructors. Furthermore, one very important aspect of learning to program is to see how other students approach the same problem, and learn to work together via team project. In an online environment, collaboration among students is not easy. This paper describes our journey of redesigning and teaching an online programming course from 2008 to 2010. We examined issues encountered and addressed in the process, described how we used students' feedback to improve course content and adjust teaching styles, and discussed impact of these changes on students. Finally we made some suggestions for future improvement. We hope all of these will shed lights on offering quality online programming courses.*

### Introduction

Online education has gained increasing popularity over the years as the result of prevalence of Web Wide Web. In addition to online universities, traditional brick and mortar universities are also offering courses online [1][2]. The advantages of online distance learning are hard to miss: flexibility to students in terms of location, time, and study pace. But its disadvantages are also obvious: difficulties to evaluate fulfilment of teaching objectives, continuous course update required due to its dynamic nature [3] etc. It is hard enough to teach programming in the classroom setting, it is even more challenging to teach in online environment. This case study shares our journey of redesigning and teaching a programming class. Hopefully our experience will shed lights on providing quality online education.

### Background information

This online course is one of the required courses for students majoring in computer sciences. It is delivered in a learning management system developed in house. The goal is to introduce students to object-oriented programming using Java. Students in this course should have taken one programming course in python. No textbook is required. Students in this course are working adults, mostly active-duty military personnel who live in different time zones all over the world. In the section, we will discuss issues related to course development and delivery, and conclude with future work for improvement.

### Course development

This course was first designed over 10 years ago. It heavily used a lot of online books and tutorials, most of which were developed by companies such as IBM and Oracle. Students were required to read and work through these materials. Although the course had well-defined learning objectives, and online materials and tutorials are interesting, there were a lot of issues that needed to be addressed:

First of all, the online books and tutorials were too difficult to understand for beginners. Many students do not have much prior programming experience, they need more explanations on the concepts. These materials were written by programmers for programmers, thus beginners usually found a hard time to follow. Secondly, it is difficult to update the online materials. Since technology changes very fast, materials written over 2 years ago would already be dated. Very often there are bugs in the programs from these materials. And the problems got worse by the difficulties of communicating with original authors. Authors who wrote these materials were mostly affiliated with company such as IBM, communications with them have been problematic. They were either no longer affiliated with the company, switched to another department, forgot about details related to the tutorials, or simply did not have time for update. Given the problems we had over third party materials, we decided to revise this course and develop our own in-house teaching material.

Before we started to develop in-house materials, we would need to decide on how to organize this course. In what order should we introduce object oriented programming concepts: should it be top down, or bottom up? To make the material easier to learn, before jumping into the technical details of Java, the revised course first discusses why it is necessary to learn programming languages, and its evolution, characteristics of various types of programming languages, then an overview of Java. As a result, students would get a clear idea on the importance of the materials they are about to learn, and also picture of main characteristics of Java.

Next, the course moves on to explain each characteristics using sample programs. Once for a while, students are brought back to the overview of Java so that they can see clearly how all the pieces fit into the part of the bigger picture. Since all programs are written by the course developer, it is easy to change them whenever there is a need. Students' responses to the newly revised course have been very positive. They have been happy with the course content, and stopped complaining about missing links, dated materials, and difficulty to understand the course content. Students who failed this course before were pleased with the revision when they retook this course. They commented that the new course materials have helped them learn better.

## Course delivery

Learning programming online is very different from in the classroom setting. We will discuss this from three perspectives: interaction with students, homework grading, and interaction among students. In the classroom, students can ask the instructor questions easily and get help immediately. In online learning environment, synchronous learning would be difficult. Most students are military personnel who are currently in active duty, they live in different time zones. Very often, they move to another location with very short advance notice. In many cases, internet connection is either not reliable, or simply not available. Students would not be able to interact with the instructor in real time. Therefore, it is important for the instructor to check emails frequently and reply students' questions in a timely fashion. Sometimes students experience a lot of difficulties in understanding course materials or homework. When it is hard to explain fully and clearly by email, the instructor would need to call students to communicate verbally.

Online students are quite different from classroom students. Typical online students tend to be adults who are busy with a full-time job, a family, or in this course, the military duty. It is unrealistic to expect them to turn in assignments on time. Some students do not have reliable internet access for an extended period of time. They would need to wait and turn in assignments whenever they can. Some students have a busy work schedule, they can only work on the course materials whenever the time is available. So the deadline for assignment is more a suggestion rather than being strictly enforced. Since students cannot turn in assignments all at the same time, instructor would need to grade them as they are turned in, instead of wait and grade them all at the same time.

Another very important aspect of learning to program is to learn from each other and work as a team. In the traditional programming class, it is common that students are assigned to work on a team project. In online environment, it would be very difficult. Since students live in different time zones, coordination for team projects will be unrealistic. To encourage students have more interaction and learn from each other, the course creates a space called "Study corner" where students can post their questions and seek help from their fellow classmates. For social purpose, students can also go to a section called Cafe in the course to post their information there and get to know each other better.



## Suggestions

Based on our experience, we have the following three suggestions:

- 1) create a virtual computer lab;
- 2) add more multimedia materials into the course,
- 3) create a sense of community among students.

With a lab component students can exercise the concepts they learn [4]. To improve this course, and give students a better experience, it would help greatly to create a virtual computer lab. Lacking fast and reliable internet access, it usually takes students a long time to download software such as JDK and Eclipse and they have to try for multiple times. Very often the internet access gets disconnected. Students need to restart the downloading process, and it wastes a lot of time and brings a lot of stress. In addition, we found that computers in the military usually do not allow software download. Even if students have course CDs, they cannot use them. Creating a virtual lab which has all the required software installed in a server would be a great help for students. They can access software via a virtual lab portal, save their work to their designated area, and whenever the internet access is available, log in and resume their work. To help simulate the real computer lab setting where students can communicate to each other, it would help to add the chat feature in the virtual lab. When students log in the lab, they can see who else is online, and ask each other questions. Some students prefer to associate name with a face. It would help to have the personal photo feature, students can decide whether to make their pictures viewable. Also, in the virtual lab, for learning purpose, it would help to build a library that contains a collection of programs with all kinds of bugs. Students can run the programs, the error messages will explain in great details what causes these bugs.

During our teaching and revising of this course, we also found that students responded really well to multimedia materials. For example: after students download Eclipse, many of them have difficulties to configure it by following the instruction manual. The revised course material include a video clip explaining how to set it up step by step. That enables students to pause the video and try again when necessary. Students' responses have been really positive.

One of the challenges that we encounter both online and offline is that, students tend to have different learning styles and understanding of the materials. Some students feel bored, whereas others are struggling. So far, the approach has been that one style fits all: All students get the same materials. We believe the customization of teaching materials is the future of education [5]. Online environment will be a great platform for experimentation. Possibilities for Instructional information technology are endless.

## References

- [1] S. Edwards, "Can Quality Graduate Software Engineering Courses Really Be Delivered Asynchronously On-line?," in Proceedings of the International Conference on Software Engineering, Limerick , Ireland, 2000, pp. 676-679.
- [2] R. Thomas, "Experiences Teaching C++ Programming Online", Journal of Computing Sciences in Colleges, Vol15(5), May 2000. pp. 214-222.
- [3] T. Reeves, P. Baxter, and C. Jordan, "Teaching computing courses - computer literacy, business microcomputer applications, and introduction to programming online utilizing webCT," Journal of Computing Sciences in Colleges, Vol 18(1), October 2002, pp. 290-300.
- [4] R. Martinez-Unanue, M. Paredes-Velasco, C. Pareja-Flores, J. Urquiza-Fuentes, and J.A. Velazquez-Iturbide, " Electronic Books for Programming Education: A Review and Future Prospects." In Proceedings of the 7th Annual Conference on Innovation and Technology in Computer Science Education, Aarhus, Denmark, June 24-26, 2002, pp. 34-38.
- [5] A. Klačnja-Milićević, B. Vesina, M. Ivanović, and Z. Budimac, "E-Learning personalization based on hybrid recommendation strategy and learning style identification," Computers & Education, vol 56(3), April 2011. pp. 885-899.