Web Application Development

Academic Program Review

May 2017

Website Development History

The Computer Sciences Program as originally established offered an Associate in Science in Computer Science with three options: Networking, Programming, and Website design, had one program coordinator, and was under the direction of the EENT/CENT Department chair. All three options for the freshman year were identical. The senior year provided the courses unique to each option.

In 2005 the Computer Sciences programs were separated from the EENT/CENT Department and a Computer Sciences Department chairperson was named. Under the newly appointed Computer Sciences Department chair's direction the program coordinator responsibilities were split up, resulting in the creation of a Networking program coordinator and a Programming and Website program coordinator. In 2006 the Programming and Website coordinator was tasked with reviewing both programs and developing plans to improve the programs. At that time, no formal curriculum recommendations existed. However at the time of this writing in 2009 The Web Standards Project introduced the Open Web Education Alliance and the World Wide Web Consortium (W3C) embraced the idea by forming a web education incubator group.

The review highlighted the following deficiencies:

- Multiple entry level programming courses
- Minimal math requirement
- No software engineering methodology
- No formal analysis concepts
- No client-side scripting
- Minimal coverage of CSS
- No productivity tools
- No exposure to graphic design principles

The following changes were made to the curriculum to correct these deficiencies:

- Modify the programming courses to follow an introductory, intermediate sequence
- Modify the Java programming courses to require the introductory course first
- Create a systems analysis course
- Weave software engineering concepts into all of the programming courses
- Ask the math department to create a discrete math course
- Add MTHN110 Algebra and Trig as a required course
- Create client-side scripting course
- Split CPTN103 into two courses
- Create an introductory XHTML course using Dreamweaver
- Modify the existing XHTML course to be more in depth regarding XHTML and CSS

- Change the program name to Associate in Science in Website Development to more accurately reflect the curriculum

At the end of the 2010 – 2011 academic year the Computer Sciences Department was disbanded and the Web Application Development Program was moved to the Business and Technology Department.

As Planned, a new course intended to replace CPTN101 PC Assembly and Operating Systems in curriculum called Introduction to Software Development and Web Application Development was developed. This course is more applicable to the curriculum and will facilitate transfer to 4-year schools better.

The number of Running Start courses has grown since the creation of CSCI102 Introduction to Web Development I. Below is a list of high schools currently participating in Running Start. Some schools do not offer their Running Start course every year due to their budget constraints.

- Campbell High School
- Nashua North High School
- Milford High School

Program Goals

What are the program's goals and how do they relate to the College's mission? How do the program goals relate to the current and future needs of the community college and the region?

The Web Application Development program's mission and objectives are:

The Web Application Development Program's Mission:

To be a leading provider in southern New Hampshire and northeastern Massachusetts of an affordable, high quality, well rounded two-year Web Application development program that is responsive to industries changing demands, and providing the most and best options for students that continue their education after completing this program or go directly into the workforce.

Program Objectives:

- Follow W3C Web Standards curriculum, formerly the Opera Web Standards curriculum as closely as possible.
- Develop articulation agreements in Computer Science, IT, IS, or a web related area with four-year institutions.
- Conduct a program review every 5 years.
- Adjust program curriculum to meet local business needs identified by the advisory committee, and by feedback from student part-time employment, and alumni.
- Employ faculty having professional software development experience.
- Develop a marketing plan to increase awareness in user groups such as nh.js a JavaScript user group in Manchester, New Hampshire.

The Community College's mission is:

> The Community College System of New Hampshire (CCSNH) is committed to providing comprehensive, market-driven, accessible, quality programs of higher education that respond to the needs of students, businesses, and communities.

The Nashua Community College's mission is:

> Nashua Community College provides quality, academically rigorous, higher-education programs focused on the diverse needs of students and the community.

The Web Application Development Program's mission relates to both the System's mission and the College's mission in the following areas.

- Market driven and accessible
- Quality program of higher education
- Responsive to needs of business and industry
- Being a leader or the preferred provider of post-secondary education in New Hampshire

The program tracks industry needs via feedback from the advisory committee, industry publications, and attending New Hampshire High Tech Council software special interest group meetings and other user related user group meetings.

Program Relevancy and Competitiveness

Has the program's related industries or markets changed in the past five years and, if so, how does it impact on the relevancy and attractiveness of the program? Have you made changes to the program to accommodate changes in the market and, if so, what have you changed? What skills taught by the program are important to keep its graduates competitive in the program's related industries?

As the computer industry matured, the World Wide Web was born to make information available to the world in a timely manner. Then, with the passage of the High Performance Computing and Communication Act of 1991, funding became available for the development of the first graphical web browser. The need for information combined with funding formed the seeds necessary for the web to grow. The availability of a graphical web browser combined with companies such as Compuserve and AOL having recognized a business opportunity provided the fuel necessary for the web and its websites to experience unprecedented growth in popularity and use. In fact by 1996, most publically traded companies realized that a World Wide Web presence was almost mandatory.

This recognition first led to the development of websites and later to web applications (webapps)[1]. In fact, there were several phases each marked by the inclusion of more capabilities. Initially websites and their webapps consisted of simple hypertext files that presented information, by using text and limited graphics. This phase provided the user with the ability to down load files upon request. The next phase was marked by website owners and users wanting websites to do more than just push information to users, the users wanted to interact with websites and customize the information sent by the website. Webapps now needed to collect and store information provided by users. Once the information flow became bidirectional between the user and the webapp, the software needed capabilities that traditional non-webapp software used to store and organize this information. This added functionality required web developers to possess some of the same skill sets that traditional software engineers possessed. Also, given the installation ease of browser based application software, new terms such "webtop applications" are beginning to take the place of terms such as "desktop applications"[2].

The integration of web access into smartphones and tablets has continued to drive the popularity of webapps as well as continue to increase their level of sophistication as more and more uses are found. This mobile frontier has created the opportunity for webapps to solve more and more complex problems while working in a more complex environment causing the roles of web developers to evolve. No longer will the generic term of web developer correctly describe all the roles required to develop webapps. As a result more specialized terms have been created to describe web developer roles.

- Front-end developer - is the practice of producing HTML, CSS and JavaScript for a website or webapp so that the user can see and interact with them directly.
- Back-end developer - is the practice of using PHP or some other scripting language combine with SQL to store organize and retrieve information and implement the sites' business logic.[4].
- Full-stack developer – Is the practice of performing the work of both the front-end and back end developer[3].

Sundeep Pattem and Olivia Zhao, data scientists at Skilled Up recently studied a dataset of over 28 million online job postings and produced the following statistics. Illustrating the trend away from web developer to either front-end developer, or full-stack developer.

Relative Demand Trends for Web Development Roles[3]

Year	Web Developer	Front-end Developer	Full-Stack Developer
2013	55%	20%	1%
2014	44%	25%	6%

They believe rise of the font-end developer might be attributed to the increasing demand for interactive web elements, such as animated narratives, interactive maps and images, simulations and illustrated essays.

In addition to webapps which have multiple pages and interact with databases and customize the information sent back to the user, a webapp having just one page are being created. According to Wikipedia a Single-page application (SPA) is a webapp or web site that fits on a single page with the goal of providing a user experience similar to that of a desktop application[5]. An example of an SPA is the Google search page. Its ability to guess the words being typed before the word is completed and display those words in a combo box without updating the web page demonstrates this behavior.

In the last 5 years the program's related industries or markets have not changed, however the markets have grown in size and are demanding more complex webapps. Additionally the high use of smartphones and tablets to run webapps has increased the complexity of the webapp themselves as the app must now detect and adjust to and gracefully handle multiple hardware environments. One of NCC's alumni stated the following "the actual computer science that I learned at NCC is invaluable. With the advances in JavaScript frameworks, they are requiring sound computer science knowledge" [8].

These changes in demand and complexity have caused the demand for web developers in general to grow at a pace of about 27% between 2014 and 2024[7]. According the Bureau of Labor Statistics. They also state that web developers need knowledge of both programming and graphic design. They continue to say employment demand will be driven by the growth in popularity of mobile devices and ecommerce.

The curriculum in this program is constantly being evaluated to identify the changes needed to keep current with industry needs. Some of the major changes that have occurred in the last 5 years are:

- Move from Xhtml to html 5.0
- CSS 3
- Addition of input form patterns (RegEx) used to validate input data

- Ajax used in SPA & multiple page sites
- DOM used in SPA & multiple page sites
- Introduction of tools like jQuery and Bootstrap
- Node.js

This program focuses on the following skills and/or concepts.

- Client/Server
- Problem solving
- Graphic design
- Process of Software Development
- Programming languages such as Html 5.0 CSS 3.0 JavaScript PHP SQL
- Testing
- Database design
- Database access Create, Read, Update, Delete (CRUD)[6]

[1] Pressman Roger, S. David Lowe. Web Engineering A Practitioner's Approach. McGraw Hill: 1221 Avenue of the Americas, New York, New York 10020.

[2] Deitel, Paul, Harvey Deitel. C++ How to Program 7th ed. Prentice Hall: Upper Saddle River, New Jersey 07458.

[3] Kraus, Josh. Front End vs Back End vs Full Stack: Web Developers & Demand 3/12/15. http://www.skilledup.com/articles/front-end-vs-back-end-vs-full-stack-web-developers-demand.

[4] Ferguson, Nicole. What's the Difference Between Frontend and Backend?. https://careerfoundry.com/en/blog/web-development/whats-the-difference-between-frontend-and-backend/

[5] Wikipedia, the free encyclopedia. https://en.wikipedia.org/wiki/Single-page_application.

[6] Wikipedia, the free encyclopedia. https://en.wikipedia.org/wiki/Create,_read,_update_and_delete.

[7] Bureau of Labor Statistics Occupational Handbook. https://www.bls.gov/ooh/computer-and-information-technology/web-developers.htm

[8] Broden, Robert. "Subj: New Job", "Received by David Hubbs April 10, 2017".

Program Performance

Based on the performance statistics on enrollment, persistence, completion, transfer, gainful employment and licensure passage rates (where relevant), how successful do you believe the program has been? Please explain your reasoning. Note: Most of the data will be supplied by the Office of Institutional Research but should be supplemented with information supplied by the program personnel.

The Web Application Development program enrollment during the academic years 2010-11 thru 2016-17 has been consistent. This has resulted in 137 students enrolled in the program during that time frame.

The student enrollment by academic year is shown below.

Student Enrollment by Academic Year*						
	AY2011-12	**AY2012-13**	**AY2013-14**	**AY2014-15**	**AY2015-16**	**AY2016-17**
Students	23	22	20	25	22	25

During this academic time period the program experienced an overall retention rate of 73.6%. For the same time period the NCC's average retention rate for all A.S. degree programs was 59.1%.

Web Application Development Program's Retention Rate*						
	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**Overall**
Retention	63.6%	80.0%	81.3%	58.8%	88.2%	73.6%
NCC	61.2%	61.6%	59.4%	60.3%	59.8%	59.1%

The 2013-14 graduation rate fell, however the retention rate for the period was 60.9% therefore, this indicates the current group of students is taking more than two years to complete the program. This could be due to math or English deficiencies which required extra courses or due to working more hours.

Web Application Development Program's Graduation Rate*						
	2010-11	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**
Students	3	5	5	5	2	2

Transfer Rates. For the years 2011 – 2016 42.9% of the graduates transferred to a 4-year institution.

The schools of choice for transfer are:

- Plymouth State University
- Southern New Hampshire University
- University of New Hampshire – Manchester
- Harvard University Continuing Ed

The program's stabile enrollment rate does not reflect the Bureau of Labor Statistics 27% growth rate. One reason for this deviation may be the perceived web developer education requirements. The barriers to entry into a front-end development career are low as Html and CSS can be self-taught. According to CNN Money in 2013 as of 2010 about 38% of web developers had less than a four-year college degree and many of them were self-trained. The author went on to say that is because The job is still too new, and the labor pool is not quite large enough yet. The program's transfer rate of 42% validates program's mission of providing options to students wanting to continue their education after completing the program or go directly to the workforce[1].

*All data used in this section was provided by the NCC Office of Institutional Research unless otherwise noted.

[1] Kurtz, Annalyn. Make $30 an hour, no bachelor's degree required. http://money.cnn.com/2013/05/21/news/economy/web-developer-job/

Program Staffing

Describe the program's current staffing composition (including adjunct faculty and the advisory council). How well does the current staff meet the needs of the program and, if deficient, what additional skills or personnel are needed to improve success of the program?

The Web Application Development Program has one full-time faculty member and four adjunct faculty members teaching in the day program. Approximately 50% of the eleven core courses are taught by adjuncts. The evening program is taught by adjuncts only. Fortunately this program has found and been able to retain skilled adjunct faculty members to teach during the day and night. This adjunct consistency combined with their theoretical knowledge and extensive industry experience has had a positive impact on the program. Additionally three of the adjuncts are currently teaching either undergraduate or graduate courses at other colleges in the area, this raises the level of credibility of the courses in the program and helps the program coordinator monitor the status of similar programs in the area.

The advisory council consists of five members, two of which are also adjuncts, that are working in industry and others that have extensive industry experience.

Name	Position	Company or Affiliation
David Hubbs	Program Coordinator/Professor	NCC
Jeff Wiener	Adjunct Professor	NCC, Daniel Webster College
Susan de Steuben	Adjunct Professor	NCC
Kathleen McConnell	Adjunct Professor	NCC, Merrimack College
Richard Boyer	Adjunct Professor(night only)/Advisory Committee	Senior Software Eng. Partners Healthcare
Betsy Gamrat	Adjunct Professor (night only)/ Advisory Committee	Application Developer Game Creek Video
William Schnaars	Adjunct Professor	NCC
Steve Long	Advisory Committee Member	Ektron, Inc
Nick Thickens	Advisory Committee Member	President Syam Software Inc
Stephanie Collins	Advisory Committee Member/Professor at SNHU	Southern New Hampshire University
Ian Warnock	Advisory Committee Member	NCC Graduate, Software Developer Creative Logistics Inc

The faculty skill sets are an excellent match for the curriculum being taught however if areas such as mobile computing are added to the curriculum additional adjunct faculty will need to be added. The 5 external members of the advisory committee provide industry direction to program coordinator. The faculty are doing their best to track technology changes in the industry and to keep their skills updated

via self-study, however the current work load of teaching, academic advising and other responsibilities does not provide sufficient time for this activity.

Resources Usage of Program

Describe the inventory of program-specific equipment and lab space. How well does it meet the needs of the program and, if deficient, what additional equipment is needed to improve support of the program? How well do the College's support services (e.g., Registrar, Student Services, Advising, Learning Commons, IT Support, Marketing, Library resources, etc.) assist the program in accomplishing its goals? What changes would you make to improve support of the program?

The condition of the computer laboratories located in rooms 102, 104, and 170 used by the Web Application Development program is adequate. The program coordinator is doing his best to schedule as many classes as possible in room 170 to take advantage of the dual monitor work stations located in that room. At this time the computer hardware has sufficient power to run the current versions of the software needed by the students.

Since, the purchase of a computer to host the web server and database software five years ago no major pieces of equipment have been purchased specifically for the program. This server is approaching the end of its useful life as most computers are not designed and built to last more than 5 – 7 years. Therefore within the next 2 years a new server will need to be budgeted for and purchased.

The huge growth in popularity of tablet class devices, and smart phones has created a huge growth in the interest of developing web sites and applications for these devices. Therefore, the program has been investigating the use of Amazon's AWS services to host and provide easy access to the student's mobile applications as an alternative to hosting these services on campus.

The Computer Science Department's MSDNAA membership has worked out well, by providing the opportunity for students in the department to acquire Microsoft software at little to no cost.

The services offered by the Registrar's Office, Student Services, Academic Support Center, Library have done a terrific job supporting the Software Development Program.

The support from the Marketing department has been excellent.

The IT support has been adequate; however, the program coordinator spends approximately 3 -5 days per semester updating and configuring software installed on lab machines needed by the students enrolled in the program.

The program coordinator provides advising during the fall and spring semesters for all of the students enrolled in the Web Application Development Program. Therefore the program coordinator can only comment on the support provided during the summer, which has been excellent. The program coordinators providing of student advising has been a conscious decision due to the technical nature of the computer software industry and the speed at which new trends occur. The adjunct professors due to their significant industry experience have also informally advised the students in regards to industry trends.

Program Strengths, Weaknesses and Needs

Overall, what do you believe are the major strengths and weaknesses of the program? What actions are needed for the program to maintain or improve it strengths and resolve its weaknesses? What additional support can the College provide to assure success of the program in the future?

Program Strengths

To determine the major strengths of the program students, and faculty were surveyed. A summary of the responses from the student perspective and the faculty perspective are included. The actual surveys are available upon request.

A mix of 12 freshman and senior students completed the survey. The major strengths of the program and their percentage weighting as reported by students are show below.

- 91% Professor's practical knowledge
- 50% Transferability of courses
- 91% Access to Professors
- 66% Access to the faculty advisor
- 50% Multiple professors teaching core courses
- 75% Applicable software
- 58% Mix of practical and theoretical courses

The survey also indicated that 50% of the students surveyed indicated they plan on transferring and continuing their education towards a bachelor's degree.

As reported by the faculty, the major strengths of the program include:

- Low turnover rate of faculty
- Professor's practical knowledge of industry practices
- Professor's depth of topic knowledge
- Multiple professors teaching core courses
- Small class sizes, allowing better student faculty interaction
- Utilization of industry standard software
- Incorporation of SDLC concepts throughout the curriculum
- Students working in a collaborative environment
- Inclusion of relevant topics such as UML, Agile, AJAX, jQuery, DOM
- Program faculty members provided student advising
- Adjunct faculty with industry experience

Program Weaknesses & Needs

- No formal articulation agreements with 4-year colleges
- Only 1 full time faculty member
- No server platform to provide access to student developed web sites on mobile devices
- No server platform to provide access to student developed mobile applications
- Current web and database server nearing the end of technical functional life

No 4-year schools in the local area have degrees in Web Application Development, therefore NCC students interested in transferring must transfer to Computer Information Systems degrees or similar degrees.

Program Needs

For the program to maintain its current strength, the following actions need to be continued or completed during the 2017 – 2022 time frame.

- Complete articulation agreements with four-year programs
- Track of industry trends by professors
- Continued participation in NHHTC
- Obtain feedback from advisory committee
- Monitor W3C model curriculum
- Every two years, review the advisory committee membership to maintain member's program relevancy and strong community connections
- Continue to support the current student advising currently provided by program coordinator
- Obtain more Running Start agreements with local high schools
- Continue review and observation of student projects and presentations by Program coordinator in as many of their courses as scheduling permits
- Continue to review all curriculum offerings for needed updates and relevancy
- Adjust the program coordinators teaching load to provide sufficient time to complete the additional tasks
- Replace hardware on a scheduled end of life basis
- Add mobile computing to the curriculum

APPENDIX

New Job

Broden017,Robert <RBroden017@students.ccsnh.edu>

Mon 4/10/2017 10:13 PM

To:David Hubbs <dhubbs@ccsnh.edu>;

Professor Hubbs,

I just got a new job in Portsmouth over at Amadeus Hospitality. I'll be their senior Angular 2 UI developer. Finally, a normal job haha. The place, that I work at, use to be Newmarket but got bought out by Amadeus. They didn't fire anyone or make any drastic changes. However, they want to redesign the look of the application. Most of the people there currently work with Salesforce, but the new design will be in Angular. That's why I got hired. I'll be working on a small team of four developers and I'll be responsible for helping others learn Angular. There's also a QA person, product owner, and scrum master on the team. A key part of the work is test-driven development. It seems like interesting work.

I'll also be becoming one of the organizers of the JavaScript group in Manchester. My first meeting for that is on Wednesday where I will find out what type of role I will play. I really didn't expect JavaScript to be such a big part of my career, but that's life. I've been studying machine learning and that actually interests me. I've seen a few positions that for UI developers that work with machine learning but you need experience in Python and Django. I'm going to attempt for that as my next career move.

Matt Douston just got promoted. He went from an associate mobile games developer to a mobile games developer (lost the associate prefix).

Anyways, thanks again for all the hard work put in to teaching us! The business knowledge that I am learning over at SNHU does really help but the actual computer science that I learned at NCC is invaluable. With the advances in JavaScript frameworks, they are requiring sound computer science knowledge. My work over at Amadeus isn't even for websites. They are using web technology to create a UI but it's a distributed software used at restaurants and hotels. JavaScript frameworks have a lot of tools for making native applications, too. One large benefit of that is not needing a team for IOS and Andriod to release native applications.

Thanks again! I'll be busy but try to stop by some time!

Rob