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2nd edition

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Special Tracks

Learning to Program using Immersive Approaches: A Case Study

Learning SAS®, IBM Bluemix and Watson Analytics

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Abstract. Learning to program is an activity which needs the learner to develop a range of new skills. Traditionally, this has been achieved in Universities by presenting a series of structured lectures and tutorials covering the syntax and grammar of the language. This approach often leads to disengagement by many of the weaker students. It is becoming clear that this may not be the most effective approach in the twenty first century because of the continuous development of software packages which leads to the need to continuous revision of teaching materials. In addition, modern students demand engagement in learning that also prepare them for employment. This paper evaluates a directed, immersive, and engaging learning approach that mirrors the real world of employment, and prepares students for lifelong learning, development, and maintenance of new skills and languages. The approach should be applicable to most STEM subjects which require using specialist software packages.

Keywords: SAS, IBM Watson, technical skills, soft skills, engaging learning, STEM subjects

1 Introduction

The traditional perspective of the academic role is as “Domain Expert” who knows more that the students and can, therefore, always provide the necessary technical guidance. However, in the field of computer science this is becoming ever more difficult because of the very rapid rate of development of software packages, especially those that are open source. This leads to ever increasing levels of stress on academics [6].

It also leads to the use of activities that often do not seem to the students to have any relevant context, other than that of learning the syntax and grammar of a new language or package, thus leading to boredom and lack of engagement. It also generally fails to develop soft skills demanded by employers, such as curiosity, problem identification, creativity, problem solving, collaboration, communication and

story-telling [5]. This position is also repeated annually in the UK in surveys of employers of the employability of recruited graduates.

A very different approach is required that develops soft skills and life-long-learning. This requires an academic mind-set of “Academic as Learning to Learn Expert”; as a facilitator of the learning process, rather than a teacher of technical domain skills. It relies on the (modified) observation by Plutarch that “Education is not filling (leaky) buckets but lighting fires (of enthusiasm)” [1].

Fundamental to this approach is the concept that much contact time should be devoted to working with each student to develop their skills in learning rather than teaching the language, for which there are many sources. Once our graduates are employed, they will mostly have to learn software from online sources, rather than from taught courses, using YouTube videos and relevant Technical Fora, alongside self-tutorial materials which are sometimes provided by the software vendor. The necessity of this is regularly commented on by our students on their third year internship placements.

The author has recently been leading two courses with very different types of software using this approach, for students who had not demonstrated significant levels of aptitude for (or even interest in) computer programming. The results demonstrate both high levels of achievement and, in general, good levels of engagement.

The Department of Computing and Maths at the University of Derby in the UK is a member of both the SAS Student Academy and the IBM Academic community. As a result we have strong support from both vendors to help our students to gain skills in the respective product sets.

For SAS our students have access to the Base SAS environment through the SAS 9.3 environment installed on the specialist lab PCs and the SAS Analytics U environment on their own PCs.

For the IBM product set, our students have free access to the whole IBM Bluemix environment and also, on a module by module basis to the full Watson Analytics Professional environment, all of which are delivered via the Cloud. IBM Bluemix provides access to some 100 different products from application programming environments, via Internet of Things toolsets such as Node Red through to significant analytics products such as SPSS, Cognos and Watson Analytics.

2 Pedagogy

Traditional approaches to teaching computer languages and systems are approached from the “Academic as Domain Expert” perspective which leads to a style that emphasizes the language features in the abstract, often without any context as to why the features are important or to what the features might be relevant. This can very rapidly lead to students becoming disengaged from the lectures and workshops and to poor levels of achievement, as found in module reports and student surveys.

In contrast, the “Academic as Learning to Learn Expert” perspective leads to intense engagement in the subject during the supervised learning periods of seminars or workshops or tutorials. It draws on the ideas of experiential learning and the “learn by exploring” [2] variant of “learn by doing” which explicitly employs elements of problem-based learning [3] and enquiry-based learning [4]. It also leads to very high student achievement and satisfaction.

One of the founding principles is that scheduled contact time with students is far too valuable to be used for presenting information that they can easily find elsewhere. Contact time must be dedicated to enthusing the students to research for themselves and to find the right answers and to connect with the overall topic.

It is to be noted that programming skills are, for most people, a tool with which to achieve some objective, whether that be to gain insights from data or to develop application systems; it is rarely an end in itself. As a result, for many students, expertise in the language or system is incidental to being able to achieve some wider and more significant goal.

Another of the key principles is that of the academic teaching questions rather than answers. They want the academic to guide them to find the relevant sources of “how to” experience and knowledge from web based resources provided either by the relevant vendor or in appropriate technical forums, as is common practice in the business environment. Focus groups with students shows that this is their preferred means of getting guidance to solve their technical problems. They were very clear that they did not want the academic to just “give the answer”. They wanted probing and prompting questions to help them learn the answer for themselves (module feedback surveys and focus groups).

3 Case Study Courses

Both modules in this case study which are designed for Undergraduate programs in Information Technology which are related to the application of computer science based tools to achieve business objectives, such as gaining and compellingly communicating valuable insights about businesses from data. As such, the critical learning outcomes are about applying technical and soft skills to achieve these aims [5]. In some respects, therefore, the technical skills of using the chosen software packages are a secondary objective, albeit a necessary pre-requisite to being able to achieve the real objectives. High quality employability depends on both technical and soft skills in our graduates.

The first course results in the students teaching themselves SAS from the official Base SAS course materials and then applying their knowledge to create small information analysis systems. The second course allows the students to choose from a very wide range of software packages from the IBM Bluemix and Watson Analytics portfolio and then, through a blend of on-line tutorial materials and assistance from IBM staff in seminars and workshops, develop analyses which provide insights.

In both courses, the course leader has a broad understanding of the capabilities of the packages but not necessarily with detailed levels of expertise in all areas. The course leader's expertise is in defining significant challenges for the assessment process which will enable the students to develop both technical and soft skills.

3.1 Common Principles

In the UK University system a 20 credit module (or course) represents an allocation of 200 hours of study time, from which 36 to 48 hours will be allocated to scheduled contact time over the 12 week semester, or 3-4 hours contact time per week which will include lectures, seminars and workshops or tutorials.

Both courses rely on the students learning the relevant technical and programming skills, initially during a few scheduled workshops but mainly in their own study time as part of the overall 200 hours of study time allocated to each 20 Credit module.

In each of the modules, students are required to identify a large open data source that is of interest to them and then to identify typical stakeholders who might be interested in gaining insights from the data. They are then required to analyze the data and to identify a small number of valuable insights that can be gained from the data, using relevant tools in the defined product set.

The assessment tasks and related marking rubrics then ensure that both the necessary technical and soft skills are developed and demonstrated.

Both modules lead the students to totally immerse themselves in the product for the duration of the module.

3.2 Introduction to Data Analytics (Course 4CC522)

This is a first year module for students on the BSc Information Technology module and is based around learning "Base SAS" as the tool for analyzing data. The students learn the basics from the standard SAS provided teaching materials. During the first three weeks of the module, the students are supervised by the tutor during the two hour workshop in the computer labs. Their technical skills are assessed via four computer based tests which carry 40% of the module score. The weekly two hour lecture / seminar is primarily used by the students to develop their research and presentation skills and, using the "Student as co-creator" approach to share their learning with each other. During each seminar the academic will provide a short fifteen minute contribution on one of six key topics covering the data identification through to gaining final analytical insights to provide an overall context to the module. For the rest of the seminar, the students will give short ten minute presentations, in pairs, on a range of specified topics which they research and also develop short tutorial materials for the rest of the cohort.

3.3 Emerging IT product Developments (6CC515)

In this final year undergraduate module a different approach is taken. Rather than using Base SAS which is essentially a single product, this module exposes the students to the totality of IBM Bluemix and Watson Analytics. In this environment, it is not feasible for the academic to have a comprehensive technical capability in all the products. Instead, the academic only needs to have a broad awareness of the capabilities of the various packages that might contribute to the students' analytical activities.

IBM have provided us with staff who visit to lead seminars and workshops to both introduce the products and also to give advice during the exploration of the capabilities and the development of the tools to gain the planned insights.

The students are also required to find a significant set of data that fires their enthusiasm. They are not given any specific data.

Given that IBM Bluemix contains approximately 100 different products, many of which are in a continuous state of development, this module demands an even more immersive involvement from the students.

4 Analysis of Results

There were 19 students on the IDA module and 13 students on the EITPD module with the following results profiles. The horizontal axis identifies the grade band that the students achieved.

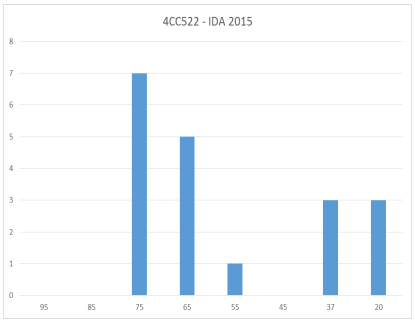

Fig. 1. First Year Results

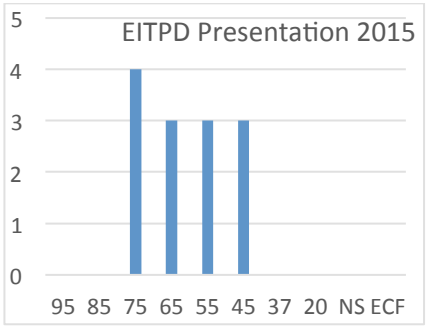

Fig. 2. Final Year Results

4.1 First Year Module – Introduction to Data Analysis

It should be noted that the six students on the right-hand side of the graph in Fig 1, displayed a similar level of disengagement with all their modules. It appeared that

there was a fundamental issue with their approach to University level education rather than disengagement with the SAS programming element of the module. The remaining students demonstrate considerably better levels of achievement that we were expecting.

4.2 Emerging IT Product Development Module

The main assessment for this module was a fifteen minute critical review presentation covering the totality of the exercise from identification of the data and the potential questions that might be answered, through the data cleansing and integration of the necessary product elements, to the insights gained. The structure and timing of the presentation was designed to replicate a post-project presentation to the business customer and CIO that would be normal in a business setting.

The notable result is that no students failed the task, although some came close. The ones scoring above 60% all developed extremely interesting insights and used a wide range of unexpected datasets from crime statistics linked to locations of CCTV cameras to an analysis of the Steam and Valve activity statistics. Their presentations have been re-engineered and posted on the departmental YouTube channel as exemplars of the types of insights that can be gained by using Watson Analytics, see https://www.youtube.com/playlist?list=PLWT0aRqpyk1oBwS8t5QVz-qVeX_ndURi0.

5 Conclusions

The "Academic as Learning to Learn Expert" and facilitated immersive learning has allowed students who specifically enrolled on the BSc IT program in order to avoid computer programming have all surprised themselves by developing the ability to teach themselves how to program in SAS and use Watson Analytics and to also communicate well.

Research is continuing to refine and develop this approach to further improve the levels of engagement and achievement.

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