

Gender Differences in completion and credit obtained in Level 2 study in Physical Sciences

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Executive Summary

At the UK Open University Athena SWAN/Juno projects involving analysis of historic examination data for the Level 2 (FHEQ Level 5) physics module S207 *The Physical World* raised concerns about the success of women studying S207 compared to men. For presentations of S207 in the period 2009 – 2013 this analysis suggested that there may have been significant statistical differences between men and women for both completion and credit. A new L2 module S217 *Physics: from classical to quantum* was in production to replace S207 in 2015 and these investigations would be able to inform S217 in relation to tuition and assessment strategies

This project involved further data analysis in relation to various aspects of the assessment in S207 - both continuous assessment and various exam components. Data from other modules in related areas was also examined. Results suggested that the difference in success between the genders in S207 could be not explained by the assessment strategy or by other factors (e.g. online forum activity, gender of tutor) (Jordan et al, (2015)). Demographic information gave no obvious differences for women and men e.g. age, previous qualifications etc but for Open University student previous study is very varied and individual student information known is very limited. To determine further information in this area some students on the 2016 presentation of S217 were surveyed and a cohort of these students interviewed by phone. These telephone interviews allowed more detailed discussions of students' reasons for studying S217 as well as their preparedness for the module particularly in terms of any previous study of physics and/or mathematics.

Common themes were identified and allowed recommendations for additional resources to be made to the module team. Further academic outputs are also detailed, which have included publications and conference presentations

Aims and Scope of Project

Initial preliminary examination of data carried out in 2014 (as part of Juno/Athena SWAN) for the core Open University Level 2 60 point Physics module (S207 *The Physical World*) suggested that for the previous 5 presentations there was a statistically significant difference between men and women in both completion and credit on S207. Analysis of data from 2013J (the 2013 October presentation of the module) indicated that the performance of women had significantly diminished compared with previous years.

Women do less well at L2 physics than men however in L3 they do slightly better. Similar trends are seen on other level 2 modules in the Physical Sciences curriculum however equivalent L2 modules in other science disciplines do not display this effect.

The aim of the project was to carry out further data analysis comparing the genders in the following areas:

- 1) Tutor Marked Assignment submission
- 2) Performance on an initial Computer Marked Assessment
- 3) Performance in the different sections of the exam eg Part A is multiple choice worth 40%
- 4) Contributions to forums (asynchronous discussions) and OU Live Sessions (on line tutorials).
- 5) Equivalent data for MST121 (a Level 1 30 point module in maths studied by many physical science students as preparation for their level 2 physical science studies).

This would give a rigorous data set on which to base understanding of the differential behaviour of men and women.

A new L2 module S217 *Physics: from classical to quantum* was in production to replace S207 for the 2015J presentation and these investigations would be able to inform S217 – specifically in relation to the tuition and assessment strategies.

Results obtained would link to actions required for Athena SWAN and Juno and allow sharing of good practice with other Physics Departments within the South East Physics network (SEPnet).

Prof Sally Jordan is also involved in a project with the University of Hull and the University of Edinburgh 'Investigating the impact of question type on concept inventories' and data from the analysis in areas 2) and 3) link to this.

Activities

An Associate Lecturer (AL) was appointed and undertook statistical analysis and preparation of data relating to two physical science modules, namely S207 (The Physical World) and S282 (Astronomy). She analysed the performance of women and men on the various components of assessment in the modules, ie interactive Computer Marked Assignments, TMAs and exams. Their participation in forum discussions and attendance at on-line tutorials for S207 was also looked at.

Raising awareness of this analysis for both module teams and ALs involved in supporting Physical Science students was important. Information about the project was raised at various staff development activities. This included a presentation of some of the analysis at a 2 day AL staff development event for Physical Science ALs at Walton Hall (March 2015) to raise awareness for ALs and module team members working with both Level 2 and 3 students. Reports have also been presented at Departmental meetings and teaching days.

It had been planned that the results should feed into discussions with Student Support Teams – however at this time changes in structure in the organisation with the creation of Student Recruitment and Support Centres meant that it was not possible to do this.

Following the data analysis further investigation of possible reasons for the attainment gap between women and men at level 2 was required. Thus, the final stage of the project involved surveying students to obtain information concerning students' previous qualifications prior to study with the OU in Maths and Physics. The plan was that this should be sent to students at the beginning of the first presentation of S217. However, as a new module, S217 was involved in various other projects with surveys and it was decided to defer this to the 16J presentation.

The survey opened at the module start of the 16J presentation of S217 and students were also asked if they could be contacted by phone to discuss their studies on S217. 90 students completed the survey (out of ~300 surveyed). Telephone interviews were carried out in early January 2017 with 34 students (22 men and 12 women) who were studying S217 16J at this time representing ~10% of the students initially surveyed. The interviews were all recorded, and transcripts are available of all the interviews. This enabled follow up qualitative studies to take place exploring motivation to study, preparation for studying at level 2, confidence issues etc in relation to student attainment.

Findings

Results of the data analysis which sought to investigate whether the observed effect on S207 can be explained by the assessment strategy or by other factors (eg online forum activity, gender of tutor) suggest that none of these factors explain the difference in performance at Level 2 between women and men. Some evidence suggests that women do less well in the early part of the module where Newtonian mechanics is taught and the skills of problem solving are starting to be developed (Marigheto et al, 2015). For the level 2 astronomy module the multiple choice questions show some differences in that there is some evidence that women do not perform as well on these.

Demographic information gave no obvious differences for women and men e.g. age, previous qualifications etc. However, the information known about previous study is limited e.g. the number of A Levels students have is similar for men and women, but no information is known about the subjects studied. There is some indication that women with less than 2 A levels and/or who do not have English as a first language may be particularly likely to withdraw. (Jordan et al, 2015). For a subject such as physics previous study may be particularly important especially in maths.

Further investigations were needed to obtain more detail of student backgrounds in terms of previous study and qualifications. This took the form of a survey followed up with telephone interviews with a number of students. The survey was sent out to S217 students

as the 2016 J module started and 90 students responded. From this group a series of telephone interviews were arranged with 34 students (22 men and 12 women) who were studying S217 16J at this time which represents ~10% of the students initially surveyed.

Appendix A is the statistical report prepared by an AL based on the results to the survey and Appendix B is a report summarising the main points from the telephone interviews – full transcripts of all the interviews are also available. These provide evidence about the backgrounds of individual students and their reasons for studying Level 2 physical sciences – which may be part of a number of different qualifications or even as a standalone module – as well feedback on various aspects of S217. Tables at the end of the report summarise the qualifications being studied, the ambitions of the students and their previous qualifications in terms of gender. Appendix C looks specifically at the responses from students concerning their preparation for S217 (particularly concerning the maths skills required) and what if any other resources would have helped them.

These student interviews were an unexpected opportunity for members of the School of Physical Sciences to have conversations with their students about their preparation for and experiences of studying this new level 2 online course. The interviewers were 3 academic staff from the School of Physical Sciences (1 senior lecturer and 2 staff tutors) and an Associate Lecturer (Science). As the amount of face-to-face contact with students has decreased in recent years this gave an opportunity for students to ‘talk’ to us and could be an important feature in the building of academic communities. Many of these students did not post to forums and this was an opportunity for them to discuss their studies in Physical Sciences (to give feedback and to ask questions) with academic members of the School which they clearly appreciated.

Impact

During the period of this project huge change has taken place within the Open University in terms of student support with the creation of the SRSCs and the tuition strategy with the implementation of the Group Tuition Strategy in 2016J. In terms of Level 2 Physics the module S207 (conventional module with books) was presented for the last time in 2014J and S217 (completely online module) replaced it in 2015J. Measures of success in terms of improved retention etc are therefore impossible to obtain as for each presentation it was not possible to isolate the effect of single factors.

Both module teams (S207 and S217) were keen to implement any recommendations. Early analysis of data in the project found that the female academic presence (both in terms of ALs and module team members) on S207 module wide forums and in presenting module wide OU Live tutorials was low particularly in the early part of the module. For the 14J S207 presentation changes were made to the staffing of such events to improve the female presence in this early part of the module. S217 15J used a cluster approach to tuition and forum support (4 or 5 tutorial groups so ~ 80 – 100 students in each cluster) in anticipation of Group Tuition which was to be implemented in 2016J. It was ensured that there was at

least one female tutor in each cluster in 15J and with the larger clusters used in 16J (~140-160 students) most clusters had 2 or 3 female tutors. Thus, there has been an increased female presence on the forums/delivering OU Live Tutorials.

This project came out of analysis of data for Juno/Athena SWAN. During the period of the project the Department of Physical Sciences obtained Juno Champion and Athena SWAN Silver Award and so the project fed into wider discussion of gender in the undergraduate populations of Physical Sciences students.

In 2016 Prof Sally Jordan organised the Institute of Physics Higher Education Group meeting “**Exploring demographic differences in performance in undergraduate physics**” which was held at the Open University in London. In Dec 2017 Sally was invited to give a presentation at the Equality and Diversity in STEM HE meeting in London. The presentation was entitled “Learning gain, attainment gaps and student diversity”.

Further work relating to question type and the gender gap is continuing in other projects. Analysis of question types for various modules in the physical sciences curriculum has been carried out and initial findings from this have been presented as a poster by Dawkins et al , (2017) at the 6th eSTeEM conference and in a journal article Dawkins et al, (2017).

Deliverables

Report prepared by Dr Nicky Wright giving a statistical analysis of S217 student survey data – see Appendix A.

Summary of main points from telephone interviews with S217 students on the 2015J presentation – see Appendix B

Summary of student comments relating to preparation for S217- see Appendix C

Journal articles (refereed)

Dawkins, H., Hedgeland, H. & Jordan, S. (2017). The impact of scaffolding and question structure on the gender gap. *Physical Review Physics Education Research*, 13, 020117. DOI: <https://doi.org/10.1103/PhysRevPhysEducRes.13.020117>.

Conference contributions

Jordan, S., Dawkins, H. & Hedgeland, H. (2017). What questions cause the biggest gender gap?: Myth and reality. Oral presentation at Variety in Chemistry Education and Physics Higher Education Conference (ViCE/PHEC), 24th -25th August 2017, York.

Dawkins, H., Hedgeland, H. & Jordan, S. (2017). Identifying the characteristics of assessment questions with a particularly large attainment gap by gender. Poster presentation at the Sixth International Conference on Women in Physics, Birmingham, UK, 16th-20th July 2017.

Dawkins, H., Hedgeland, H., Budd, P., Gorfinkiel, J., Pearson, V. & Jordan, S. (2017) The impact of scaffolding on learning physics: is there a gender difference? Poster presentation (prize winner) at the 6th eSTeEM Annual Conference, 25th-26th April 2017, Milton Keynes

Jordan, S., Budd, P., Marigheto, N., Pearson, V., Jordan, R. & Gorfinkiel, J. (2015) Why do women do less well on some of our physics modules? Oral presentation at Variety in Chemistry Education and Physics Higher Education Conference (ViCE/PHEC), 20th- 21st August 2015, Nottingham

Marigheto, N., Pearson, V., Budd, P., Gorfinkiel, J., Jordan, R. & Jordan, S. (2015). Gender differences in completion and credit on physical science modules. Poster presentation at the 5th International Assessment in Higher Education Conference, 24th-25th June, Birmingham.

Marigheto, N., Pearson, V., Budd, P., Gorfinkiel, J., Jordan, R. & Jordan, S. (2015). Gender differences in completion and credit on physical science modules. Poster presentation at the 4th eSTeEM Annual Conference, 16th-17th April 2015, Milton Keynes.

References

Dawkins, H., Hedgeland, H. & Jordan, S. (2017). Identifying the characteristics of assessment questions with a particularly large attainment gap by gender. Poster presentation at the Sixth International Conference on Women in Physics, Birmingham, UK, 16th-20th July 2017.

Dawkins, H., Hedgeland, H., Budd, P., Gorfinkiel, J., Pearson, V. & Jordan, S. (2017) The impact of scaffolding on learning physics: is there a gender difference? Poster presentation (prize winner) at the 6th eSTeEM Annual Conference, 25th-26th April 2017, Milton Keynes

Jordan, S., Budd, P., Marigheto, N., Pearson, V., Jordan, R. & Gorfinkiel, J. (2015) Why do women do less well on some of our physics modules? Oral presentation at Variety in Chemistry Education and Physics Higher Education Conference (ViCE/PHEC), 20th- 21st August 2015, Nottingham

Marigheto, N., Pearson, V., Budd, P., Gorfinkiel, J., Jordan, R. & Jordan, S. (2015). Gender differences in completion and credit on physical science modules. Poster presentation at the 5th International Assessment in Higher Education Conference, 24th-25th June, Birmingham.

Marigheto, N., Pearson, V., Budd, P., Gorfinkiel, J., Jordan, R. & Jordan, S. (2015). Gender differences in completion and credit on physical science modules. Poster presentation at the 4th eSTeEM Annual Conference, 16th-17th April 2015, Milton Keynes.

Appendices

Appendices A, B and C.

