



# White Paper

Teaching basic through advanced programming skills  
using a web based coding platform.

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## A problem faced by every economy today

Teaching children and students to code has is now firmly on the global agenda and rightly so. Cambridge University, one of the top Computer Science departments in the world, has the following to say ...

*We became concerned about the **year-on-year decline in the numbers and skills levels of students applying to read Computer Science**. From a situation in the 1990s where most of applicants were coming to interview as experienced hobbyist programmers, the landscape in the 2000s was very different; **a typical applicant might only have done a little web design**.*

This is a very bleak scenario for any developed country that prides itself on being at the forefront of key technologies; and a very positive one for developing economies looking to build a global reputation in a sector that requires very little capital investment and a low barrier to entry.

Computing is now as fundamental to an economy as engineering was a century ago. Recently, many countries, such as the United Kingdom, were very happy to see their engineering skills decline in preference to service industries such as banking and finance, very much to their detriment. Allowing a population to be merely ardent consumers of apps and applications rather than being able to create them would be a mistake that cannot be easily corrected.

Unless programming and computer science does not become a part of our educational DNA and form a standard part of the schools curriculum ranking equally alongside subjects such as biology, history and languages, we are in danger of committing a serious educational blunder.

Codio is certainly not the first to recognize the urgency and importance of the problem and companies like Code.org, Codecademy, Khan Academy and Team Treehouse have sprung up to try to shore up the damage.

## A platform for local and global, crowdsourced teaching

At Codio we believe that the global community of teachers and education oriented developers is best placed to produce high quality content.

One only has to look to the Open Source community for an excellent analogy. Developers all over the world have contributed to an extraordinary number of very high quality libraries and tools that now power almost every web application from the likes of Google, Facebook and Twitter to millions of smaller ones. At the heart of this lies

GitHub, a platform that is now used by almost all Open Source projects to collaborate on Open Source code.

Codio proposes a similar format for teaching coding. As you will see below, Codio is a superb platform for both teachers and students. However, Codio does not itself produce any actual teaching content, which is left entirely in the hands of teachers and education oriented developers. Crowdsourcing features enable coding courses to be created and shared freely amongst schools, universities and individuals seeking a self-teaching approach.

We will now look at the problems faced by teachers and students of coding and then discuss how Codio addresses each of these problems.

## **Specific problems faced by teachers**

There are a number of real world problems faced by teachers that severely impact their ability to teach this subject in a modern, efficient way that takes advantage of all that web technologies have to offer.

### **Stack Hell**

Stack Hell is something that almost all teachers will be familiar with today. It refers to the need for teachers to ensure that every one of their students has a correctly configured programming environment. This is extremely difficult as each student will have a different combination of machine type (PC, Mac Linux) and Operating System versions. Added to that is the need to choose desktop IDEs that may only work on certain operating systems and that are generally far too complex for novices. And beyond that, projects may require the installation and configuration of many additional components such as languages and databases.

The net effect of Stack Hell is that many teachers are finding that it takes as much as 3 weeks of actual course time until all students are in a position to write their first line of code.

The Codio platform is friendly enough for beginners yet built to meet the needs of professionals and completely eradicates Stack Hell. Additionally, Codio allows teachers to install entire stacks with a single command using Codio Box Parts. Codio also offers 'Clonable Boxes' so teachers can preconfigure an entire development stack as a part of a Course Module. When the module is cloned, the entire stack is also cloned, so students can avoid (if desired) the entire stack setup process.

### **Accessing student assignments**

Once students have begun coding, teachers need to access student code projects whether to offer general assistance or to grade. Current systems are entirely unsatisfactory and require either attaching code as attachments, which then need to be

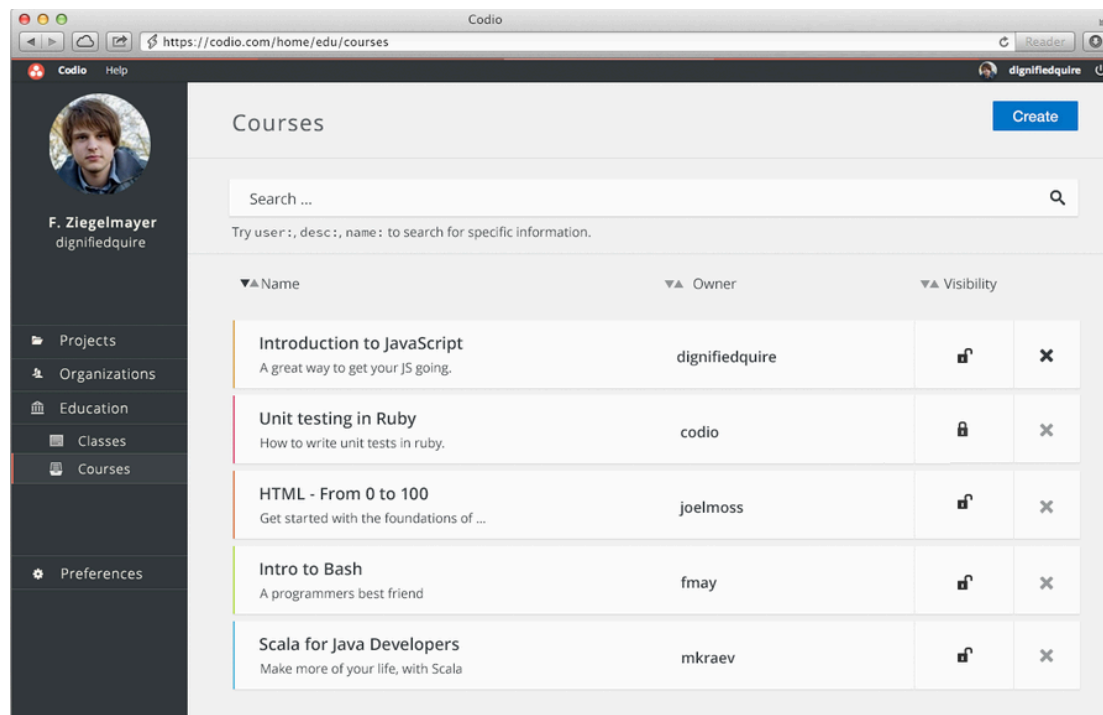
loaded into the teacher's IDE, or require that the teacher access code that has been uploaded to a web server, which results in further complications and costs.

Codio addresses these issues by allowing teachers to access student code with a single click thanks to Codio's administrative capabilities, which are detailed below. When a teacher accesses a student project, the code can not only be seen, but it can actually be run without the teacher having to do perform any special setup or configuration.

### Teacher/Student administration

The ideal scenario for a teacher is an IDE integrated with a full set of administrative features. Codio is the only platform today that offers a professional grade IDE that is easy enough for beginners but also has these administrative features.

**Course & Module management** – a teacher can create a Course and, within it, any number of modules. Courses can then be either private to your organization or made public to further our crowdsourced teaching content initiative.



**Introduction to JavaScript**

Name: Introduction to JavaScript  
 Description: A great way to get started with your career in JavaScript.  
 Owner: dignifiedquire  
 Visibility: Public: Open and viewable to all

**Assignments**

Title	Source
1. Get Started	get_started.zip
2. Variables	dignifiedquire/variables
3. Flow Control	dignifiedquire/flow_control
4. Introduction to the Grunt Tool Chain	dignifiedquire/grunt
5. Recursion	dignifiedquire/recursion
6. Object Oriented Programming	dignifiedquire/oop

**Class management** – you can create and manage classes of students in Codio. You can then assign a course, with its modules, to the class.

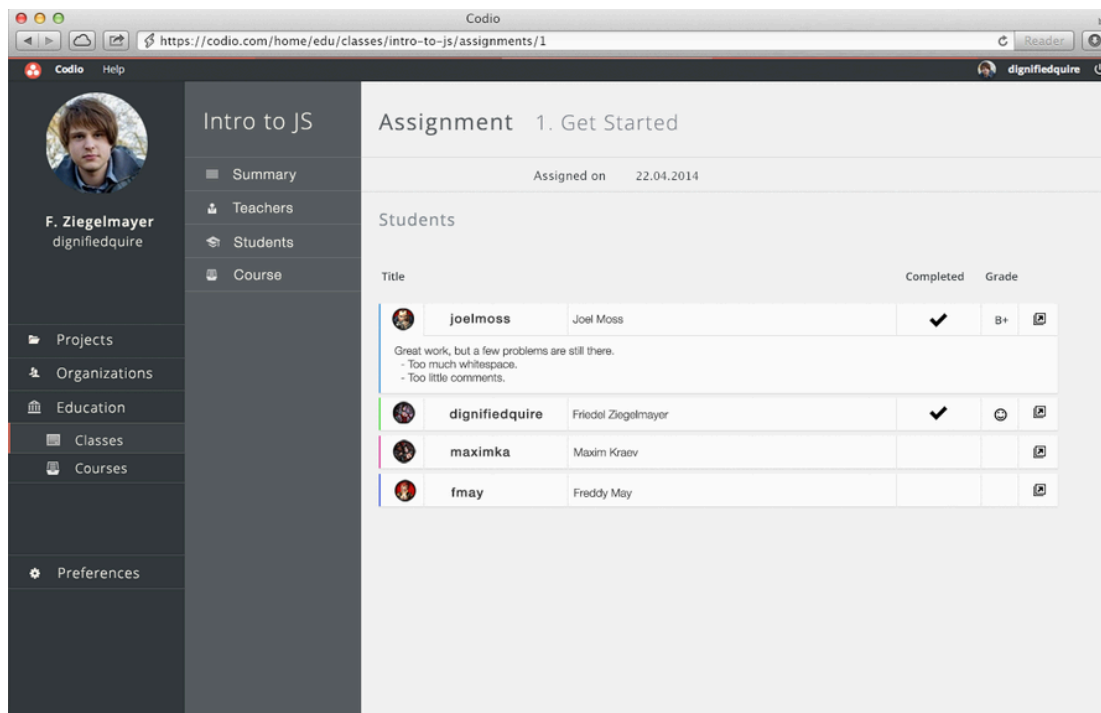
**Intro to JS**

**Students**

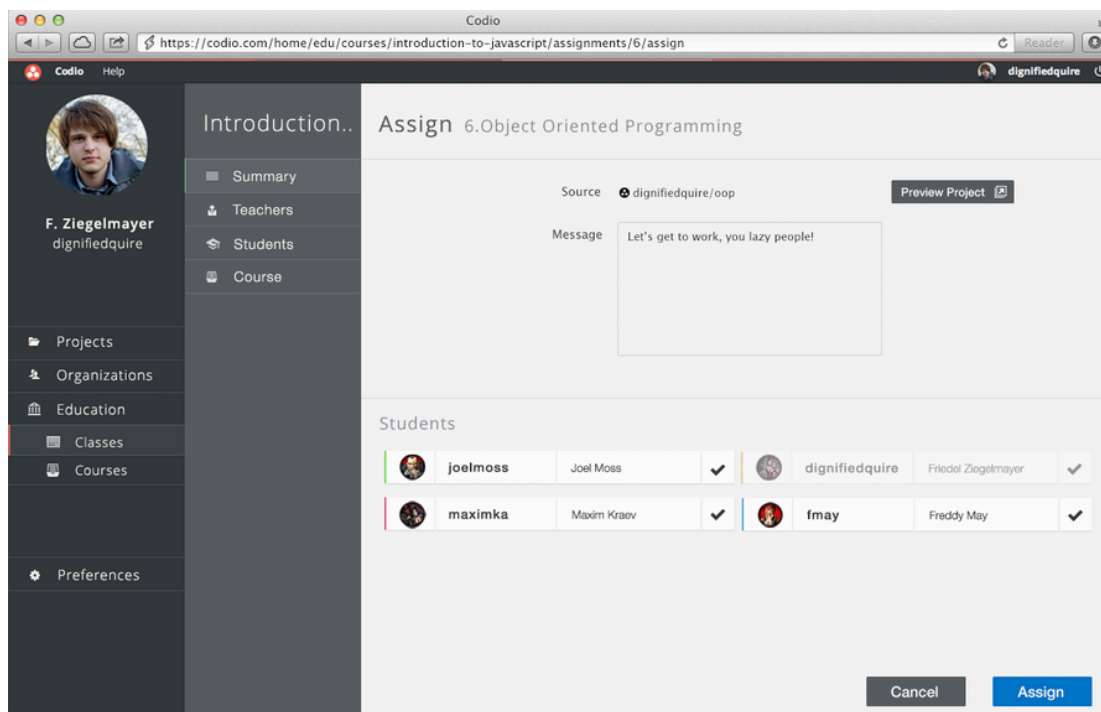
This is the **students team**. You can do stuff here Lorem ipsum dolor sit amet, consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate deserunt mollit anim id est laborum.

add another member... **Add**

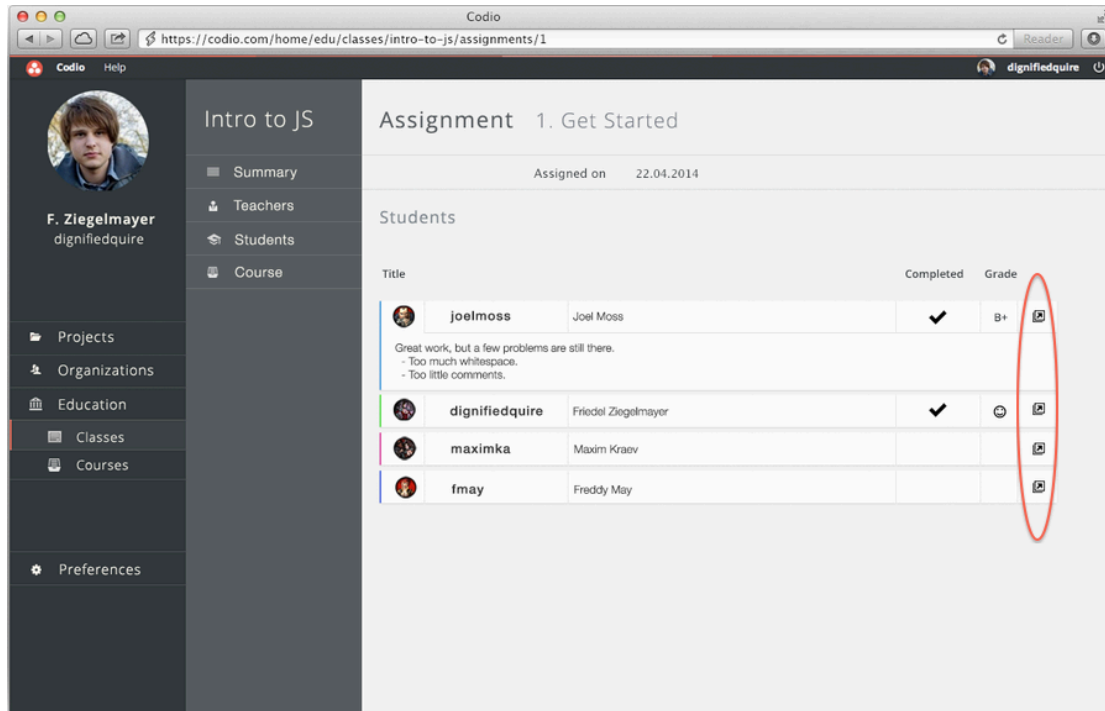
joelmoss	Joel Moss		dignifiedquire	Friedel Ziegelmayer	
maximka	Maxim Kraev		fmay	Freddy May	



**Assignment Notification** – from the class management screens, a teacher can assign a course module to a student or the entire class with a single click.



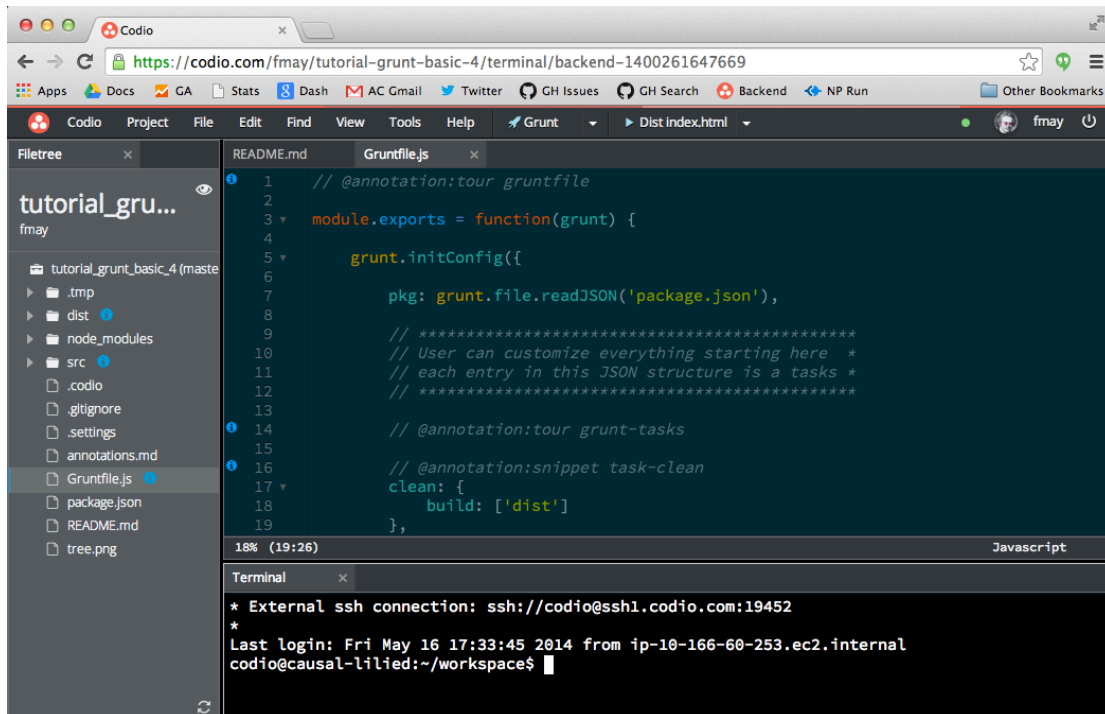
**Instant access to student code** - using the class management screens, the teacher can instantly access a student's code with a single click as shown below.



The screenshot shows the Codio web interface for a class named "Intro to JS". The teacher, F. Ziegelmayr, is viewing the "Assignment 1. Get Started" page. A table lists the students and their progress:

Title	Completed	Grade
joelmoss Great work, but a few problems are still there. - Too much whitespace. - Too little comments.	✓	B+
dignifiedquire Friedel Ziegelmayr	✓	😊
maximka Maxim Kraev		
fmay Freddy May		

A red circle highlights the "Completed" and "Grade" columns, indicating the teacher's ability to view and manage student progress.



The screenshot shows the Codio IDE interface for a project named "tutorial\_grunt...". The file tree on the left shows the project structure, including a "Gruntfile.js" file. The main editor displays the content of "Gruntfile.js", which defines a Grunt task named "clean". The terminal window at the bottom shows the SSH connection details and the last login information.

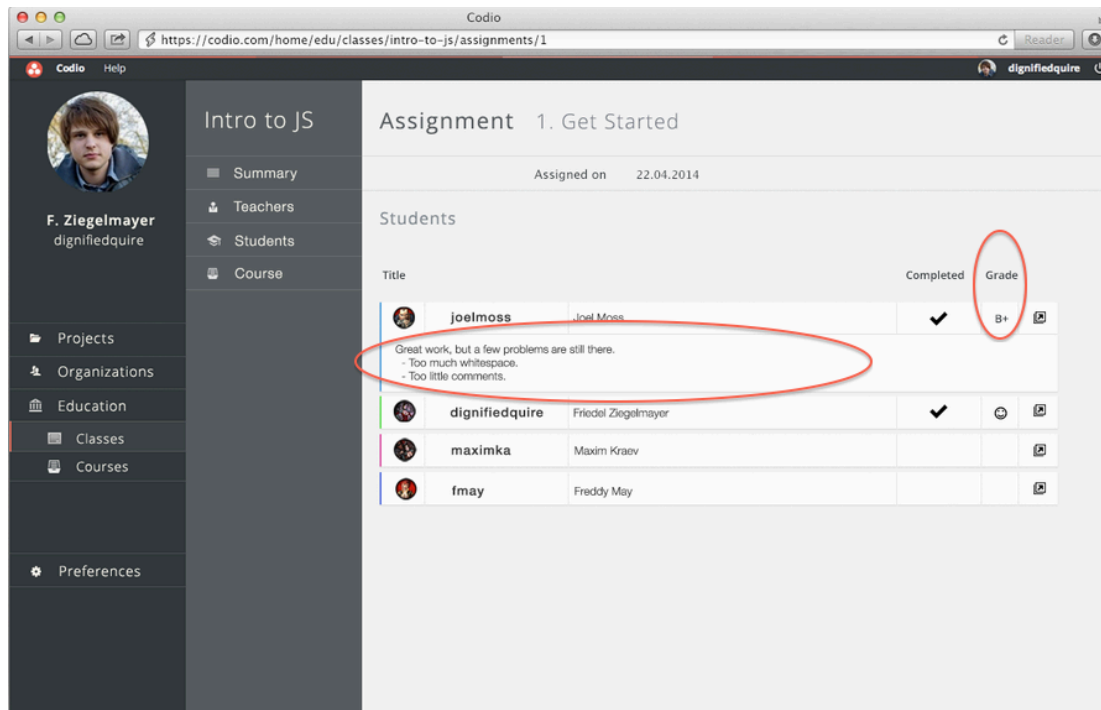
```
1 // @annotation:tour gruntfile
2
3 module.exports = function(grunt) {
4
5   grunt.initConfig({
6
7     pkg: grunt.file.readJSON('package.json'),
8
9     // *****
10    // User can customize everything starting here *
11    // each entry in this JSON structure is a tasks *
12    // *****
13
14    // @annotation:tour grunt-tasks
15
16    // @annotation:snippet task-clean
17    clean: {
18      build: ['dist']
19    },
19  }
```

Terminal output:

```
* External ssh connection: ssh://codio@ssh1.codio.com:19452
* Last login: Fri May 16 17:33:45 2014 from ip-10-166-60-253.ec2.internal
codio@causal-lilied:~/workspace$
```

**Grading/Marking** – students can indicate when they have completed a module at which point the teacher is notified and can also see the status within the class

management features. They can then assign grades/marks along with detailed comments for each student.



## Roadmap

We will be adding many new features in the coming months to make the Teacher/Student collaboration even richer. Here are a few of the planned additions

- **Discovery support** : allowing teachers and students to find out the best courses to meet their needs.
- **Rankings** : teachers and students can rate any course in Codio
- **Trending** : what courses seem to be trending
- **Google Docs Collaboration** : allows students and teachers to work on code simultaneously as Google Docs does. Includes Chat.
- **Messaging** : providing an integrated messaging system that avoids the use of email and ensures that teachers and students can message one another and track all communications.
- **Video** : allows one-to-one or group video chat to deliver an enhanced teaching experience
- **Live Demonstration** : allows teachers to show what they are doing in the IDE and for students to be able to watch it. Like screen sharing, but faster and easier.



## Other General Issues

Besides the administrative and practical challenges faced by teachers, there are many other challenges that Codio helps to address.

### Which programming language to use

There are a plethora of programming languages that teachers and courses may prefer. Besides HTML, CSS and Javascript there are many back-end programming languages that a teachers or course might prescribe. There is no such thing as the ‘best’ language. It is, will and should remain a simple preference of each teacher. Almost all programming concepts apply across all language boundaries, from Javascript, Java, Python to Haskell, Ocaml, Scala and many others.

At Codio, we believe that the teachers should be free to produce teaching content that they believe in most strongly and that this will lead to the best outcome for students.

Codio is completely language, database and components agnostic making it the ideal platform for any teaching configuration. A global, crowdsourced approach should also give teachers looking for suitable course material a real head start.

### How to teach the teachers

This is perhaps one of the most serious challenges faced by governments and teachers. There are many teachers and schools that feel they do not have the necessary skills to teach programming. Waiting for teachers to be fully trained is not an option. Teachers of traditional subjects find a fully developer system in place to prepare them for their profession. This is not the case for coding and so a very different approach is needed.

Crowdsourced content provides a first rate solution to this problem. We have already mentioned how a lot can be learnt from the Open Source world. A web based platform allows teachers all over the world to create, use or even improve other people’s content. Experienced teachers can contribute back to and improve existing Courses, exactly as happens with systems like GitHub in the Open Source world.

Inexperienced teachers can use these teaching materials to teach themselves before they start to teach their students. Kids need a lot less formal teaching or rote learning than you might expect, thereby reducing the burden on the novice teacher.

Programming can be a thoroughly enjoyable journey of self-discovery whether for a student or a teacher.

## The problem with Codecademy and Khan Academy

Platforms such as Codecademy and Khan Academy are truly excellent for the complete beginner and they do a superb job of introducing novices to the basics of programming.

For anyone wanting to learn how to code beyond the basic, these systems are inadequate. Their integrated consoles shield students from something they should not be shielded from – a development platform and IDE, whether desktop or web based. Real world coding projects require the student to work with multiple files and different tools and libraries and the sooner a student is exposed to this the better.

The major advantage of the web based approach is that the teachers can standardize without fear of Stack Hell issues discussed earlier.

We have many absolute novice developers using Codio perfectly happily and so we know that complexity is not an issue.

## Slum Teaching

As a slight digression, we strongly recommend you watch some of the TED talks given by Sugata Mitra. The link below addresses the issues of how kids can learn with only the most minimal formal guidance, provided the basic tools and content are available.

[http://www.ted.com/talks/sugata\\_mitra\\_the\\_child\\_driven\\_education](http://www.ted.com/talks/sugata_mitra_the_child_driven_education)

It talks about the concepts of learning in very small groups, typically groups of four, and allowing kids to teach themselves as much as possible. Self-teaching is, in fact, the way that professional developers work every day. Even the most advanced professional developer is constantly learning by researching solutions to problems on the Internet.

Embracing this also means that teachers do not feel they have to have a deep mastery of their subject and teach everything face-to-face in the way they might teach a subject like mathematics. Teachers can act more as shepherds while all the time learning themselves, where necessary.

## Contacting Us

If you would like to get in contact with us to discuss any aspects of our education endeavors including partnering with us, integrating with Codio APIs, content creation etc. then please email [fmay@codio.com](mailto:fmay@codio.com).