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Analysing student study choices to qualification: which study routes are best?

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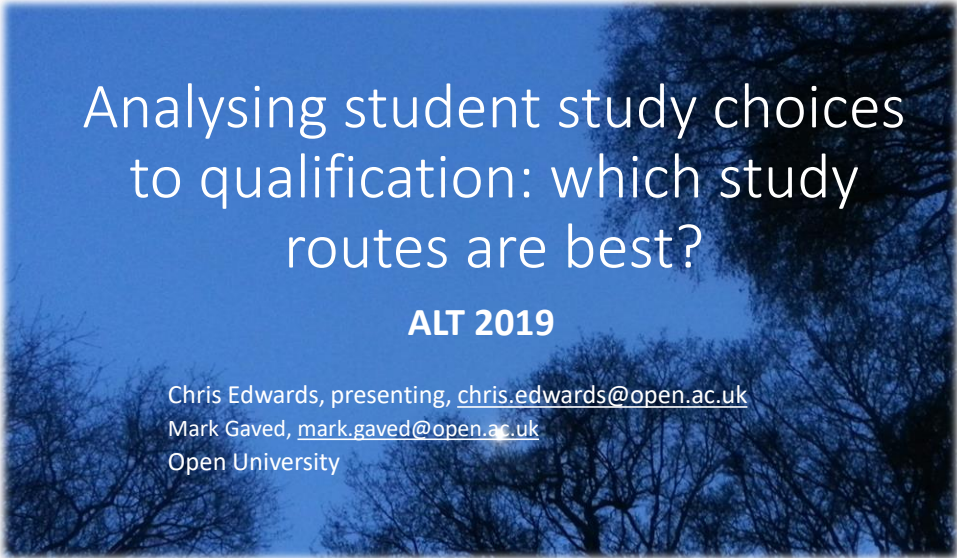
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Analysing student study choices to qualification: which study routes are best?

ALT 2019

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One of their roles brings Chris and Mark together as data wranglers, primarily to support the OU's Faculty of Arts and Social Science. This work is now also being used to answer questions on student pathway choices within four of the University's five faculties. In short, our data wrangling is intended to produce analyses of data relating to student study that lead to an enrichment in the understanding of the student experience and the effectiveness of the curriculum in order that we might improve both. It relates to the learning analytics work within the Institution but reflects on data after the event, rather than in real time as most of the learning analytics work.

Abstract

Higher education institutions would like to give students choice in their studies and want as many as possible to be successful. However, in module based qualifications, it is often difficult to establish how each module serves students aiming for a particular study outcome: with modules often linked to many qualifications. Without this information universities can neither fully understand the impact of student choice or give useful advice to students as they decide which modules to study.

We describe an approach that is being developed within The Open University, UK, to understand the impact of student module study choices on progression through

qualifications. This session will describe how the data model and this pathway approach can yield valuable insights that were previously not readily accessible. We will show how we can follow the ongoing study of a single cohort from their first module, take a snapshot of an entire undergraduate degree qualification and explore how one qualification is represented in a dataset spanning several years. We will reflect on the approach we have taken, including challenges faced and the impact of this work.

The Open University offers the Open degree, which has a very high level of student choice and is the most popular qualification offered by the institution. The Open degree has thousands of potential pathways and in any given year, Open degree graduates could possibly each have taken a different study path. However, even relatively tightly constrained qualifications with perhaps just one point of choice during each study level, or year, can rapidly diverge into many potential study paths – fragmenting the original cohort. Therefore, understanding the differing rates of completion, success, and continuation as students opt for these many different routes is highly complex yet can provide great insight to qualification and module teams, as well as learning designers as to how effective different pathways are and where interventions or corrections might be required. This pathway approach would be of relevance to colleagues in other institutions as they determine to explore what we could perhaps describe as ‘the health of curriculum’ alongside increasing understanding of the student experience on diverse module pathways towards qualification completion.

The context

- OU has some complicating factors, others may share to some extent
- Although we have much data we have struggled to use it to explore pathway related questions.
- Trying to get better clearer perspectives on data
 - To compare like with like and
 - Better deploy learning analytics

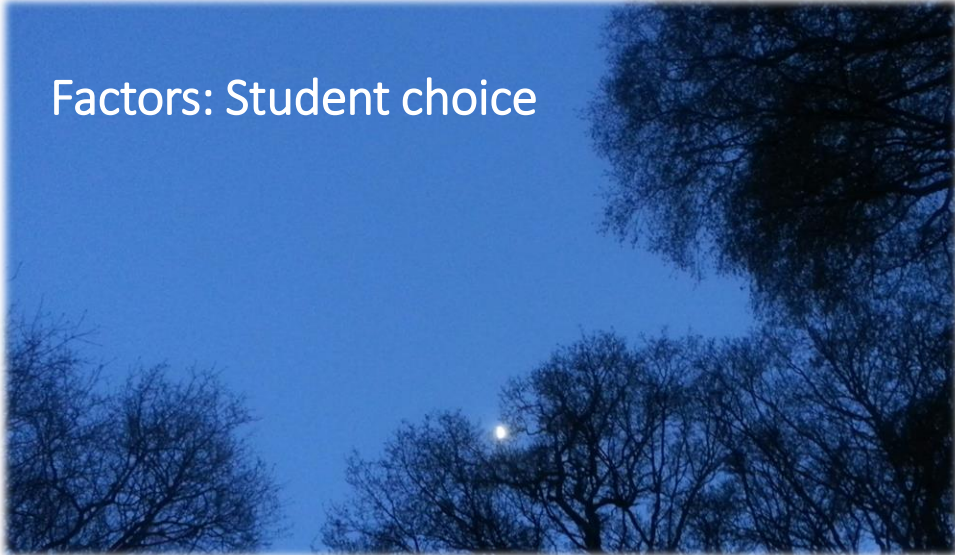
OU students mostly declare an intended qualification at the outset – some need to, if they are going for a loan from the Student Loans company in England.

They can change their intended qualification as they wish during their study and it is only fixed at the end of their studies when they accept their degree
Students can study modules outside of an expected programme of study. It is their choice

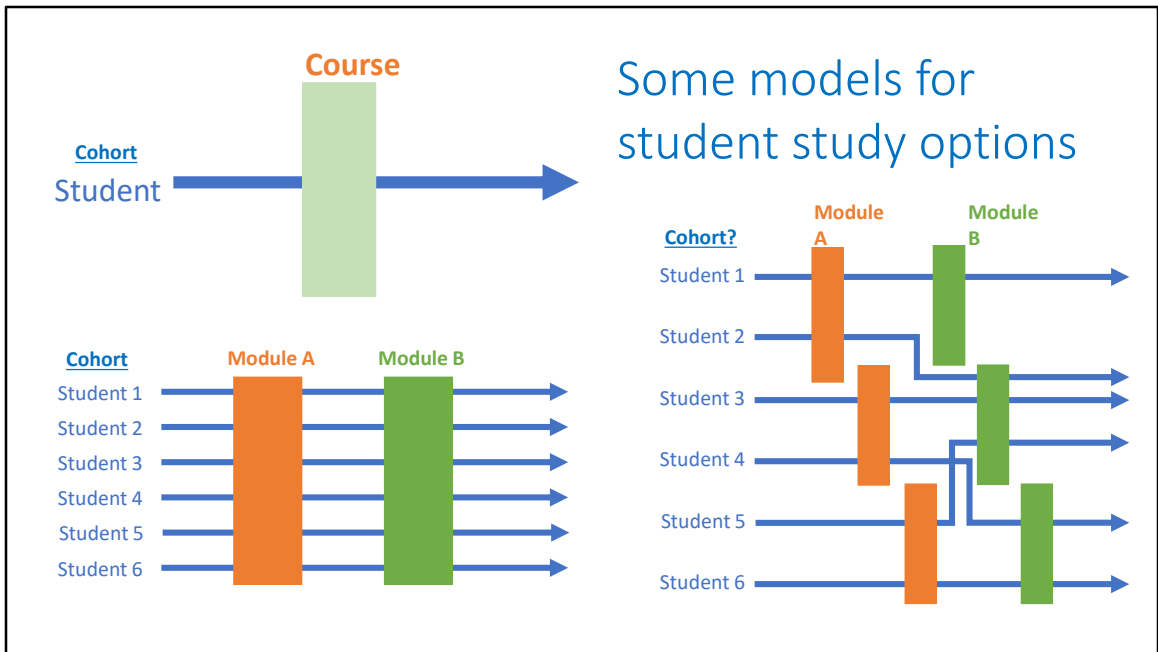
On average an OU student takes 6 years to complete their qualification. However, they can (unless, for example, professional bodies impose shorter periods) take up to 16 years

We have massive fragmentation of cohorts – *see the following slides...*

Factors: Student choice



The OU context of study relating to student choice in what they study and when. And the cohort fragmentation that choice and flexibility lead to...



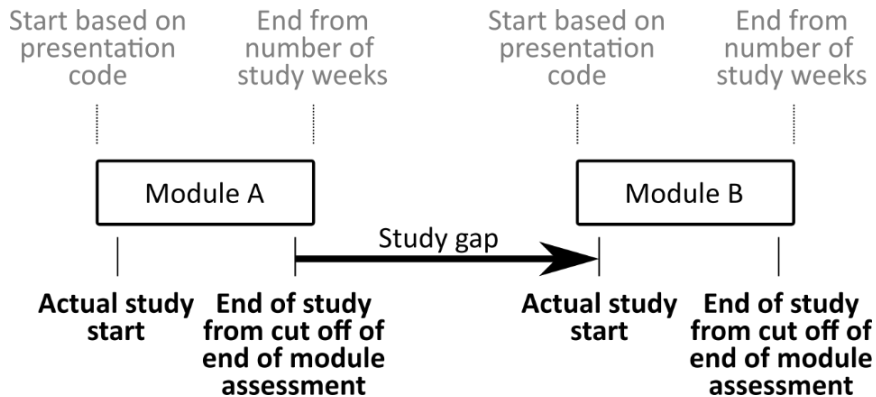
Take three potential outline tuition models:

1. Straightforward, one tutor per student – *the student study experience is relatively straightforward to describe and understand.*
2. Many students per module, with sequential modules – allows teachers to teach to their strengths – *understanding the student experience is more complicated but not problematic.*
3. Offer choice and flexibility to students - partially lift the time constraint by offering several choices of time to study each module (retaining a sequential format). *This is getting close to the OU's model*
 - a. each module may be taught by a different tutor in different presentations. *We now have a fragmentation of the cohort and the further we look down the programme of study, the greater this fragmentation.*

Therefore, as we **increase choice, flexibility and personalisation**, we will also **increase** the complexity in trying to understand the student experience.

Note: am ignoring concurrent study on this slide – see the next one.

Study gaps/overlap – concurrent study



Students generally have the option to take a break between modules.

- Taking a break introduces a **study gap**.
- Most programmes are designed with some study gap – simply due to the University’s teaching model.
- Students may often opt for a negative study gap – **study overlap**
- Which, at its maximum would be **concurrent study**

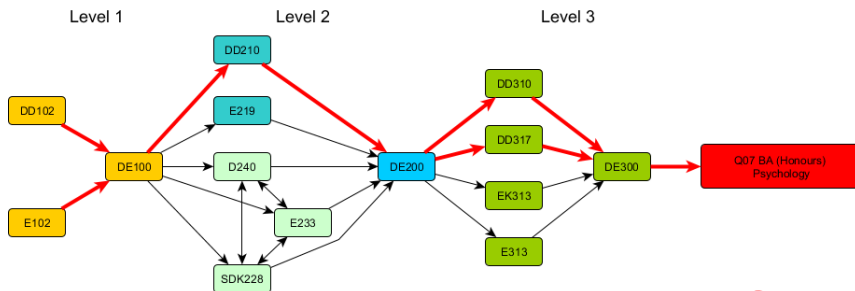
Different study gaps contribute to cohort fragmentation.

Factors: Curriculum design



The cohort fragmentation introduced by the design of the curriculum.

Psychology programme



- Very pale blue modules are 30 credits, all others are 60 Credits
- red arrows indicate a subset of study routes.

64

Potential study routes
To qualification

<http://www.open.ac.uk/courses/qualifications/q07>

Even seemingly straightforward programmes of study lead to cohort fragmentation which increases as students progress.

The OU's Psychology programme is represented in this diagram. The structure designed into the programme provides 64 different study routes to the final module.

This means that on each presentation of the module DE300 there are up to 64 **sub-cohorts** of student rather than a single cohort. Each sub-cohort could have had a very different study experience and we therefore need to be able to identify and follow each of these if we are to gain an improved understanding of these.

Languages



Potential study routes
To qualification

BA (Honours) Language Studies, Q30

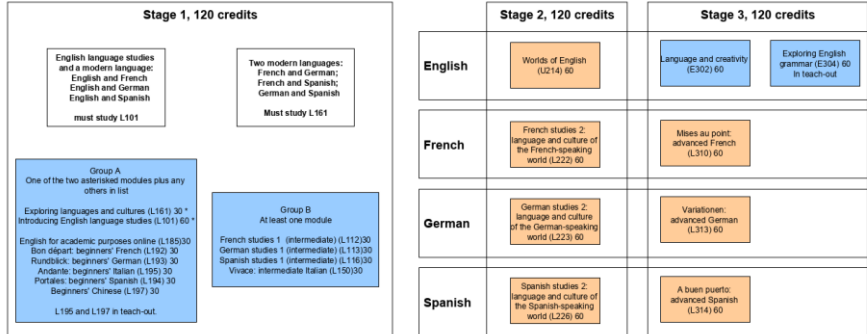
Source: Online prospectus
<http://www.open.ac.uk/courses/qualifications/q30>
June 2019

Red shading shows compulsory.
Blue shading shows optional.

At Level 1 choose either:
A-English language studies and a modern language. Or
B-Two modern languages

Simplified: every module appears just once.

Choose two languages through Levels 2 and 3



Exceptions:
1. Students can begin the next stage of study after having only completed 60 credits of the previous stage. As long as in same language?
2. Students can complete all stages in one language before starting the next.

<http://www.open.ac.uk/courses/qualifications/q30>

The OU's Language programme of study is more complex and needs to be represented differently to fit onto a single page/slide.

The number of study pathways is very much larger than 64.

The number of study pathways is further increased because Languages differs from subjects like Psychology in that students study two languages and progression through the levels for each can be decoupled. Allowing students to progress through each language independently.



Because of the **flexibility, personalisation and choice** built into OU study, there is great **complexity, fragmentation and variation** in student experience.

- The University and no single tutor really know about each student's experience beyond a single module in our current context.
- This makes the need to find new ways to understand student experience and effectiveness of curriculum more urgent



As many have asked, and are asking, questions relating to student experience on different study paths and we have struggled to answer to these questions – even with a wealth of data – we postulate that whilst the University’s data structures work well in ensuring smooth running, they mitigate against those trying to understand student experience. Therefore, we look for a new model.

The model

Smallest Creditable Element:

Student - Module - Presentation

Database environment:

Move from **relational** database to **multi-model** database

Starting from scratch, we need to determine what the most appropriate quantum of learning is. Although many have over the years researched learning objects and other small elements of learning or teaching, breaking individual modules into smaller units would overcomplicate things for our purposes, and (in the OU) there is currently no credit associated with less than a module. Therefore, we consider the

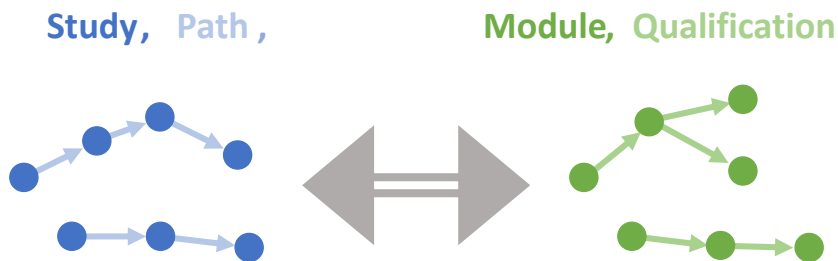
Smallest Creditable Element as the combination of three variables: **student**, **module**, and **presentation**

All relevant data can be accrued to these elements.

Secondly, we decided to use a graph database. There was precedent, as this option was mooted and considered several years earlier when a major Institutional project to redesign our data systems began. At the time it was felt these databases were too new to be considered for such a critical role. Ultimately, we settled on a multi-model database that enables enormous flexibility of approach, including a graph database. It is also highly efficient, has the option of a simple web interface, and under continual development. We are using ArangoDB.

The structure

- Hypothesis: **four data entities will be sufficient:**



We are working on the hypothesis that **four** data entities will give us the facility to extract data readily for any analysis we can currently conceive.

Study – a node data collection around the [student-module-presentation] element

Path – and edge collection of the links between what a student attempts to study and what they attempt next

Module – a node collection of data for each module, includes first presentation, length, number of credits...

Qualification – an edge collection linking modules into study paths to qualifications

Arango enables

- Graphical queries like:

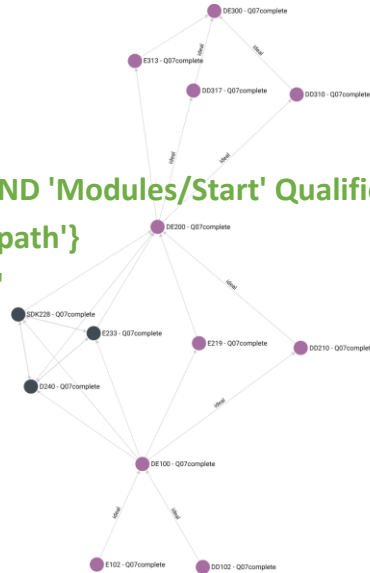
FOR v, e, p in 1..10 OUTBOUND 'Modules/Start' Qualifications

OPTIONS {uniqueEdge: 'path'}

FILTER e.`Qual` == "Q07"

RETURN DISTINCT e

- Which plots,



11 nodes 24 edges

We have constructed a test database with the Study collection containing records for **396,058** students recording **1,190,748** attempts at studying a module.

The straightforward and powerful study path queries Arango enables, are proving exciting and valuable, with four of the University's five faculties involved in projects exploring its use.

Long/short pathways

Standardised notation

Query: students who were new at start of dataset- ignore those that weren't (reduces number). All those attempting one of the Stage 3 modules in the 2017 October presentation. Also, all aiming for Q30 from the start. And just consider Passes and Fails, not withdraws and deferrals

(L120-Pass, L161-Pass) -> (L211-Pass) -> (L310-Pass) **x5**

Same query but without the filters. So includes new and continuing students from start of data and all outcomes and all quals

(B120-Failed, MU123-Pass) -> (M140-Pass, MST124-Failed) -> (B203-
Withdrawn, B291-Failed) -> (B120-Deferral) -> (MST124-Pass) -> (B120-
Failed) -> (B292-Failed) -> (LB160-Pass, T215-Failed) -> (B291-Pass) ->
(DB234-Failed, L314-Pass) -> (B292-Failed) -> (T215-Pass) -> (BZX628-Pass) -
> (DB234-Pass) **x1**

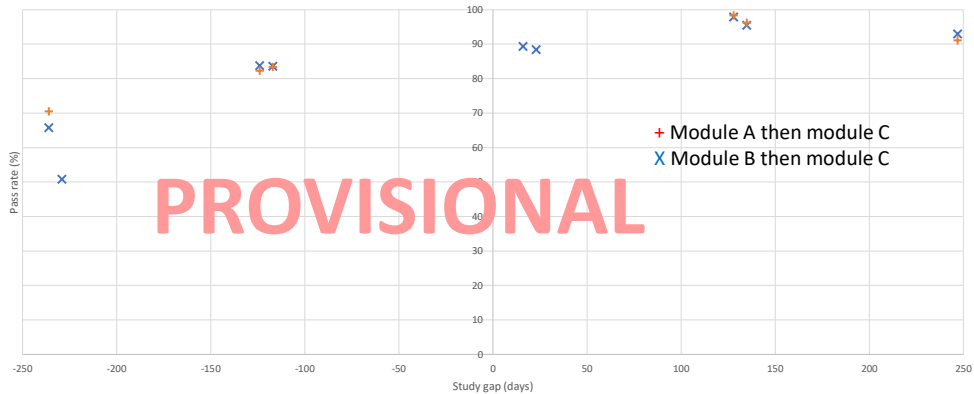
In order to discuss student study experience relating to particular study paths, we need a standard notation to represent these study paths. Here are two examples using the notation

(Modules studied by the student in a particular presentation, in alphabetical order)
-> (modules studied by the student next)

We adapt this notation to include other data, as required.

More on study gaps/overlap

The model readily enables an analysis of study gaps/overlap



Pass rate (at first attempt) v study gap for the first year of one qualification. **PROVISIONAL**
For the plot n=8421 and each data point represents at least 100 students

Returning to the study gaps and overlaps discussed above. We have used the model to explore this for the first year of study for one qualification and have these provisional results.

These are sufficient to warrant a larger study.

Whilst our goal is still some way off
We can at least see it and plot a route



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