

The Right Programme: Academic pathways of engineering transfer students

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In South Africa, the variety of engineering qualifications available makes the task of appropriately placing students unusually problematic. Students who are unsuccessful in a particular engineering programme may excel in another, and frequently students who are excluded from a four-year Bachelors programme are recommended to a three-year National Diploma programme. However, these recommendations are often made without understanding the expected outcome of such a transfer, and to the best of knowledge there has not been an engineering-focussed study of how transfer students perform. This study fills that gap, classifying and analysing the performance of students who have transferred between engineering qualifications at the University of Johannesburg. The academic pathways followed by students are codified in a manner similar to that suggested by Robinson (2004), adapted to show more details relevant to South African engineering programmes. The results provide insight into the pathways followed by students as they transfer between programmes, and consider student characteristics that can be used to evaluate policies on transfer students. Notably, several common theories on which transfer students are successful are considered, though the results show that the indicators are not significant enough to form a basis of policy. Generally, a more comprehensive policy on transfer students must inform decisions.

Background

One of the persistent challenges in engineering education is predicting student success in a chosen programme. Trying to identify significant factors affecting student success became a popular research field in the late 1960s (see, for example, the survey of (Tinto, 1975)) and continues to be popular today (e.g.: (Tough, 2014), (Murray, 2014), (Jia & Maloney, 2014)).

A consistently significant factor is the selection and placement of students into the most appropriate programme (Cosser & Nenweli, 2014). Not all students will be successful in all programmes, and students who do not succeed in one programme may excel in another. The variety of qualification types offered in South Africa makes this problem relevant even within the field of engineering; students who are ill-suited to a science-heavy, four-year Bachelors programme may be well-suited to a more hands-on, three-year National Diploma programme. On the other hand, some students may be ill-suited to engineering and would be better served by another career choice entirely.

Hence, there is a need to investigate the academic success of students who transfer to a different engineering qualification. Unfortunately, most studies do not track students once they have left their initial higher education programme. Studies that follow students through their full higher education career frequently depend on survey results that may have inconsistent response rates (e.g.: (Eckland, 1964), (Cosser & Nenweli, 2014)), and may not provide an appropriately complete view of higher education pathways.

The Faculty of Engineering and the Built Environment at the University of Johannesburg (UJ) offers a uniquely diverse set of qualifications, including 4 four-year Bachelors (BEng) programmes, 16 three-year National Diploma (NDip) programmes. UJ is therefore able to track all of the students who transfer between these programmes to their ultimate result. This study will examine the body of students who have transferred from one engineering qualification at UJ to another between 2006 and 2015.

Methodology

Complete student records are complex and difficult to analyse, particularly when seeking patterns of behaviour (rather than trying to identify a known pattern). In order to approach the body of data, we will utilise a coding scheme that will summarise a student's progression through one or more qualifications. The coding scheme (described in detail below) follows the precedent of Robinson (2004) who proposed a sequence of numerical digits to indicate a student's status in each year of higher education. Robinson used six digits to indicate commencing, continuing, repeating, temporarily absence, transferring, or dropping out; in a sequence, these digits provide a neat summary of a student's pathway through higher education, even if the student spends some time away from higher education.

For the current study, more detail about the student's academic status is desirable in order to grasp the

student's situation before and after the transfer between programmes. This detail should not interfere with the readability of student pathway, but should indicate a student's academic status. The proposed coding therefore will use two digits for each calendar year. The first digit will indicate the highest nearly-completed academic year, while the second will indicate a student's academic status, both measured at the end of the calendar year. Table 1 below defines the codes used, and Table 2 describes three illustrative examples in detail. To avoid ambiguous vocabulary, the scheduled year of the programme will be referred to by abbreviation (Y1, Y2, etc); by contrast, the number of years a student has been enrolled in a particular qualification will always be written. For example, "The third-year student finished the last of the Y1 modules" should be interpreted as a student who has been enrolled for three years has completed all of the modules scheduled for the first year of the programme.

Table 1. Pathway coding definitions.

| Code | Definition |
|------|--|
| 0 | Student has more than one Y1 module outstanding at the end of the calendar year |
| 1 | Student has at most one Y1 module outstanding, but has more than one Y2 module outstanding (if applicable) |
| 2 | Student has at most one Y2 module outstanding, but has more than one Y3 module outstanding (if applicable) |
| 3 | Student has at most one Y3 module outstanding, but has more than one Y4 module outstanding (if applicable) |
| 4 | Student has completed all Y4 modules |
| T | Student transfers to a different programme |
| G | Student graduated at the end of the year indicated |
| w | Student was placed on academic warning |
| e | Student was excluded for academic reasons |
| D | Student dropped out for at least one year but was not excluded |
| - | Student was enrolled normally |

Table 2. Examples of coding used to describe student pathways.

| Example Coding | Description |
|----------------|---|
| 1-2-3-4G | Student completed all modules each year and graduated at the end of the fourth year. |
| 0w0eT 1-2D | Student was placed on academic probation at the end of the first year, still did not complete all of the Y1 modules in the second year and was academically excluded. The student then transferred to a different programme, completed (or was exempted) from all but one of the Y1 modules, then completed all but one of the Y2 modules, but finally dropped out for non-academic reasons. |
| 1-2w2eT 2-3G | Student completed all of the Y1 modules in the first year, was placed on academic warning in the second year, still didn't complete the Y2 modules in the third year and was academically excluded. The student then transferred and was able to complete or be exempted from all of the Y1 and Y2 modules in the first year of the new programme, completed the Y3 modules in the following year, and graduated. |

In the current study, the pathways of transfer engineering students at the University of Johannesburg were analysed and coded as described. Since 2006, 412 students have transferred either from an NDip to a BEng programme or from a BEng to an NDip programme. Of these, 156 are currently enrolled in an engineering qualification, and so their undergraduate

academic pathway is incomplete. The remaining 256 have either completed their ultimate qualification or discontinued their studies at the University, and these students' pathways will form the basis of our study. The numbers of students in each category are detailed in Table 3.

Table 3. Transfer engineering students at the University of Johannesburg, 2005-2015

| Student transfer description | Number of students |
|--|--------------------|
| Started BEng, transferred to NDip, and graduated | 125 |
| Started BEng, transferred to NDip, and dropped out | 123 |
| Started NDip, transferred to BEng, and graduated | 3 |
| Started NDip, transferred to BEng, and dropped out | 5 |

Transferring to the National Diploma

Over the eight years included in this study, 392 students transferred from a BEng programme to an NDip. 144 of these students are still enrolled in an NDip programme, and their incomplete academic pathways provide only partial insight into their success within the programme. The other 248 students, however, provide a set of complete academic trajectories that are analysed in all of the following three sections.

Pre-transfer academic status

The first interesting characteristic of students transferring to an NDip programme is their academic status before

transferring, and this is one area of analysis where the entire set of 392 students can be considered. It is frequently assumed that students would prefer to pursue the more exclusive and rigorous BEng programme if the choice is offered, but rarely do academics provide evidence that this assumption is valid.

As shown in Figure 1, in the current set of 392 BEng-to-NDip transfer students 277 (70.7%) were academically excluded before transferring. The high percentage supports the supposition that the majority of such transfers are motivated by a continued desire to study engineering even if the programme initially chosen is no longer available. However, an additional 45

students (11.5%) were on academic warning, but were not barred from continuing their BEng studies, and the remaining 70 students (17.9%) transferred to an NDip programme without any formal academic status change. This suggests that although academic

exclusion motivates many students to continue their studies via an NDip programme, a significant number of students choose to transfer from the BEng programme for other reasons.

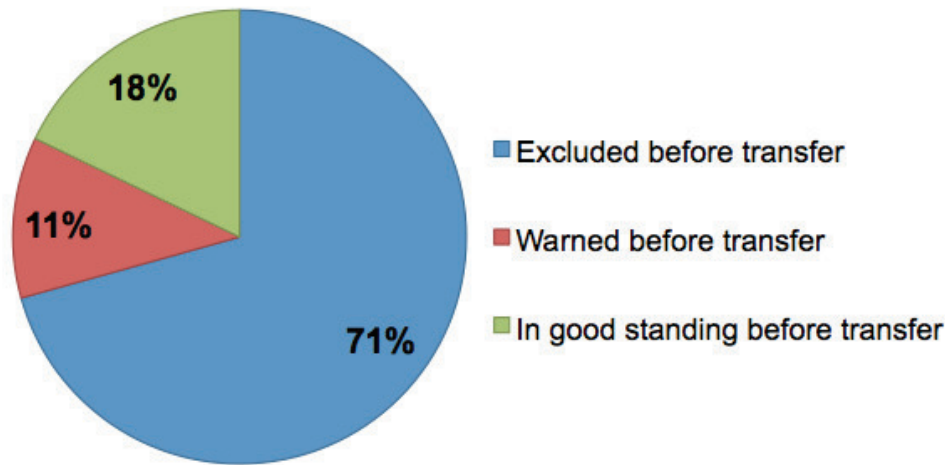


Figure 1. Academic status of 392 students transferring from BEng to NDip.

Another useful observation relates to how much progress students have made before they transfer to a new programme. Generally, the results show that most students transferring from a BEng programme to an NDip programme did not make significant progress through the BEng curriculum before transferring. As shown in Figure 2, 243 students (62.0%) transferred without having completed the Y1 modules. 113 students (28.8%) completed all but one of the Y1 modules

before transferring, and 36 students (9.2%) completed all but one of the Y2 modules before transferring. No students transferred after completing Y3 of the BEng curriculum. However, it should be noted that this data is based on the pathway coding described earlier, which necessarily removes some of the detail of a student's performance. For example, some students may have completed most of the Y2 modules, but still are coded as a "0" due to outstanding Y1 modules.

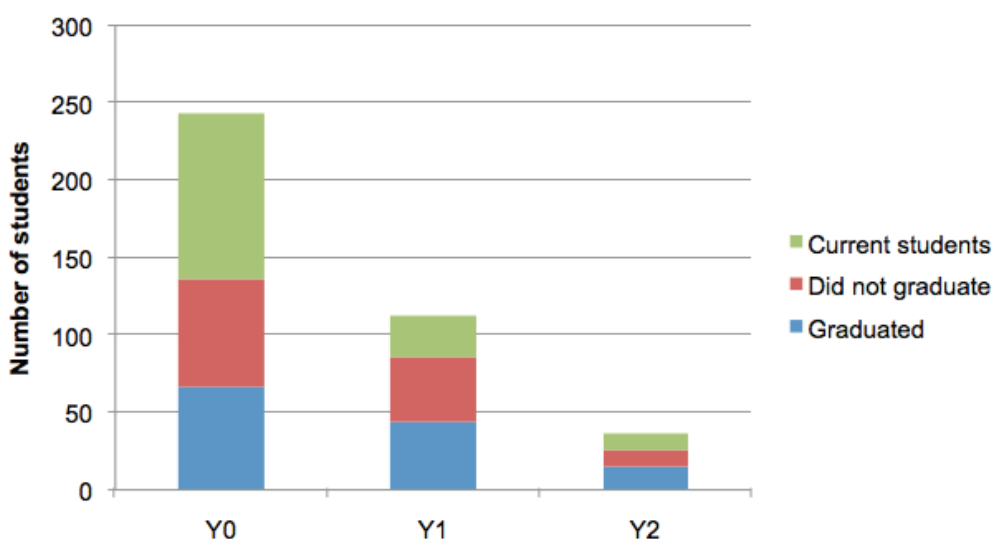


Figure 1. Curriculum progress before transferring from BEng to NDip.

Transfer between programmes

An interesting question is whether the students transferring to the NDip programme chose to remain in their initially chosen discipline. The three BEng programmes offered at UJ (Civil, Mechanical, and Electrical & Electronic) have a very similar Y1 and Y2 curriculum, so a student changing to a new field is not significantly disadvantaged in terms of transfer credits. However, 316 (80.6%) of the students chose an NDip programme in the same discipline as their initial BEng programme. This could suggest that students identify themselves with their chosen discipline quite early in the curriculum, or could be a product of the relationship between the academic department Heads coordinating and accepting transfer students.

Another notable feature of the pathways gathered is a non-academic hiatus (coded as D in the above tables): 108 (27.6%) of the students spent at least one year away from the University without being academically excluded. This finding suggests that other significant issues may be affecting students' academic pathway decisions, such as financial or familial concerns.

Completion rate

The next notable feature of the BEng-to-NDip transfer pathways studied is the rate of completion of the ultimate programme. 248 of the students have been

tracked to the end of their engineering studies, allowing evaluation of transfer student success rates. 125 students (50.4% of the students with complete pathways) completed the NDip programme after transferring.

One might hope and expect that a student's performance in the BEng modules might provide a good indicator of the expected success in the NDip programme. The graph in Figure 2 further indicates which transferring students went on to complete the NDip curriculum or dropped out before graduating. Interestingly, although students who completed more of the BEng curriculum were slightly more likely to graduate after transferring to the NDip programme, the difference in performance is not dramatic. This finding indicates that students who are progress further in the BEng are not necessarily going to perform well in an NDip programme.

Traditionally significant modules in the BEng programme at UJ are the Y1 first-semester physics and mathematics modules. As can be seen in Figure 3, though success in mathematics and physics does suggest an increased chance of success after transferring to an NDip programme, the correlation is not significant enough to recommend a policy based on the pre-transfer module success.

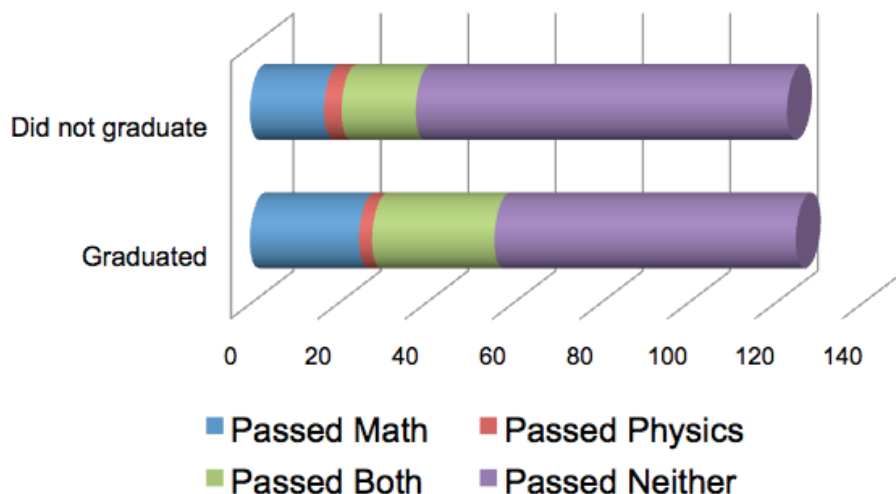


Figure 3. Modules passed before transferring from BEng to NDip.

Completion time

The final characteristic of the academic pathways considered here is the time that transfer students take to complete the NDip programme. The time taken by the 125 successful BEng-to-NDip transfer students is shown in Figure 4.

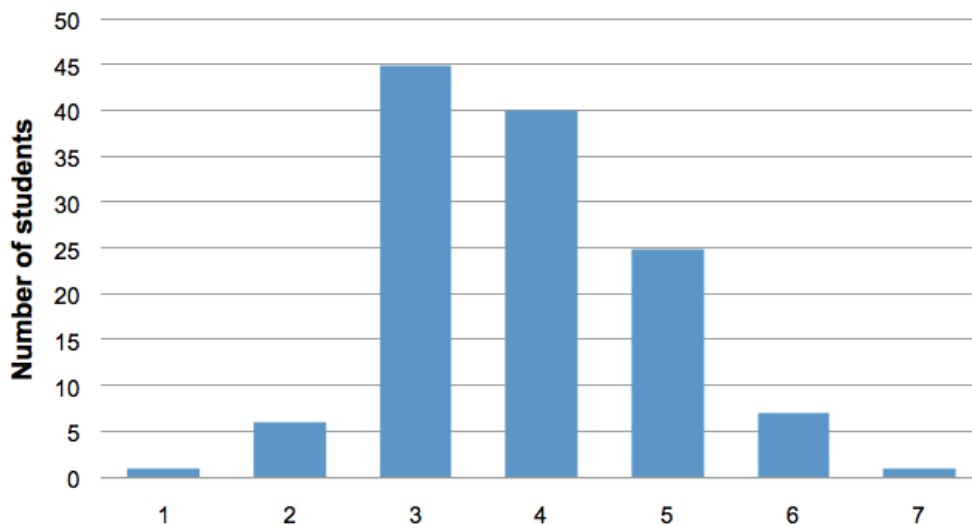


Figure 4. Years taken to complete an NDip after transferring from a BEng.

The largest number of students finished the NDip programme in the expected three years, following their transfers. A few students managed to complete in two years, or in one case one year; this is possible because transfer students are able to obtain credit for some modules based on modules completed in their original programme. Overall, though, the transfer students are able to complete the NDip in a reasonable amount of time, particularly given their frequently inconsistent performance with the BEng programmes.

Transferring to the Bachelors

There are notably fewer students transferring from the NDip to the BEng. This is not surprising since the entry requirements for the BEng are significantly higher than the requirements for the NDip, meaning that all BEng students are eligible to study an NDip but many NDip students do not qualify for the BEng programmes. For such a small number of students, it is more convenient to present those students' complete pathways in their entirety, presented in Table 4.

Table 4. Students transferring from an NDip to a BEng.

| | |
|----------------|--------------|
| | 1-T 0-0-0w0e |
| 0-T 1-1-2-3-3G | 0-T 0-0wD 1e |
| 0eT 2-2-2G | 0-0wD T 0e |
| 1-T 1-2-3-3G | 0wT 0e |
| | 0eT 0e |

The eight students who have transferred to the BEng from a National Diploma programme fall into two dramatically different categories of performance. The three students who completed the BEng degree are shown on the left of Table 4; all three completed the degree in five years or less, and all completed the entire Y1 within a year. (Note that the middle student was able to complete Y1 and Y2 due to credits earned prior to registering in an engineering programme.) Somewhat surprisingly, the successful students did not

necessarily have completely flawless academic records while studying Y1 of the NDip. However, all three finished the BEng curriculum in good time, with only one of the three requiring an extra year to complete. On the other hand, the unsuccessful students (shown on the right of Table 4) made rather poor progress through the BEng curriculum irrespective of performance in the NDip. Only one of the unsuccessful students managed to complete Y1 of the BEng, and none progressed further.

Despite the extremely small data set, it is still interesting to note that there is little difference between the pre-transfer performance of the successful and unsuccessful students. Yet the degree of success is markedly different. Indeed, the successful students were actually more successful than the average BEng student, while the unsuccessful students were less successful than average. Further study with a more significant set of data would be required in order to draw significant conclusions about these transfer students.

Conclusions and Future Work

This study presents an adaptation of Robinson's scheme for coding academic pathways, suited to the South African context and including sufficient information to evaluate student progress through multiple programmes. Generally, the results confirm several notions of student behaviour cited by South African academics; however, the pathways presented do not show a strong enough pattern to particularly guide policy around transferring students. Particularly, progress through the BEng curriculum and performance in physics and mathematics do not make reliable indicators of post-transfer NDip success, and no probable indicators could be found for students transferring to a BEng programme.

Further studies should pursue a more comprehensive portrait of student decisions, seeking to identify motivations through surveys or interviews with students who have transferred between programmes. Greater insight into the student situation is also necessary to create informed policies for allowing students to transfer between programmes.

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