Improving Retention of Science Student Teachers

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Abstract

Our on-going research aims to try and find out why some Science graduates on one year (PGCE) teacher training courses are not successful in completing the course. The course itself has been judged 'Outstanding' (Ofsted, 2010), so we have focused on the student teachers (trainees).

Some key characteristics of trainees 'at risk' of being unsuccessful were identified in a variety of ways, including data analysis of records for trainees who left the course early and those who successfully completed the course, focus groups, questionnaires and case studies.

Loss of trainees during PGCE courses appears to be a characteristic across many providers of initial teacher education for Science in the UK. Key factors emerging include gender, age, previous experiences/careers, support (or otherwise) of family/partner, caring issues (children/parents), subject knowledge, attendance at a subject knowledge enhancement course and more.

If characteristics of 'at risk' trainees can be identified, strategies can be put into place to identify applicants, who might be at risk, at the selection stage and to support them during the course to reduce the drop-out rate.

Recent work, described in the paper, appears to be improving our retention. Further research is needed to confirm and extend our current approach, which could, perhaps, be applied in other institutions and across other disciplines.

Aims and rationale

We aim to identify and address reasons why Science graduates on a one year (PGCE) initial teacher education (ITE) course appear to have more problems than their peers in other PGCE subjects. These problems can result in them withdrawing or failing to complete the course successfully.

The secondary PGCE course at the University of Worcester was judged 'outstanding' by Ofsted in 2010, so our focus is mainly on the initial selection of Science trainees and the nature of their emerging personal and academic learning needs during the course. Tutor support at Worcester, was described as 'excellent' by Ofsted (2010); however, our research aims to find ways to identify trainees 'at risk' of withdrawal at one or more points during the year so that tutor support can be refined to be responsive to their additional needs. Despite increasingly stringent selection procedures and a withdrawal rate below the national average, we are keen to develop a greater understanding of the complex underlying tensions that lead trainees to withdraw. We believe that this will help future selection, induction and support programmes.

Currently, the research has been mainly based on trainees at Worcester, though we are interested in extending it to other teacher-training providers to investigate whether our findings apply to more than one institution, in which case they may have wider value. Additionally, it may be appropriate to link our findings, should they be significant, to other vocational, graduate, training programmes, such as some midwifery and engineering programmes where retention is also a known issue (Cameron et al, 2011; Le and Tam, 2008).

Background to the study

There is a shortage of Science teachers, especially teachers of Physics and Chemistry in England (The Schools White Paper, DfE, 2010 and TDA, Aug 2011a). Most institutions have difficulty in attracting sufficient 'quality' applicants to train as Physics and Chemistry teachers and too many drop-out during their training programme. Table 1 gives data about retention for Physics trainees in 2006 (Smithers and Robinson, 2006).

Table 1: Retention issues with Physics trainees, Centre for Education and Employment Research, University of Buckingham.

No. universities surveyed	Entered	Completed	Deferred/dropped out %	Non-completion %
27	281	228	53	18.9

Dropping out during the course has financial and personal ramifications for the trainees concerned, and, along with low recruitment, ultimately results in fewer qualified Science teachers entering the profession.

Retention issues appear to be common across many providers of Science ITE in the UK and have been identified, particularly for Physics, by the TDA as a priority (TDA, 2011b). At the University of Worcester we have well developed and highly respected trainee support mechanisms in place but nevertheless, a number of Science PGCE trainees with much to offer the teaching profession elect to leave the course each year.

Initial work in this area was reported at the ASE Conference in January by Collins (2010a) and emerging descriptions of profiles of 'at risk' trainees were shared with an audience of UK ITE providers. This forum confirmed that the generic 'at risk profiles' appeared to be common across providers and that there was need for further research into support strategies

Methods

1. Analysis of data

a. Risk at interview versus outcome

For the last two years, records of trainees offered a place on the PGCE Science course have been kept, containing a quantitative risk assessment. This overall 'risk' assessment is obtained from several elements of the interview process including a subject knowledge written task, communication skills assessed via a presentation and during interview, professional values and personal qualities. An analysis to look for any correlation between initial risk assessment and final outcome was carried out, simply in terms of successfully completing the course and in more detail by considering the trainees' final grading (a combination of their final school report and Ofsted characteristics).

b. Initial qualification versus outcome

All subjects tutors are asked, by our Centre for Secondary and Post-compulsory Education, to supply an 'initial qualification' grade for every PGCE trainee. This is based on academic and professional qualifications, such as degree class, A level grades in specific subjects and

professional experience e.g. time in school (see Appendix). As the bursary scheme from September 2012 for Scientists, amongst others, is heavily dependent upon class of degree, it was felt that a correlation between initial qualifications and outcomes from the course would be of interest.

Pearson's correlation coefficient tests were carried out on both initial risk, assessed at interview and 'initial qualification' grade versus outcome for one cohort of trainees (2010-2011) using on-line software (Wessa, 2011)

c. Profiles versus outcome

The circumstances surrounding science PGCE trainees who elect to leave the course prematurely or have gone through a period of doubt before successful completion are being scrutinised. Each case of threatened or actual course withdrawal has been compared to the factors that might be potential 'triggers' for withdrawal. Over three years of data are being analysed. The subject (Biology, Chemistry or Physics) which trainees are hoping to teach was also studied in relation to outcome. For comparison, data about retention rates of other trainees at our institution were collected and compared.

d. Use of Virtual Learning Environment versus outcome.

A virtual learning environment (VLE) 'Black Board' is used to share resources with trainees. All trainees have access to this and early on in the course an exercise is set to check that they can use the VLE. It is possible for tutors to see how many times individual trainees log on to the VLE as well as the length of time spent using the resources. Analyses of frequency of log-ins and time spent using the VLE are being carried out to see if the pattern of access links with students at risk of leaving the course.

e. Attendance at a Subject Knowledge Enhancement Course (SKEC) prior to start of course versus outcome

Lack of subject knowledge is a known issue for Science PGCE trainees (e.g. Lock, R. and Soares, A. 2011) Many trainees attend a SKEC before the start of the course, mostly a 2 week intensive course in either Chemistry or Physics. An analysis of trainees who withdrew from the course was carried out to see if the majority had, or had not, attended a SKEC.

f. Analysis of reflective writing versus outcome

A website, Wordle, (http://www.wordle.net/) was used to examine pieces of reflective writing by trainees at the start and end of the course. This allowed comparisons of key words used by trainees with different outcomes with the idea that this may provide a diagnostic tool in future.

2. Focus groups

A variety of focus groups for trainees have been run over the last few years. Some of these used the pilot *Starting Out* scheme, funded by the TDA (Collins, 2010b). Others were, and

are, more informal, with trainees opting into meetings, usually when in university for taught sessions. Feedback from these groups is being collected and used to collect qualitative data

3. Questionnaires

Questionnaires have been given to Science trainees at the end of the course to try and ascertain what made those who completed the course successful. In the spirit of appreciative inquiry methodology (Cooperrider and Whitney, 2005) the trainees were asked, among other questions, what they thought were the qualities that made them successful. They were also asked if they 'wobbled' at any time in the course and if so, when, and how they overcame their 'wobble'. A similar questionnaire was given to non-Science trainees and a modified version to some Science mentors. Additional questionnaires were completed by Science trainees from another institution.

4. Case studies

A number of trainees who matched the 'clusters of characteristics' that categorised them as being potentially at high risk of leaving the course early, yet successfully completed the course, are being used as case studies. If we can find out how they managed to 'buck the trend', this might give some powerful strategies for supporting other trainees.

Throughout, an appreciation of the ethical implications of carrying out research on our own trainees, for whom we act as assessors, was kept in mind. An ethical checklist was completed and submitted to our institute's ethics committee for approval. At all times, we guaranteed participants that any data collected had no bearing on any assessment outcomes.

Findings

1. Analysis of data

a. Risk at interview versus outcome

The risk at interview (using a scale 1-4, where 1 is low risk), was studied for those that left the course early and for those that successfully completed the course. The results are shown in Table 2 below:

Table 2 A comparison of risk given to trainees at interview with outcomes

Outcome for trainees	Number of trainees	Mean risk given at interview	Range
Successful course completion	34	2.0	1.00 - 2.50
Unsuccessful course completion	5	2.4	2.00 - 2.75

Interviewers appear to be reasonably good at 'spotting' trainees at high risk of not completing the course, with everyone who later withdrew from the course being given a score of 2 or above. This might be a quick and effective way of identifying some 'at risk' trainees needing further support.

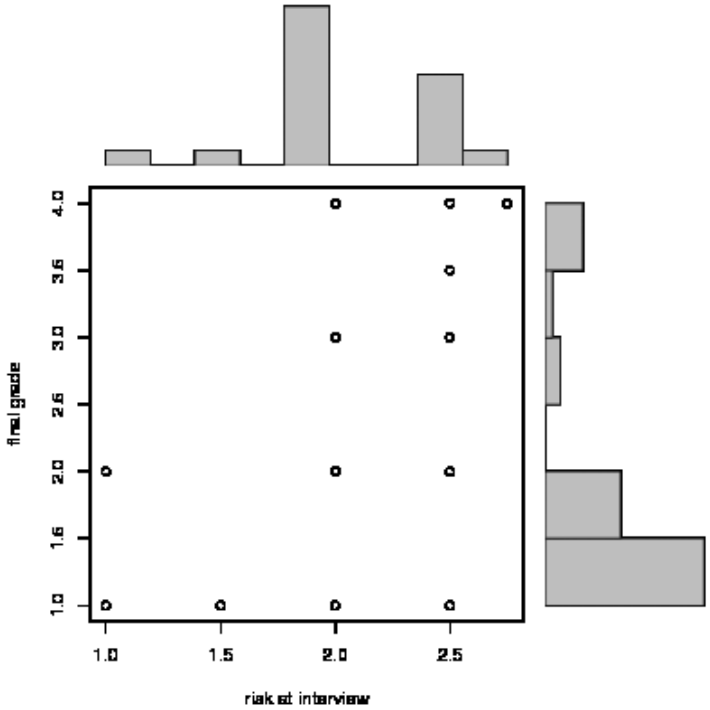
However, there is overlap between the two categories, with several trainees (11) who were given scores of 2.50 successfully completing the course. This may have been due to interventions as a result of this risk factor or to other factors, including unreliability of assigning the risk factor. Unreliability may be due to different interviewers having different subjectivity as well as the 'snap shot' nature of interviews, relying on impressions collected mainly on a single day, though backed up with interview paperwork.

The range of risk is also limited as this study used trainees on the course. Usually, any interviewee obtaining a score of three or over would not be accepted onto the course.

A more detailed analysis of the data for this cohort was carried out, where the risk factor given at interview was compared with the final grade given at the end of the course. Here, trainees who withdrew early from the course were given a final grade of 4. The results are shown in Graph 1 below.

Graph 1: Results of Pearson Correlation Coefficient test on risk at interview v. final grade.

A



correlation coefficient (r) of 0.25 was calculated. This indicates a weak positive correlation, suggesting that interviewers are reasonably good at predicting outcomes as might be expected from experienced university tutors and school mentors being involved in the interviewing process. However, the correlation is weak and it will be interesting to see the effect of adding data from this year's cohort in summer 2012.

b. Initial qualification versus outcome

Initial qualifications, (using a scale 1-4, where 1 is a high level of qualifications), were studied for those that left the course early and for those that successfully completed the course. The results are shown in Table 3

Table 3: A comparison of initial qualifications given at start of course with outcomes

Outcome for trainees	Number of trainees	Mean initial qualification given at interview	Range
Successful course completion	34	2.0	1.00 – 4.00
Unsuccessful course completion	5	2.4	2.00 – 3.00

Trainees with both very high entry qualifications (such as 1st class degrees in an appropriate subject) and with very low qualifications (such as a 3rd class degree in a less scientific degree) all completed the course. No trainee who started the course with a '1' failed to get a final grade of 1, but of the four trainees starting with a grade of 4, two finished the course with a grade 1 and two with a grade 2.

A Pearson correlation coefficient, r, of -0.05 was generated, indicating that there is not only no correlation between initial grade, but also actually a slight indication that those with lower initial qualifications on admission to the course do better than those with higher initial qualifications.

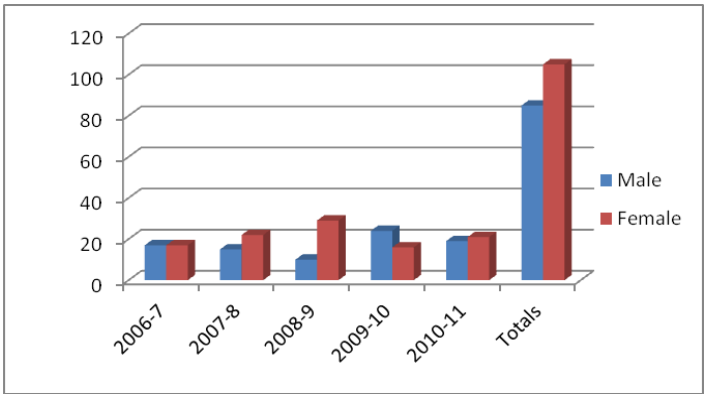
Further data, from this year's cohort will help to make this clearer.

c. Profiles versus outcome

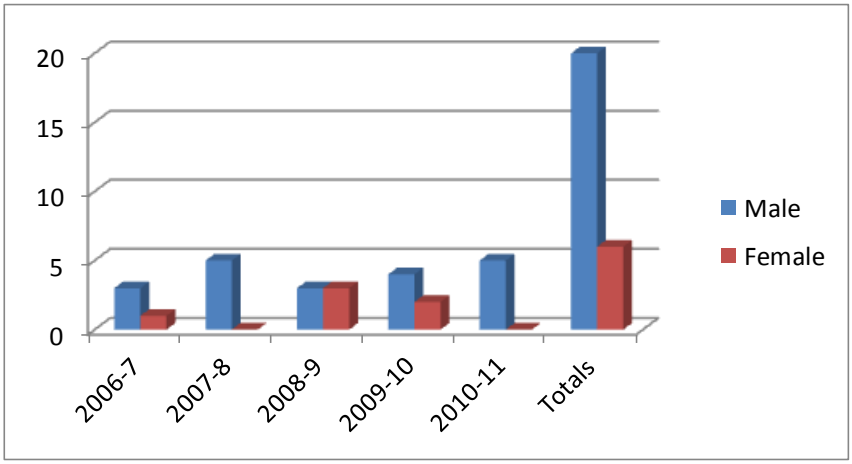
Evidence examined over five years suggests the presence of some dominant characteristics in trainee drop-outs. Gender appears to be a major factor. Some of the data for gender is shown below (Graphs 2 a-c).

Graph 2(a) Gender of Science PGCE cohorts, 2006-2011

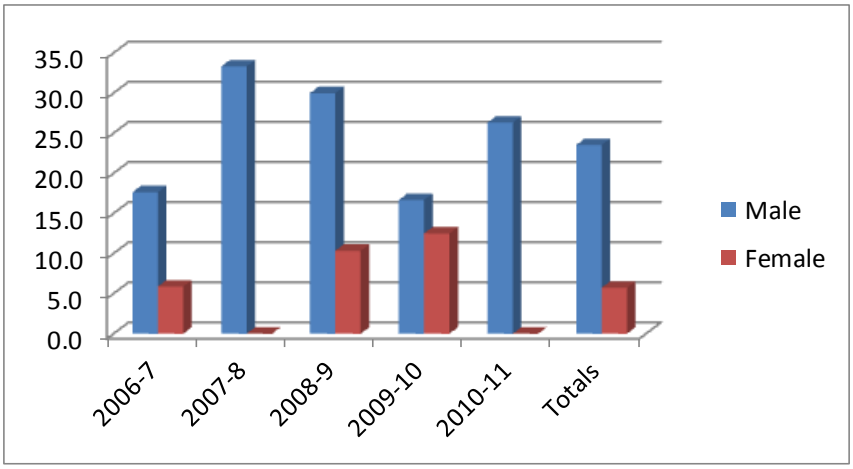
Y axes of graphs (a) and (b) show numbers of trainees



(b) Gender of students who withdrew



(c) Gender of students who withdrew portrayed as a percentage



One of the strongest 'risk factors' appears to be being male. Graph 2 (c) shows that whatever the cohort gender ratio for a particular year, there have, in the last five years, always been a greater percentage of males leaving the course early, compared with females. On average, over 1 in 5 males have left the course, compared with 1 in 20 females. Other key factors appear to be 'maturity' (over 35 year in age), the nature of previous experiences/careers, support (or otherwise) of family/partner, carer issues, cultural background and subject knowledge (Collins, 2010b).

Although every trainee who leaves the course prematurely has a unique set of personal and professional reasons behind his or her decision, an ongoing examination of the circumstances surrounding non-completions amongst Science trainees over the past five years is suggesting that the majority who leave possess multiple risk factors from the above list.

Identification of clusters of characteristics common to non-completing students has led to exploring their value in generating an early warning of potential 'at risk' trainees in current and future cohorts.

As understanding of risk factors increases, a range of targeted support strategies are being deployed and developed. This should increase the potential of vulnerable trainees to complete the course successfully and hence enter the teaching profession.

Yet another risk factor also appears to be the trainee's subject. Retention trends from other PGCE subjects at the University of Worcester show that the greatest similarities in non-completion rates are found in Maths and Business & Economics cohorts. The least similarity is found in English and P.E. cohorts. These comparisons may strengthen suspected associations between identified risk factors and non-completion as the demographic compositions of Maths and Business & Economics trainees are closer to those of the Scientists than of the other subjects.

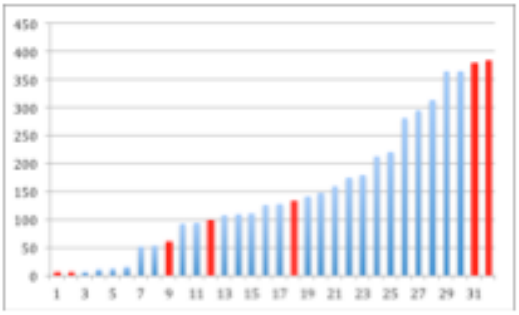
Prominent differences in demographics of trainees displaying retention issues were age and degree of time spent out of formal education before entering the PGCE course. Generally the latter was because the trainees had left relatively lengthy successful careers in business, industry or academia (in the region of 15 to 20 years) or had had a prolonged period of career break, for example to be a primary carer. For this reason, literature exploring the challenges to completion for mature students (for example, Day et al. 2006) was consulted to gain a greater understanding of the pressures experienced by mature trainees which might compound the already challenging demands of the PGCE course.

d. Use of Virtual Learning Environment (VLE) versus outcome.

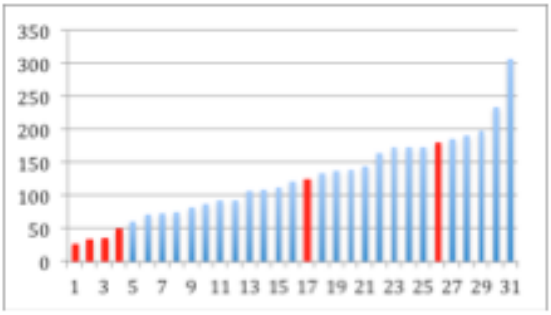
Data from trainee's patterns of accessing our VLE is providing some intriguing patterns, when linked to successful/non-successful completions of the course. Currently, our VLE mainly provides help from tutors via PowerPoints from sessions and additional resources. Graph 3 shows an analysis based on frequency of accessing the VLE and outcomes for trainees.

Graph 3: Frequency of access to VLE (y axis), individual students in ascending order of use of VLE (x axis). Students represented in red withdrew during the course

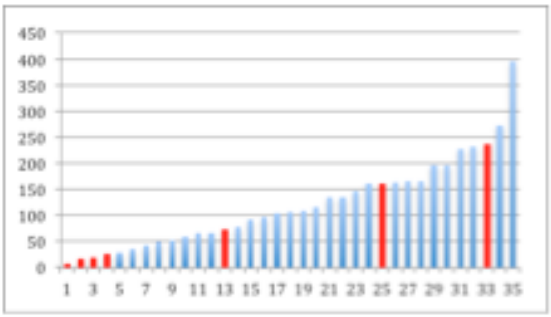
2006/07 Cohort



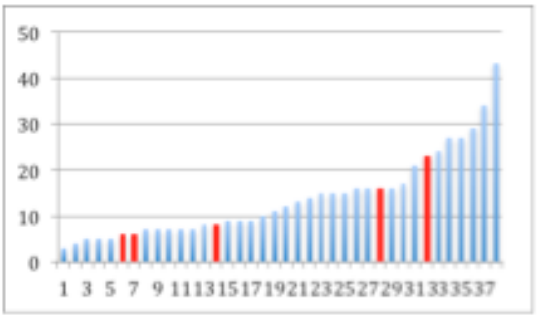
2007/08 Cohort



2008/09 Cohort



2009/10Cohort



The pattern of data suggests that some students who leave the course tend to access the VLE very little and in some cases a lot. This is not as clearly shown in more recent years so perhaps a realisation of this effect may be influencing tutors to recommend the use of the VLE more strongly to trainees.

e. Attendance at a Subject Knowledge Enhancement Course (SKEC) prior to start of course versus outcome

One outstanding statistic is that, over the past three years, only one trainee who withdrew before the end of the course had attended an SKEC prior to starting the PGCE. The majority of our trainees attend a 2 week SKEC delivered by our staff, in July/August i.e. within two months of the start of the PGCE course. Although trainees attending our SKE courses are assessed, the course content is delivered in an atmosphere which, though intensive, is relatively relaxed and non-judgemental compared to the pace and constant assessment which is associated with the PGCE course itself.

An emerging hypothesis is that trainees from the high risk groups attending the SKE courses benefit more than other groups from the camaraderie and spirit of mutual support generated during the SKEC over the intense period of the PGCE course. For the mature trainees in particular, the course effectively acts as an extended induction period and provides a valuable extra 'buffer' between their previous professional lives and the relative 'exposure' of the reflective, emotionally charged journey that accompanies initial teacher education.

f. Analysis of reflective writing

Wordle (www.wordle.net) was used to examine pieces of reflective writing near the start and end of the course to allow comparisons of key words appearing for trainees with different outcomes. Some initial comparisons suggest that there may be differences that could be picked up by running electronically submitted work through software. This could, perhaps, be used to raise awareness of imminent or on-going issues if the most common words used by trainees tended to have negative connotations as opposed to positive ones.

For example, one Physics trainee, identified with a higher than average initial risk factor (2.5 on a 1-4 scale where 1 is low risk), and low initial qualifications (4 on the 1-4 scale, with 1 being strong qualifications) wrote an early commentary in which the seven most frequent words were, in order of frequency:

Pupils; Placement; Behaviour; Lessons; Class; Learning; Teaching

It is hardly surprising that these words feature prominently. However, compare this list with the seven most frequent words from a commentary submitted at the same time, but by a Chemistry trainee with a lower than average initial risk assessment (1.5) and better initial qualifications (2)

Students; Lessons; Works; Well; Different; Group; Practice

The first set of words seems to be more prosaic, and focused on possible problems e.g. behaviour. The second set of words could be interpreted as more positive, confident and adventurous.

Both trainees gained an outstanding grade 1 at the end of the course. A comparison of their final piece of reflective writing produced the following lists:

Physics trainee, initially higher risk and with weaker initial qualifications:

Pupils; Maths; Lessons; Questions; Placement; Skills; Think;

Chemistry trainee, initially lower risk and with higher initial qualifications:

Students; Learning; Lessons; Placement; Objectives; Teaching; Feel

Here both lists might be judged as more comparable. Issues with this kind of analysis include small numbers, possible gender differences in writing styles (the Physicist here was male and the Chemist female), the effect of Science specialisms as well as interpretation of the different meanings of the words. Some judgements also had to be made about which words to ignore ('and', 'also', 'use' etc) and whether counting the most frequent seven words was the best number. However, this style of investigation does appear worth further consideration and the intention is to analyse more pieces of trainees' written work.

2. Focus Groups

Kruger and Casey (2009) suggest that focus groups might be considered when looking for a range of ideas, opinions and feelings that people have about something. The pilot 'Starting Out' scheme allowed our trainees to opt into various formats of mentored groups, which featured mentors who were non-assessors. Some of the groups, for most 'at risk' trainees agreed to have their meetings recorded and an analysis of their conversations is being

analysed. Notably, some of these students who were part of such focus groups withdrew from the course (in one year, this was 60% of the focus group members). This suggests that our identification of 'at risk' students is good, but that our support needs additional attention. On the positive side, one attendee of a 'high risk' focus group not only completed the course but was promoted to Head of Science within two years of gaining her PGCE.

3. Questionnaires

Questionnaires completed by students who successfully completed the course (both Scientists and non-Scientists) , along with Science mentors in school as well as Science PGCE students from another institution have generated a lot of data and these are currently being analysed. Some initial findings indicate that that most of the trainees who said that they 'wobbled' did so in the Spring term, about one third of the way through the course. A variety of reasons were given, but in terms of what kept them from leaving the course, the main reasons were 'stubbornness' plus support from colleagues and mentors. Peer-support during the course appears critical, especially face-to-face contact backed up by use of social media. Perhaps these reasons can be used to help those in danger of leaving the course.

One limitation of the questionnaires so far is that they apply to only one year, 2010- 2011 and so further data is required to consolidate the information.

4. Case studies

This is an area of on-going research. We believe that useful information may be collected by studying individual trainees who have either successfully completed the course or who left the course without completing. Hopefully, this information will help future trainees.

Summary

We are making considerable progress, using a variety of methods, in identifying Science trainees at risk of not completing our PGCE course. The next steps in our research would appear to be to check and consolidate our data and to apply our findings to support future trainees with the aim of further improving our retention rate, resulting in more Science teachers available for employment.

It appears that risk factors identified at interview can be positively correlated with successful course completion, so maintaining experienced interviewers is essential. This is in contrast to using trainees' initial qualifications, which do not appear to correlate with course outcomes.

A cluster of characteristics seems to be important in determining successful outcomes. Successful characteristics include being female and being under 35 years old. Male trainees, older than 35 years, appear to be particularly vulnerable and trainees fitting these characteristics may need additional support. This, of course, creates the issue of how to offer such support without providing excuses for failing students or providing self-fulfillng prophecies

The pattern of accessing VLE resources by trainees is providing some indication of those with difficulties. Particularly low, or no, use of the VLE, as well as particularly high use, seems to be a characteristic of some trainees in difficulty. This has possible potential to be used as an 'early warning signal' amongst other signs.

Attendance at subject knowledge enhancement courses, prior to the start of the course, appears to increase chances of successfully completing the PGCE. This may be due to increased confidence during the course, not only due to improved subject knowledge but also due to increased socialisation within the cohort. This needs exploring and confirming as the current TDA rules are now restricting Biologists from attending such course to help with their Chemistry and Physics knowledge.

Trainee's reflective writing may provide clues to those in difficulty and needing more support. Initial analysis of some samples of reflective writing suggests that greater use of words with negative connotations may be helpful in identifying trainees needing help.

Focus groups have been used to support trainees either identified by tutors as at risk or by trainees identifying themselves. Strategies, such as using the pilot Starting Out scheme to provide facilitators, who are not assessors, for such groups seem to have been rewarding, but further analysis of this and other data from the focus groups is needed.

Questionnaires have produced quantities of qualitative and quantitative data. Some results indicate that the Spring term (one third of the way through the September-starting course) is the time of year when most trainees experience difficulties. Other results suggest that key factors in preventing trainees from leaving the course are 'stubbornness' and support from peers, including social networking, and school mentors. Other information may result from further analysis of the data.

Case studies are on-going and analysis of these will hopefully provide material to support future students.

The science trainee retention rate at the University of Worcester remains above the national average, so in examining the potential reasons for trainees withdrawal from the course, one limitation is the small numbers available for analysis. Expanding the study to include earlier science cohorts produced more data to help test emerging patterns of commonalities between withdrawing students. Data from current and future cohorts will add more information, as will data collection from other disciplines and institutes. Our on-going research continues to explore and extend our current approaches.

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Appendix: Determining an Initial Qualification Grade

Initial Qualification Grade (IQ)	Degree	A Levels or equivalent	Other experience
1	Good (1 / 2:1) 1st degree (or higher) in **teaching subject**	○ Grade A or B in teaching subject	○ Has significant work experience using subject ○ Has recent extensive teaching or coaching experience in subject ○ Is a native speaker (MFL)
2	Good (1 / 2:1) 1st degree (or higher) in a **relevant subject**	○ Grade C, D or E in teaching subject. ○ High overall A Level grades, but not in teaching subject	○ Has undertaken a full (12 week – 6 month) enhancement course in teaching subject ○ Has some relevant work experience ○ Has some teaching or coaching experience in subject
3	Lower degree (2:2 or less) in **teaching subject**	○ Average grades but not in teaching subject	○ Has done booster course in additional subject areas ○ Has some teaching or coaching experience
4	Lower degree (2:2 or less) in **relevant subject** or **…** Degree in an **unrelated subject** – but meets higher expectations elsewhere	○ Low grades overall	○ Has needed to undertake booster course in teaching subject

Tutors grade incoming PGCE students using the table above. Obviously, there are other relevant factors, and arguments could ensue, such as what is a 'relevant' degree or how recent is their knowledge acquisition, but this is the current working model.

Working on a **best fit basis**, first two columns are used, with the third column used to 'moderate' if necessary. This is used for all subjects, not just Science. **Example**. A Science student has a low degree in Physics, but a grade A at A level – they are given IQ2