Please Explain: Peer Feedback as Teaching in First Year Computer Programming

Dr Eamon Costello, Open Education Unit,
National Institute for Digital Learning, Dublin City University

Class Size
55 and 27

Feedback Approaches
Peer Feedback

Discipline
Computer Programming

Technologies
Peerwise

Challenge & Aim

Learning a programming language can be difficult for novices. It involves learning a large amount of syntactical and semantic rules and conventions. Novice learners may lack confidence as they grapple with this new subject. As in many areas, practice is key (Wing, 2006; Barr & Guzdial, 2015). Moreover, in computing education research it is noted, perhaps unsurprisingly, that there has often been a heavier focus on the tools and technologies of software development than on trying to identify and promote successful pedagogies (Settle, Vihavainen, & Miller, 2014).

The online assessment feedback strategy described here was designed and iterated over two academic years to actively engage learners in the assessment of a first year online module with introduces programming concepts (C1: Introduction to IT and Web Technologies). The Peerwise system was used to implement a peer-assessment and feedback component to the module which was supplemental to traditional tutor-lead formal feedback opportunities.

The aims of this work were threefold:

1) To explore the use of the Peerwise platform as a tool for increasing student engagement and practice.

2) **To assess the utility of the peer feedback in getting students to explain concepts to each other via both peer teaching and assessment.**

3) **To enable students to focus on tackling small well defined problems (as opposed to writing large complex programs for example) and on which they could receive immediate feedback.**

Evidence from the Literature

There is a rich body of scholarly work around peer assessment and feedback which itself draws on an even wider literature around feedback as part of assessment more generally a relevant synthesis of which is given in the earlier published report of the Y1 Feedback project (Y1Feedback, 2016). One theme in peer feedback for assessment is the issue of how reliable peer evaluations are when used in a formal grading mechanism. Falchikov and Goldfinch (2000) for example conducted a widely cited meta-analysis of studies that examined correlations between peer and tutor grades. Ultimately the impetus for this type of work may well be rooted in existential concerns of the privileged role of the teacher. Just as computers and robots that may make our jobs obsolete students teaching themselves may consign teachers to redundancy. There is indeed a link here, as much peer assessment feedback, for logistical reasons, relies on technology so online peer assessment may represent something of a perfect dystopian storm.

At the other end of the spectrum is research that broadly aims to enhance opportunities for feedback and inculcate increased levels of social presence in educational scenarios. Boud (2000) makes a case for peer assessment that is modelled around a particular course climate. He describes the creation of "a climate in a course in which the giving and receiving of feedback is a normal part of the teaching and learning processes and leads to worthwhile peer learning" (Boud, 2000, p. 157). To take Boud's course climate idea further we can use peer assessment to socialize students to the idea of feedback in general, by showing that it is something we are willing to trust them with. Peer assessment can be at the heart then of a democratic classroom (Brookfield & Preskill, 2012).

More generally the peer feedback process can be seen not just as beneficial to students for receiving feedback but for also attaining it. Nicholas, Thompson and Breslin (2014) for example showed that producing feedback engaged students in acts of evaluative judgement about the work of their peers, but also reflectively about their own work and that it involved them in invoking and applying criteria to explain their judgements.

One of the advantages of peer feedback is that it provides an opportunity for allowing the student to be a teacher; to create teachers as students and students as teachers (Hatttie, 2008). In the context of this study, with a subject like computer programming, the ability to communicate technical concepts to others is very important. Lastly, an obvious practical advantage of peer feedback is that students can receive more feedback from peers and more quickly than is usually possible with teachers. This was also a strong motivation to the development of this approach.

The Peerwise system itself has been the subject of several studies. In an investigation of student motivation and engagement with Peerwise, Denny (2013) conducted a large-scale ($n > 1000$) randomised controlled experiment and found a significant positive effect on the quantity of student input, without compromising its quality,

as well as on the period of time over which students engaged in assessment and feedback. Other studies have signified the benefits of utilising Peerwise, both for staff and students. It has been shown to foster deep learning whilst not relying on additional tutor time (Draper, 2009). In receiving immediate feedback students also acquire a new opportunity to self-assess their current knowledge level (Denny, 2010). Furthermore, students can use the platform with confidence as they can remain anonymous to their fellow peers; this establishes an environment where students can comfortable and fully engage with the tool (Biggins et al., 2015; McClean, 2015).

Feedback Approach

The approach involved the creation of a detailed guide for students which included an assessment document outlining what students had to do and all dates and timelines involved. Detailed instruction was important as students were off campus with less opportunity for classroom interaction and the accumulation of tacit information. The assessment was designed to be carried out in two successive phases which included intermediary submission dates so as to allow students to give and receive feedback at successive stages. A set of videos was also developed to guide students through the environment. Although there are guides and tools available for using Peerwise that range from academic articles comprising full case studies e.g. (Ryan et. al. 2015; Bates et. al. 2012; Singh, 2014), to more practical implementation guides, it still required a lot of work to customize and develop materials for the unique requirements of the course. There was also some administrative work involved in getting a list of all student names into an excel file and importing this into the Peerwise system in order to generate accounts for them on the system. There was then a reverse process following the assessment where I needed to extract the marks from the Peerwise system, calculate them according to the marking scheme the students had been provided with, and uploading these marks to the Moodle gradebook.

In phase one students were required to write several Multiple Choice Question. Students were given detailed instructions on the number and format of questions they needed to write according to best practice in MCQs Item writing. Effectively students were given a short rubric to use. The components students were asked to consider when grading each others questions were as follows:

(a) The question is clearly stated;

(b) The question is error free;

(c) The distractors (incorrect answers) are feasible;

(d) The accompanying explanation is good;

(e) The specified answer is correct.

Being familiar with some of the well-developed literature on flaws that MCQ writers are commonly susceptible to, I had to hold myself back somewhat and give students some clear and fairly *simple* guidelines. For example there are up to 20 item writing flaws that MCQ writers are susceptible to committing (Tarrant et. al., 2006). However what the literature does suggest was that though many educators are not good question authors in all instances (Tarrant et. al., 2006; Holsgrove, and Elzubeir,

Feedback Approach

1998) well guided students may be (Denny, Luxton-Reilly & Simon, 2009; Purchase et. al. 2010) provided they are given targeted support.

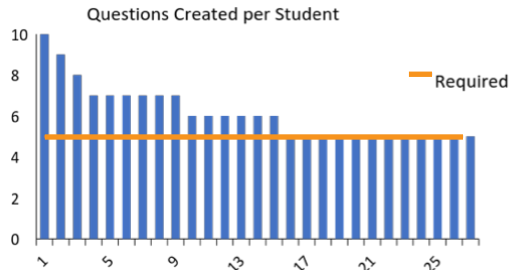
Peerwise is not a general purpose system for peer assessment (such as WebPA is for example). However, this is part of its strength. It does one thing well. A strong principle underpinning this assessment was to keep it as simple as possible for students so that they did not suffer from excessive cognitive load. To this end I adopted a mantra of "getting to learning as quickly as possible".

Following a first round of question creation each student was required to answer questions posed by their peers and comment and rate on questions. Students were instructed to use anonymous handlers in the Peerwise environment. This anonymity is important as students were asked to grade each other. Detailed instructions were given to students as to how to create their pseudonym (basically warning them not to use anything untoward).

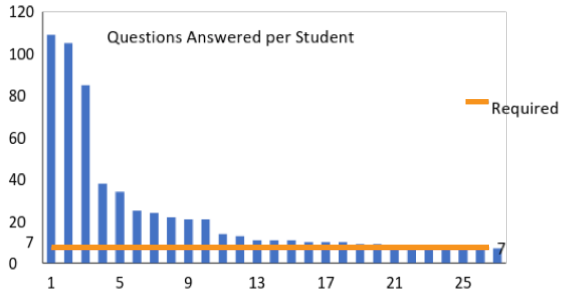
Students then created questions in a second phase whereby they used both the experience of answering the questions posed by others and the feedback from their peers in phase one to improve their skill at teaching others programming via multiple choice questions.

One early welcome finding was that many students exceeded the minimum participation requirements of the assignment suggesting that it is something they enjoy doing. Many students created more questions than they were required to for example.

The below graph shows the number of questions created by students where the red line indicates the minimum level needed to meet the course requirements:



Question creation is difficult and takes time. Answering questions by contrast is considerably easier. If you are confident that you know the answer it takes relatively little time to answer a question. The results of student engagement here were even higher as many more students exceeded the course requirements and by greater amounts as can be seen in the figure below:



Outcomes

Student Response

As part of the module evaluation, students answered both free-text and likert questions related to their experience of using Peerwise.

Across both year groups students indicated their ability to explain programming to others was improved by using PeerWise. There were also predominantly favourable qualitative comments in relation to the system *"I thought the PeerWise system worked really well, I learned a lot from it", "enjoyed using it. was a nice break from the usual assignments"*, however other students encountered some difficulty *"I had a problem checking back over early questions to see if I had rated them. Feedback from both tutor and participants would be good. Probably useful to distinguish between the two."*

Table 1 below contains a selection of the respondent feedback to questions which asked students about their experience and perceptions of the value of peer teaching and feedback**.**

	Strongly Agree	Agree	Mixed feelings	Disagree	Strongly Disagree	Avg	n
My programming ability was improved through my use of Peerwise	5 (29%)	4 (24%)	5 (29%)	3 (18%)	0	2.4	17
My ability to explain programming to others was improved	5 (29%)	8 (47%)	3 (18%)	1 (6%)	0	2	17
The quality of other student questions was high	3 (18%)	8 (47%)	5 (29%)	1 (6%)	0	2.2	17

Table 1:
Selection of student feedback from 2014/2015 cohort on Peerwise

As can be seen from the above students were largely positively disposed to Peerwise and highly rated the feedback of their peers and the act of giving feedback – here defined as the ability to explain programming to others.

Recommendations

Some key takeaways are:

- Peerwise is very easy to use for students (with clear directions and support) and was well received.
- Students find well designed peer feedback systems engaging and stimulating
- The value to students should be clearly outlined of any non-standard form of assessment
- Using dedicated peer assessment feedback systems requires time and thought to implement. So start simply and iterate

Useful Links/Further Information

Peerwise: http://peerwise.cs.auckland.ac.nz/

References

Barr, V., & Guzdial, M. (2015). Advice on teaching CS, and the learnability of programming languages. *Communications of the ACM*, 58(3), 8-9.

Bates, S. P., Galloway, R. K., McBride, K. L., Rebello, N. S., Engelhardt, P. V., & Singh, C. (2012, February). Student-generated content: Using PeerWise to enhance engagement and outcomes in introductory physics courses. In *AIP Conference Proceedings-American Institute of Physics* (Vol. 1413, No. 1, p. 123).

Biggins, D., Crowley, E. J., Bolat, E., Dupac, M., & Dogan, H. (2015). Enhancing university student engagement using online multiple choice questions and answers. *Open Journal of Social Science*s, (3), 71-76.

Boud, D. (2000). Sustainable assessment: rethinking assessment for the learning society. *Studies in continuing education*, 22(2), 151-167.

Denny, P. (2010, June). Motivating online collaborative learning. *InProceedings of the fifteenth annual conference on Innovation and technology in computer science education* (pp. 300-300). ACM.

Denny, P. (2013, April). The effect of virtual achievements on student engagement. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 763-772). ACM.

Denny, P., Luxton-Reilly, A., & Simon, B. (2009, January). Quality of student contributed questions using PeerWise. *In Proceedings of the Eleventh Australasian Conference on Computing Education-Volume 95* (pp. 55-63). Australian Computer Society, Inc..

Dochy, F. J. R. C., Segers, M., & Sluijsmans, D. (1999). The use of self-, peer and co-assessment in higher education: A review. *Studies in Higher education*, 24(3), 331-350.

Draper, S. W. (2009). Catalytic assessment: understanding how MCQs and EVS can foster deep learning. *British Journal of Educational Technology*,40(2), 285-293.

Falchikov, N., & Goldfinch, J. (2000). Student peer assessment in higher education: A meta-analysis comparing peer and teacher marks. *Review of educational research*, 70(3), 287-322.

Hattie, J. (2008). Visible learning: *A synthesis of over 800 meta-analyses relating to achievemen*t. Routledge.

Holsgrove, G., & Elzubeir, M. (1998). Imprecise terms in UK medical multiple-choice questions: what examiners think they mean. *Medical Education, 32*(4), 343-350.

McClean, S. (2015). Implementing PeerWise to engage students in collaborative learning. *Perspectives on Pedagogy and Practice*, 6, 89-96.

Nicol, D., Thomson, A., & Breslin, C. (2014). Rethinking feedback practices in higher education: a peer review perspective. *Assessment & Evaluation in Higher Education*, 39(1), 102-122

Purchase, H., Hamer, J., Denny, P., & Luxton-Reilly, A. (2010). The quality of a PeerWise MCQ repository. In *Proceedings of the Twelfth Australasian Conference on Computing Education-Volume 103* (pp. 137-146). Australian Computer Society, Inc..

Ryan, B., Mac Raighne, A., Casey, M., & Howard, R. (2015). Student Attitudes to an Online, Peer-instruction, Revision Aid in Science Education.

Settle, A., Vihavainen, A., & Miller, C. S. (2014). Research Directions for Teaching Programming Online. In *Proceedings of the International Conference on Frontiers in Education: Computer Science and Computer Engineering (FECS)* (p. 1). The Steering Committee of The World Congress in Computer Science, Computer Engineering and Applied Computing (WorldComp).

Singh, L. (2014). Technology enhanced peer learning with PeerWise: Experiences and perceptions from a developing country. *The Caribbean Teaching Scholar*, 4(1).

Tarrant, M., Knierim, A., Hayes, S. K., & Ware, J. (2006). The frequency of item writing flaws in multiple-choice questions used in high stakes nursing assessments. *Nurse education in practice*, 6(6), 354-363.

Y1Feedback (2016). Technology-Enabled Feedback in the First Year: A Synthesis of the Literature. Available from www.y1feedback.ie

Contact

If interested in finding out more about this approach or technology, please contact Dr. Eamon Costello at eamon.costello@dcu.ie .

Cite as;

Costello, E. 2017. Please Explain: Peer Feedback as Teaching in First Year Computer Programming. IN: Technology-Enabled Feedback Approaches for First-Year: Y1 Feedback Case Studies in Practice: Y1Feedback. Available from: https://www.y1feedback.ie