Evaluation Report on Duke University’s Coursera Specializations on Business Analytics and Java Programming

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Executive Summary

In 2015, Duke University rapidly developed and launched Specializations in Business Analytics and Java Programming. While the short timeline for creating these Specializations created several challenges, the courses have been very successful in terms of attracting enrollments. Overall, the Specializations have been successful at the following:

- Providing career-oriented, high-demand skills training for people working in, or seeking to enter, professional fields
- Generating revenue for Duke and for the course instructors
- Raising Duke’s visibility and reputation as one of the leading elite American universities offering open, online education
- Providing the catalyst for several new methods to assess course quality that will be used in future projects including just-in-time module feedback surveys and in-house beta testing.

There were some areas in which the Specializations were not as successful as envisioned as follows:

- The Java Programming Specialization fell short of the stated goal of attracting women and people of color to the courses and the field of computer science; additional efforts are underway to accomplish this goal
- The Business Analytics Specialization did not initially include sufficient quality assurance process so revisions had to be undertaken after the courses launched to correct errors
- Coursera staff and potential industry partners did not provide the technical support expected by CIT and the faculty members; revenue expectations were also not communicated effectively

Lessons learned from these two projects include the benefits of having more flexible timelines and the need to set realistic expectations at the start of a project. In future similar projects, effective quality assurance and communication processes will be critical to success. Overall, we recommend that any similar project undertaken in the future explicitly specify, in either the project agreement or the work plan, how the following tasks will be carried out:

- Obtain details in writing of any support or resources that will be provided by companies or partners outside of Duke University
- For projects involving multiple faculty members, plan in advance for how revenue will be adjusted if time commitments change within the group
- Establish effective quality assurance process before launching courses and designate a QA lead person
**Project Overview**

Starting in August 2015, Online Duke and the Duke Center for Instructional Technology collaborated with six instructors to develop two Coursera Specializations. Four instructors worked together to create a 5-course (4+capstone) Specialization on Java Programming; two instructors created a Specialization on Business Analytics in the same format.

These two projects were unique for many reasons including:

- The course teams had just 4 weeks to create each of the 5 courses, a much faster timeline for course creation than on any prior project.
- The project leaders had to coordinate much larger course teams than Duke has used in prior projects.
- The technologies required to create the course activities and assessments were new to the project team so new skills had to be developed very rapidly.
- Just-in-time course feedback was provided to course teams through the use of very short feedback surveys embedded in each course module.
- Course teams were aware that these courses would likely be very visible and generate significant revenue for the university.

The capstone course for the Java Programming Specialization was completed in mid-January 2016 and the Business Analytics course team finished production on their capstone course in March 2016. Since that time, we have collected survey data from learners in both Specializations and tracked learner activity patterns. We also conducted interviews with most of the course team members on both Specializations to understand the staff and instructor experience. This report summarizes that information.

Note that we have also used data from several sources to help both course teams identify elements in their Specializations that would benefit from revisions. Because those revisions are in-progress (Java Programming) or have just recently been completed (Business Analytics), an evaluation of the revision process and changes will not be covered in this report but will be forthcoming. An update on revisions is provided at the end of this report.

**Industry Partnerships**

A fifth unique aspect to these Specializations that only partially materialized was that they involved several partnerships that both contributed valuable resources to the project yet did not always deliver as expected. The Business Analytics team partnered with Airbnb to provide learners with data for assignments. The same team also partnered with TerraData and Tableau to provide students software access. These partnerships did provide learners with valuable resources, but CIT project teams had to do more work than expected to grant students access to these resources. In future projects, team leads should start this process as soon as possible and explore whether Duke’s OIT office can provide support.
The Java Programming Specialization was initially going to be offered in partnership with Google, but a change in priorities due to internal personnel changes led Google to significantly reduce the role it would play in the development and marketing of the course. They decided not to affiliate the Google name with the course and limited their involvement to providing some short video interviews with Google engineers. All the faculty members who participated in this project were very frustrated that Google largely withdrew from the project; the planned partnership with Google was a significant feature that drew the faculty members to participate in the project because they anticipated being able to access expertise and resources from Google. The faculty members also anticipated that the partnership with Google would increase enrollments and thus impact revenue from the Specialization. Hence Google’s withdraw from the project was disappointing for several reasons. While future similar occurrences are largely unavoidable, it is important to note the negative impact it would have on any future project team if an important industry partnership were to fall through.

**Learner Demographics**

Learners enrolled in the Specializations typically fit the profile of learners in other courses. Table 1 below shows some demographic measures divided by course. Most learners already had a college degree and were employed. Both Specializations enrolled fewer women than men, and fewer women than the Coursera average of 39%. The Java Programming course instructors had a goal of attracting woman and people of color to the course, so additional marketing efforts to attract those groups are recommended.

**Table 1: Selected Demographic Measures**

**Business Analytics**

<table>
<thead>
<tr>
<th></th>
<th>Course 1</th>
<th>Course 2</th>
<th>Course 3</th>
<th>Course 4</th>
<th>Course 5 (capstone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>43%</td>
<td>30%</td>
<td>44%</td>
<td>42%</td>
<td>44%</td>
</tr>
<tr>
<td>Women</td>
<td>30%</td>
<td>28%</td>
<td>28%</td>
<td>29%</td>
<td>25%</td>
</tr>
<tr>
<td>College degree</td>
<td>86%</td>
<td>84%</td>
<td>91%</td>
<td>88%</td>
<td>92%</td>
</tr>
<tr>
<td>Employed</td>
<td>76%</td>
<td>77%</td>
<td>81%</td>
<td>74%</td>
<td>71%</td>
</tr>
</tbody>
</table>

**Java Programming**

<table>
<thead>
<tr>
<th></th>
<th>Course 1</th>
<th>Course 2</th>
<th>Course 3</th>
<th>Course 4</th>
<th>Course 5 (capstone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>36%</td>
<td>33%</td>
<td>32%</td>
<td>33%</td>
<td>38%</td>
</tr>
<tr>
<td>Women</td>
<td>29%</td>
<td>20%</td>
<td>20%</td>
<td>17%</td>
<td>24%</td>
</tr>
<tr>
<td>College degree</td>
<td>63%</td>
<td>75%</td>
<td>78%</td>
<td>77%</td>
<td>88%</td>
</tr>
<tr>
<td>Employed</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
<td>73%</td>
<td>79%</td>
</tr>
</tbody>
</table>
Learner Activity Data

Both Specializations were, as anticipated, highly visible likely due to the fact that they focus on teaching high-demand, career-oriented skills that are typically not part of a college education. Course two in the Business Analytics Specialization has, as of this writing, attracted almost a half million course visitors and enrolled over 100,000 people. The number of course visitors and enrollments for each course are shown in the charts below.

Chart 1: Visitors and Active Learners – Business Analytics

<table>
<thead>
<tr>
<th>Course</th>
<th>Visitors</th>
<th>Active learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>98,660</td>
<td>44,624</td>
</tr>
<tr>
<td>Course 2</td>
<td>126,266</td>
<td>33,592</td>
</tr>
<tr>
<td>Course 3</td>
<td>98,813</td>
<td>26,653</td>
</tr>
<tr>
<td>Course 4</td>
<td>103,672</td>
<td>19,492</td>
</tr>
<tr>
<td>Course 5 (capstone)</td>
<td>426,135</td>
<td>458</td>
</tr>
</tbody>
</table>

Chart 2: Visitors and Active Learners – Java Programming

<table>
<thead>
<tr>
<th>Course</th>
<th>Visitors</th>
<th>Active learners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>147,178</td>
<td>52,202</td>
</tr>
<tr>
<td>Course 2</td>
<td>106,398</td>
<td>30,283</td>
</tr>
<tr>
<td>Course 3</td>
<td>66,528</td>
<td>14,722</td>
</tr>
<tr>
<td>Course 4</td>
<td>68,786</td>
<td>12,414</td>
</tr>
<tr>
<td>Course 5 (capstone)</td>
<td>16,147</td>
<td>366</td>
</tr>
</tbody>
</table>
Charts 3 and 4 below show the number of course payments and approved financial aid applications\(^1\) for each course. All learners have the option to apply for financial aid by writing 3 brief essays describing their financial need, why they want to enroll in a course, and how they will maintain academic integrity. Learners can apply for financial aid from either the individual course pages or from the Specialization home page, but they must apply individually for each course in the Specialization; it is not possible to complete one application and receive financial aid for all five classes.

As shown below, course payments consistently outpace financial aid applications in the Business Analytics courses. Note that the numbers in the charts below do not represent individual learners; they are course payments, originating from both individual course pages and from the Specialization page.

**Chart 3: Payments and Financial Aid – Business Analytics**

In the Java Programming chart (below), the numbers to the right of the line are payments and the numbers to the left are financial aid application. In contrast with Business Analytics, the first course in the Java Programming Specialization has received more financial aid enrollments than paid enrollments. Subsequent courses in the series have more paid enrollments.

\(^1\) Coursera allows learners to apply for financial aid by answering a few questions. If approved, they receive a fee waiver for one course. This process is entirely internal to Coursera and is not associated in any way with federal financial aid or any school-based aid programs.
The next two charts show the conversion percent within each class from course visitors to active learners, and from active learners to paid enrollments. Note that we use the term “conversion” loosely; we know that not all paid learners start as active learners and complete an activity prior to purchasing an enrollment. However, displaying the data in this manner is helpful for illustrating what portion of active learners are paid learners.

As illustrated previously, the second course in the Business Analytics series has attracted the highest number of course visitors and enrollments of any course in either Specialization. However, it has the lowest active-to-paid conversion rate at 6%. This indicates that 94% of people who are active in the course have not paid. Since we know that the number of financial aid learners is roughly half the number of paid learners, we can infer that around 91% of active learners are auditing the course.
Across all courses in the Java Programming Specialization, the active-to-paid conversion rate is between 8% and 13%. There is a decline in the percent of course visitors who become active in a course with each subsequent course across the series. This could be the result of the courses building on each other so it would be difficult for someone to visit a course in the middle of the series and become active if they had not already done the prior courses. This is less true in the Business Analytics series.
Learner Feedback Surveys

All learners who enroll in any of the courses in either Specialization are emailed a survey at the beginning of the course. All learners who successfully complete a course are emailed a follow-up survey soliciting their feedback. There is an exception to this; pre-course surveys were not done in the Java Programming courses because Google researchers were distributing their own surveys at the beginning of each course in that series. We received approval to resume surveys in those courses last month so those data will be available in follow-ups to this report. In addition to the learner feedback surveys, we also collected data on the learner experience from the Online Course Builders who were active in each of the courses and thus had insight into what learners found difficult or challenging.

There are several limitations to the learner feedback surveys that should be recognized. First, they are not generalizable to all learners. Only people who successfully complete a course are emailed the post-course survey so the results should be generalized only to that sub-group of enrolled learners. Second, even within the group of course completers, the response rates are low and people self-select whether or not to take the survey. It is not known how selection bias impacts the data, but it likely does. In spite of those limitations, the data are very useful for indicating trends and patterns. When the data from one course looks different from the rest, it indicates there is likely a significant difference in that course.

An example of this is shown in Table 2 below. This table shows the mean overall course rating scores given to each course. Learners were asked, once they finished the entire course, to assign a score from 1 (very poor) to 7 (excellent). All the courses in the two Specializations have average scores between 5.7 and 6.62 with two exceptions: Business Analytics course two has a lower score (5), and Java Programming course five has a higher score (6.6). Based on this, we worked with the course development team and the instructors of the second Business Analytics course to identify why the rating was lower and target revisions to address problems. Those revisions are currently being completed.

<table>
<thead>
<tr>
<th>Course 1</th>
<th>Course 2</th>
<th>Course 3</th>
<th>Course 4</th>
<th>Course 5 (capstone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Analytics</td>
<td>5.9</td>
<td>5</td>
<td>6.1</td>
<td>5.8</td>
</tr>
<tr>
<td>Java Programming</td>
<td>5.7</td>
<td>6.0</td>
<td>6.2</td>
<td>6.1</td>
</tr>
</tbody>
</table>

We used the overall course ratings as a starting point to identify why learners gave the Java Programming capstone course higher-than-average ratings. Several students commented that they found the capstone project to be a good learning experience because it used many different skills they had learned throughout the series. They also praised the “real-world” nature of the project and the fact that the skills they used were things they would put to future use. For example, a student named Cathy wrote the following comment about her experience after the capstone:
This whole specialization was fantastic! I was a linguistics major as an undergrad and tried to learn Java, but I really struggled with it. This fall I am entering grad school for a masters program in Human Language Technology. I am aiming toward a career in computational linguistics and natural language processing but learning to program has been a huge hurdle. Now that I have completed the Specialization I have so much more confidence in my programming skills and I feel ready to apply them in grad school.

Other students commented that, “This was an awesome project. It was great getting to implement everything I learned over the certificate program”, and “This capstone project is a nice way to reinforce the learning of the material in the course”.

As an alternative measure, we also compared the course scores assigned by learners through the Coursera platform. Learners can click on stars to assign a course a rating between 1 and 5 stars (note that the scale used by Coursera is a 5-point scale while Duke’s learner surveys reported in Table 2 use a 7-point scale). Duke’s overall course average is 4.52 and Coursera’s overall average is 4.63. The Business Analytics Specialization courses received ratings of 4.5, 4.2, 4.6, 4.7, and 4.7. This is consistent with the pattern seen in the learner feedback surveys. The Java Programming scores are 4.4, 4.5, 4.7, 4.6, and 4.7, also keeping with the pattern seen in the learner feedback and comparable to other courses offered on the platform. These high course rates are also reflected in the student comments provided in the feedback surveys. For example, a learner in the first course in the Java Programming Specialization wrote:

I would like to express my gratitude to the course instructors, Susan, Owen, Andrew and Robert for their outstanding affords to teach us programming. I’ve learnt much more about programming and more importantly now I feel myself confident to solving programming problem. The instructors provide a high quality of education of computer science in very useful manner and made me feel I’m really doing programming.

Similarly, a student in the third Business Analytics course offered praise for the way all the course elements worked together:

Thanks to Prof. Jana. The whole learning experience is excellent. The video lectures, practice quiz and graded quiz all worked together to deliver an excellent course. It is by far the best in its class - being technique and tool oriented. Prof. Jana’s lecture on the neuroscience of visual perception and attention is the best foundation I had on visualization and communication.
A second set of measures we used to evaluate the learner experience in the Specializations are questions asking people to self-assess their own learning and the extent to which they felt the course was engaging. Charts 7 and 8 below indicate the percent of learners in each course who said they agreed with the following two statements:

- For the amount of time I invested in this course, I'm happy with what I learned
- The course materials were presented in an engaging manner

The data from the Business Analytics Specialization confirms the pattern indicated by the overall course rating scores. Far fewer learners in the second course are happy with what they learned or find the course materials engaging. In the Java Programming Specialization, the percent of learners indicating each outcome is similar across all courses. Overall, the learners are extremely satisfied with the courses.

Chart 7: Learner Surveys – Business Analytics

<table>
<thead>
<tr>
<th>Course</th>
<th>Happy with what I learned</th>
<th>Course was engaging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>93%</td>
<td>91%</td>
</tr>
<tr>
<td>Course 2</td>
<td>60%</td>
<td>52%</td>
</tr>
<tr>
<td>Course 3</td>
<td>95%</td>
<td>97%</td>
</tr>
<tr>
<td>Course 4</td>
<td>90%</td>
<td>89%</td>
</tr>
<tr>
<td>Course 5 (capstone)</td>
<td>100%</td>
<td>86%</td>
</tr>
</tbody>
</table>
Staff and Faculty Experience
We conducted interviews with the project leads, course support staff, and instructors to understand the staff and faculty experience. We also wanted to identify processes or experiences that could be changed to improve the course development process in the future. During the course of those interviews, several themes emerged that were repeated in the majority of conversations. The following section describes those themes.

Setting Expectations Early
It is important to set expectations for the course development process and to make all expectations explicit, not implicit. Every person we spoke to cited at least one time, and sometimes many times, during development when people on a course team had different expectations for how something would be done and it caused project delays, frustration, and people repeating work. Specific topics that should be addressed up-front include:

- Specific division of tasks within the project team, including instructors
- How to handle errors and mistakes – who to contact and how they respond
- Realistic enrollment numbers and royalty amounts
- Expectations for frequency and format of communication
- A process for revisiting and revising task assignments as needed

Several people suggested having a longer kick-off meeting to review expectations. Similarly, one person suggested having a video kick-off meeting first and then waiting a week and having a full team kick-off. This lets the instructors see the
types of video available and come to the team kick-off ready to make decisions. Another person suggested having a work-oriented kick-off meeting and a separate kick-off social event to build team cohesion.

Navigating Short Timelines
As discussed at the beginning of this report, one of the biggest challenges with both these Specializations was that they were created on a very short timeline – about 4 weeks for each course. Almost everyone we interviewed mentioned this as a challenge, and several instructors said they would not do a project like this again unless the timeline was much longer. We identified several reasons why the timeline was problematic and changes that could help alleviate the burden created by the timeline.

First, the timeline was problematic because course building is not linear. The process becomes faster as people gain experience; the Java instructors, for example, felt that building course four went much faster than building course one. The set timeline, however, allowed 4 weeks for each course. Second, there are some tasks during course development that require a significant amount of inactive time, such as waiting for a technology tool to be built or approved. A linear timeline places these events sequentially instead of simultaneously. Finally, other demands on faculty members’ time are not constant. Several instructors said that they had times during the project when they could have done more than they had scheduled, and times when they were unable to do any work on the project at all.

The obvious recommendation is to allow for a longer timeline on future projects. Four weeks is not enough time to build a course under most circumstances. Beyond that, some other possible changes are:

- Identify a back-up person for each major task so that if things fall behind, there is a person to help
- Begin all inactive tasks (seeking approvals, gaining copyright clearance, working with vendors) at the start of the project
- Overlap course development when possible, such as having instructors plan all the courses in a series so they have the option to make large amounts of video content for multiple courses when they find time available

Quality Assurance
The two Specialization teams took different approaches to quality assurance. The Java Programming team asked an Online Course Builder with a strong technical background and coding experience to take all of the courses as a learner, assuming that if she experienced difficulty learning any of the material, it would pose problems for most people. This approach helped them identify several places where they needed to make changes to both videos and assessments. There was widespread agreement that, while time consuming, this approach to quality assurance was very effective and allowed them to make changes before a course opened or shortly thereafter.
The Business Analytics team relied more heavily on the module surveys that began after a course launched for feedback. They also looked at things learners were flagging in the course and fixed errors when they were present. This was an effective approach for correcting errors, but did not allow them the option to fix them before the course opened. It was also not always clear who was responsible for looking at feedback and flags and making changes; sometimes the project staff felt that the instructors needed to make changes since they were the content experts but sometimes the errors were issues best fixed by people more familiar with the platform.

Both project teams agreed that beta testing of courses was very important. Given the short timeline, beta testing did not always happen before a course opened. When it did not happen, there were noticeably more learner-reported errors.

Support Staff
A full-time dedicated Teaching Assistant (TA) who was hired by the faculty members assisted in the Java Programming courses by answering learner questions and participating in the discussion forums. About 5-10 hours a week of her time is spent responding to learner questions. She also assists with developing and improving content, creating assessments, and designing A/B tests to experiment with new materials. She also helped the course mentors by answering their questions and providing guidance on how they should respond to various issues; she typically responded the same day a question was posted. It is likely that the reason people volunteered to be mentors is because the TA was active in the course from the beginning and learners saw the discussion forums as a way to get involved. It is clear that having a dedicated TA who is a content expert has greatly enhanced the learner experience in the Java Programming courses and been instrumental in making the discussion forums a tool for active and engaging discussions.

In contrast, the Business Analytics Specializations did not have a dedicated TA and the instructors were not active in the discussion forums. This resulted in learner posts with questions not receiving quick responses when the questions were content-related (CIT staff mostly respond to non-content questions such as how to access a resource). Over time, some learners have volunteered to be mentors, but they have not received a lot of direction on what they should do. One volunteer mentor posted in the dedicated mentor forum:

I'm having trouble keeping up already with the requests for help in the forums, especially since I've been away from this material for nearly a year and will need time to re-master it. Are there other mentors for this course who can help?

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2 Coursera course mentors are learners who successfully completed the course and then volunteered to mentor others through discussion forum participation.
It took 17 days for someone to respond to this question, and the eventual response came from another mentor. Several of the weekly discussion forums in the Business Analytics courses do not have any active discussions for 1-2 months at a time.

This was especially problematic in the MySQL class because learners found it to be a technically difficult course and therefore had a lot of questions. The course team responded by hiring 2 part-time TAs to spend 7-10 hours a week responding to questions in the forums. The course team reports that this has made a significant positive impact on learner satisfaction and reduced the number of questions being asked because learners can search for existing threads that answer their question. Whenever possible, at least a part-time TA with content expertise should be hired for future courses.

**Revisions**

Based on a preponderance of evidence, the Business Analytics team targeted course two for revisions. We analyzed all the available data and provided the course project team with a report recommending changes and identifying targets by which to measure success. The course was re-launched with revisions as of September 1. At this time, we have only collected 17 post-course surveys so it is too early to assess whether the revisions have been successful. However, based on reading student comments in the module surveys, it appears that the revisions have rectified most if not all the problems.