Maximising Student Success with Automatic Formative Feedback for Both Teachers and Students

Book Section

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Abstract.
This paper discusses the outcomes from the building and empirical investigation of two automatic feedback systems, namely OpenMentor and OpenEssayist that can support student learning. The findings from OpenMentor and OpenEssayist usage suggest that prompt targeted feedback for time poor students can maximise student success. Both systems facilitate the users to take ownership and reflect on their own work, through provision of feedback at a point where they can build on it in subsequent tasks. This should have the most impact on the users' understanding of the requirements of academic writing and the tutors' understanding of feedback for academic writing. The systems are also starting to be used as research tools that allow pedagogical strategies to be open to test.

Keywords: Formative Feedback, Automatic Feedback, Essay Feedback, Natural Language Processing, OpenSource

1 Introduction

Full time students in Higher Education are even more time poor and less prepared than their predecessors (Nonis & Hudson, 2006). They often undertake paid employment during their studies. This means their time to write assignments is concentrated in smaller bursts of activity and mastering the art of essay writing can become a more onerous task (Metcalf, 2003). Meaningful feedback is essential to gaining good writing skills, which illustrate the subject knowledge gained. One approach to this problem adopted by The Open University UK was to build an automatic feedback system to assist tutors in providing "advice for action" (Whitelock, 2011) so that students can improve their grade and open a dialogue with their tutor and improve their grade on the next assignment.

This paper discusses the role OpenMentor can play in assisting to improve their tutors' feedback, together with the findings from another tool called OpenEssayist that gives students automatic feedback on draft essays. Students can, therefore, start to judge for themselves how to improve their assignment within the time they have left before summative submission.

This two pronged approach has been adopted at The Open University and beyond to assist tutors and students in giving and receiving meaningful feedback. With each system all the users, whether they are tutors or students, are given the opportunity to test out the boundaries of their skills or knowledge in a safe environment, where their predictions may not be correct, without expecting to be penalised for it. Feedback does not always imply guidance (i.e. planning for the future) and this is the type of support incorporated into the two systems described below.

2 OpenMentor

Feedback can sometimes be the only contact students have with their tutors (Gibbs & Simpson, 2004). It plays an essential role in assessment for learning which can assist with maximising student success with their higher education studies. In order to achieve this goal, assessment has to be accompanied by appropriate meaningful feedback (Evans, 2013; Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006; Price, Handley & Millar, 2011). Feedback also needs to be commensurate with the marks awarded and this was one of the main drivers for the building of OpenMentor. The main function of

OpenMentor is to support tutors' feedback practices and in order to do this it has to analyse the tutor comments.

A classification system is employed to implement this task and the one chosen for use in OpenMentor is based on that of Bales (1970). Bales's category system was originally devised to study social interaction, especially in collaborating teams; its strength is that it brings out the socio-emotive aspects of dialogue as well as the domain level. In previous work, Whitelock et al, (2004) found that the distribution of comments within these categories correlates very closely with the grade assigned.

Bales' model provides four main categories of interaction: positive reactions, negative reactions, questions, and answers (see Table 1). These interactional categories illustrate the balance of socio-emotional comments that support the student. We found (Whitelock et al., 2004) that tutors use different types of questions in different ways, both to stimulate reflection, and to point out, in a supportive way, that there are problems with parts of an essay. These results showed that about half of Bales's interaction categories strongly correlated with grade of assessment in different ways, while others were rarely used in feedback to learners. This evidence of systematic connections between different types of tutor comments and level of attainment in assessment was the platform for the current work.

Table 1. Bales Categories

Categories		Specific Examples
Positive Reactions		
A1	1. Shows solidarity	Jokes, gives help, rewards others
A2	2. Shows tension release	Laughs, shows satisfaction
A3	3. Shows agreement	Understands, concurs, complies, passively accepts
Attempted Answers		
B1	4. Gives suggestion	Directs, proposes, controls
B2	5. Gives opinion	Evaluates, analyses, expresses feelings or wishes
B3	6. Gives information	Orients, repeats, clarifies, confirms
Questions		
C1	7. Asks for information	Requests orientation, repetition, confirmation, clarification
C2	8. Asks for opinion	Requests evaluation, analysis, expression of feeling or wishes
C3	9. Asks for suggestion	Requests directions, proposals
Negative Reactions		
D1	10. Shows disagreement	Passively rejects, resorts to formality, withholds help
D2	11. Shows tension	Asks for help, withdraws
D3	12. Shows antagonism	Deflates others, defends or asserts self

The advantage of the Bales model is that the classes used are domain-independent – this model was used to classify feedback in a range of different academic disciplines, and it has proven successful in all of them. An automatic classification system, therefore, can be used in all fields, without needing a new set of example comments and training for each different discipline.

Others (e.g., Brown & Glover, 2006) have looked at different classification systems, including Bales, and from these developed their own to bring out additional aspects of the tutor feedback, bringing back elements of the domain. In practice, no (useful) classification system can incorporate all comments. Bales was selected and preferred because of its relative simplicity, its intuitive grasp by both students and tutors, and because it brings out the socio-emotive aspects of the dialogue, which is the one aspect tutors are often unaware of.

A second point is that Bales draws out a wider context: we bring in to question the notion of feedback itself. When building OpenMentor the concept seemed to divide naturally into two different aspects: learning support and learning guidance. Support encourages and motivates the learner, guidance shows them ways of dealing with particular problems.

OpenMentor also set out to solve one of the problems with tutor feedback to students and that is a balanced combination of socio-emotive and cognitive support is required from the teaching staff and the feedback also needs to be relevant to the assigned grade.

Whitelock & Watt (2007) found that students expect to receive feedback that is appropriate to the assigned grade. This feedback provides them with the supportive comments they need to feel confident about their level of work and where to improve in future assignments.

2.1 Transferring OpenMentor to other UK Universities

The OpenMentor system which had proved successful in training tutors to give feedback at The Open University UK was then transferred for use at King's College London and Southampton University. The empirical studies and system update that resulted in the OMtetra project (Whitelock et al, 2012a; Whitelock et al, 2012b) was supported by JISC funding.

The system was trialled with tutors from both Universities. All appreciated the opportunity they were given to receive comments on their feedback. This was because feedback is received, but not always systematically, at Faculty level, at tutor team meetings and sometimes at programme exam boards.

A series of recommendations for improvement to the system were implemented. Mainly system access from networks external to the institution and the enhancement of narrative in reports as the graphical output was not always easy to interpret, without supporting explanations. This also meant that the system was migrated to Grails[1]. The OMtetra project was successful in completing its transfer to two Higher Education Institutions in the UK and is assisting with the delivery of quality feedback to support the teaching and learning process.

2.2 Further Empirical Studies

Since the upgrade of OpenMentor, after the OMtetra project, a further study was undertaken with 48 tutors at The Open University. The tutors were asked to upload three of the assignments they had marked and then to answer a questionnaire. The majority of the tutors involved in the study judged themselves to be experienced tutors. All tutors agreed that comments should reflect the grade awarded, which is a basic premise of the OpenMentor system. Over two-thirds of tutors believed that new tutors provide students with the greatest amount of written feedback. With respect to the quality of feedback most tutors felt that experienced tutors provided higher quality than new tutors (Chi Square = 10.878 $p<0.004$).

A significant majority of tutors also reported that OpenMentor would assist with Quality Assurance (Chi Square = 18 $p<0.01$). A significant number were surprised by the lack of praise they had given to students (Chi Square = 19.0 $p<0.01$). They also gave a strong indication that they expected assessments with low grades to attract more negative comments (Chi Square = 22.638 $p<0.001$).

OpenMentor is becoming successful, both within The Open University UK and beyond. However the key factor is still institutional integration, which has more chance of success with the use of open frameworks that are enabled by the use of open-source applications.

OpenMentor has also been used to extract and analyse tutor comments received by 470 ethnic minority and 470 matched white students following a distance learning course (Richardson et al, 2015). Although the black students and students of mixed ethnicity obtained lower marks for their assignments than the white students, there were only small differences between the pattern of feedback each group received. It was concluded that students from all ethnic groups received feedback that was commensurate with their mark. The study revealed the under-attainment of ethnic minority students was not due to the nature of the feedback they received. This example illustrates how OpenMentor can also be used as a research tool to identify and analyse large numbers of assignments with tutor feedback.

3 Automated Feedback Direct to Students

Another approach to maximising student success at The Open University was to construct a natural language analytics engine to provide feedback to students when preparing an essay for summative assessment (Van Labeke et al, 2013).

OpenEssayist was developed as a web application and consists of two components. The first component, EssayAnalyser, is the summarization engine, implemented in Python with NLTK[2] (Bird et al, 2009) and other toolkits. It is designed as a stand-alone RESTful web service, delivering the basic

[1] Grails is an open source web application framework

[2] Natural Language Processing Toolkit, see http://nltk.org/

summarization techniques that will be consumed by the main system. The second component is OpenEssayist itself, implemented on a PHP framework. The core system consists of the operational back-end (user identification, database management, service brokers, feedback orchestrator) and the cross-platform, responsive HTML5 front-end.

The flow of activities within the system meant that firstly, students are registered as users. Once they have prepared a draft offline and want to obtain feedback, they log on to the OpenEssayist system and submit their essay for analysis, either by copy-and-pasting or by uploading their text document. OpenEssayist submits the raw text to the EssayAnalyser service and, once finished retrieves and stores the summarization data. From that point on, the students can then explore the data at their own pace. Using the various external representations available to them, they can follow the prompts and trigger questions that the Feedback Orchestrator generates from the analysis and can start planning their next draft accordingly.

This rewriting phase takes place offline, the system simply offering repeated access to the summarization data and feedback, as a resource, until the students are prepared to submit and explore the summarization feedback on their second draft, and on subsequent changes between drafts. This cycle of submission, analysis and revision continues until the students consider their essays are ready for summative assessment. A major challenge is to provide feedback to the student that can be acted upon to improve the draft essay. In other words, to provide both textual and visual representations that can be used as cognitive tools.

OpenEssayist was used in anger by a cohort of Masters students following H817 "Openness and Innovation in eLearning". It was designed to introduce students to the latest developments in educational technological developments and open learning. Therefore the adoption of OpenEssayist was a suitable addition to the course. 41 students who were studying H817 accessed OpenEssayist at least once during the course and 30 students made use of the system to practice their essay writing skills. However Whitelock, Twiner, Richardson, Field & Pulman (2015) found a significant correlation between students' grades for Essay 1 and the number of drafts they submitted. The students from this cohort, who had access to OpenEssayist, achieved significantly higher overall grades than the previous cohort who had no access to OpenEssayist.

3.1 Implications

OpenEssayist was designed as a tool for student reflection on their draft essays. Students reported it took time to learn how to use the system but some were disappointed that it would not be available for their subsequent course of study. Hence these students appreciated that initial cognitive overload of mastering the system could have continual benefits throughout their studies. Some mentioned that using OpenEssayist gave them the confidence to submit a rough draft for feedback and the second draft was easier to complete. Others felt the feedback about the structure of the essay from OpenEssayist complemented the feedback from their tutors. The latter mainly focussed feedback about the specific content of the essay they had written. Therefore feedback from the tutor combined with OpenEssayist's advice presented the student with an excellent combination of "advice for action" (Whitelock, 2011).

4 Conclusions

Feedback has been a popular topic of educational research for some decades and it is widely acknowledged that feedback is central to learning (Black & Wiliam, 1998). Both OpenMentor and OpenEssayist implement two of the principles of good practice for undergraduate education as described by Chickering & Gamson (1987) which are:

- The giving of prompt feedback and
- Encouraging active learning

However it must be acknowledged that students may also need to receive a form of training to interpret their tutors' feedback in order to benefit from receiving good quality feedback (Buhagiar, 2012). Time poor students require prompt feedback and automated systems that elicit and capture higher order thinking skills can move some way towards that goal.

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