Identifying problem solving skills in science subjects

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Summary

In Physics and Astronomy, “Problem solving skills” have been identified as a range of skills that assist students to master their subject curricula – examples include the ability to make accurate estimation of measurements, to identify key information in questions and to be able to identify the correct method to help understand a particular concept. Identifying these skills will allow the School to improve the learning of our students by targeting these skills, tying in with objectives 6 and 8 in the Learning and Teaching Strategy 2011-15. We will also be improving their graduate skills-base. Such skills, though, could be equally applied to any science subject, and this project is designed to extend the initial work to benefit the learning and teaching of science students in general, by identifying these skills in various science subjects taught across the University of Glasgow.

The ultimate goal is to create a new level 2 “Problem Solving Skills In Science”. The course would be multi-disciplinary, using a combination of lectures, workshops and on-line learning to allow students to develop these skills. The course would use case studies from the subjects of Astronomy, Chemistry, Earth Sciences, Geography and Physics, but would be designed in such a way as to be suitable for all science subjects. The course would help to shape the curricula of students across the science subjects, in line with the current QAA enhancement theme: Developing and supporting the curriculum.

The project will use a combination of surveys and interviews to determine the relevant skills for each subject. Information and views on this will be sought from students in the participating Schools, the staff that teach them, and graduate employers. Student input on how such a course could be taught will also be collected, e.g. tutorials or practicals. The work will be carried out by a PhD student, employed as an atypical worker at grade 6 level. By using a student to help shape this work, and indeed seeking student views through survey and interview, the project ties in with objective 7 of the Learning and Teaching Strategy 2011-15.

Aims and Outcomes

The aims of this project are:

- To identify problem solving skills in science subjects.
- To determine how these skills are currently taught in the various Schools involved in the project.

The final outcome of this project will be a structure for a level 2, credit-bearing course for introduction in 2013-14.

The table below shows how these aims are aligned with objectives 6, 7 and 8 of the Learning and Teaching Strategy 2011-15:
Objective | How the project relates to this
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6. To enhance the quality of our learning and teaching and uphold our academic standards while streamlining wherever possible the associated administrative processes. | By identifying the skills, we can improve the learning of our students by improving their abilities to tackle the core disciplines.

7. To continue to build on our strong student-staff partnership to promote student engagement with learning and enhance student success | The project will seek students’ views on what these skills are, to ensure the eventual course is in alignment with students needs.
The surveys will also seek student input on how the subsequent course would be taught (tutorials, or practicals, etc.). Additionally, the use of a postgraduate student to carry out much of the work furthers the level of student involvement.

8. To embed and make transparent within our programmes, and throughout the student experience, the opportunities for the development of attributes that enhance the personal and professional development of our students so preparing them for global employment and citizenship. | Problem solving skills, by their nature, connect well with many of the graduate attributes as identified by the university. A full list is below this table.

Graduate attributes (academic dimensions) related to problem solving skills:
- Subject specialists – if students know how to tackle questions in their disciplines, then they will improve their level of understanding of those disciplines.
- Investigative – problem solving requires students to ask questions
- Independent and critical thinkers – key problem solving skills include being able to identify, define and assess complex issues and ideas.
- Resourceful and responsible – problem-solving skills are student
- Adaptable: problem-solving skills are multi-disciplinary – they are not subject specific, and the final course will be taught on that basis.

The course would help to shape the curricula of students across the science subjects, in line with the current QAA enhancement theme: Developing and supporting the curriculum.

Previous work
This work expands on a smaller-scale project that has been running in the School of Physics and Astronomy in 2011-12. This set out to define “problem solving skills” in the physics context, identifying what these skills were, and determining how best these could be/already were being taught and assessed. A range of skills were identified, some of which apply equally to science subjects in general, such as being able to make accurate estimations of results, identifying key points in a question and how to identify the correct method to help understand a particular concept.

This realisation that what we had identified as “physics” problem-solving skills could equally apply to subjects across the sciences, indicated the wider value of a project with a larger scope.

Student engagement
Students’ view of this project: The views of students on this project were gathered through Moodle and Mahara. The majority of these responses were positive, with students keen on the idea of the project, and the course that it will create. They were also keen to take part in the development process. There was some concern about not overloading a 2nd year student’s curriculum with the course, but this was always going to be one of the factors included when that course is fashioned.

Student inclusion within the project: The involvement of students in this project is vital to its success. On the one hand, a postgraduate student will be carrying out much of the research work themselves.
In addition, the views of students will be sought when it comes to determining what the problem-solving skills in their discipline are, how/if they are currently taught, and what views they have on how such teaching could be improved.

Methodology

This project will employ a PhD student to develop – under guidance from the Project Leader and other contributors – a series of surveys and interviews. These will be given out to the various stakeholders related to this: the staff in each School involved, students in each School involved, employers of graduates from each School involved.

Surveys will, where possible, be developed in hard-copy format to maximise the return rate, but online versions will be used where that is deemed more appropriate. Interviews will be carried out by the PhD student to help to clarify the results from the surveys.

Potential applicability/transferability

The outcome of this project will be a defined set of skills that will be applicable to all science subjects. It will also provide a template by which other subjects could investigate the same areas.

The course that will grow from this will be open to all students in the College of Science and Engineering, and beyond if appropriate.

Evaluation

Data will be collected from all groups with an interest in this project – the members of staff who will know what the appropriate problem solving skills are; employers of graduates with those skills; the students who need and use those skills. This will ensure that a consistent set of results is produced that addresses the aims of the project.

Surveys used will be piloted with small groups initially to ensure that they are fit for purpose. Ethical approval for this work will be sought from the College of Science and Engineering’s Ethics Committee.

Timetable

The project will run August 2012 to January 2013:

- **August 2012**: Surveys and interviews developed
- **September/October 2012**: Surveys distributed to students/staff/employers. Interview carried out with same.
- **November 2012 – January 2013**: Data processed and structure/content of subsequent course determined.

Budget

The costs of the project will be mostly taken up by the payment of a postgraduate student to develop and carry out the surveys and interviews, and then process the results. There will also be a small cost to cover consumables – paper and printing costs for surveys, a digital recorder for interviews.

- Cost of PG student: 250 hours (atypical worker, grade 6 £16.03 per hour): £4007.50
- Consumables: £50.00
- **Total: £4057.50**

Approval

Should this application be successful and be granted funding, I give consent for this application to be published on the Learning and Teaching Centre website.

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