

Enhancing the Impact of Formative Feedback on Student Learning Through an Online Feedback System

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Abstract: Formative feedback is instrumental in the learning experience of a student. It can be effective in promoting learning if it is timely, personal, manageable, motivational, and in direct relation with assessment criteria. Despite its importance, however, research suggests that students are discouraged from engaging in the feedback process primarily for reasons that relate to lack of motivation and difficulty in relating to and reflecting on the feedback comments. In this paper we present Online FEedback System (OFES), an e-learning tool that effectively supports the provision of formative feedback. Our aims are to enhance feedback reception and to strengthen the quality of feedback through the way feedback is communicated to the students. We propose that an effective feedback communication mechanism should be integrated into a student's online learning space and it is anticipated that this provision will motivate students to engage with feedback. Empirical evidence suggests that the developed system successfully addressed the issues of student engagement and motivation and achieved its objectives. The results of using the system for two years indicate a positive perception of the students which, in turn, encourage us to further explore its effectiveness by extending its functionality and integrating it into an open source learning management system.

Keywords: formative feedback, online feedback, student engagement, student motivation

1. Introduction

Feedback is an essential component in all learning contexts and serves a variety of purposes including evaluation of students' achievements, development of students' competences and understanding, and elevation of students' motivation and confidence (Hyland, 2000). Within teaching and learning activities in a higher education setting, feedback can be perceived as any information communicated to the learner as a result of a learning-oriented action (Race, 2001). Nonetheless, formal feedback is provided in response to students' work on formative assessment such as essays, assignments and projects. In order to be effective, feedback on formative assessment needs to possess a number of qualities: it needs to be timely, constructive, motivational, personal, manageable and directly related to assessment criteria and learning outcomes (Race, 2006; Irons, 2008; Juwah et al, 2004; Race, 2001). A formative feedback strategy should address as many as possible of these attributes in order to promote learning. The term feedback strategy, however, actually encapsulates two components: the contents of feedback itself and the method(s) used to communicate the feedback to students.

Communication of formative feedback is very important since the method selected may discourage or draw students' attention in the feedback process. In order to be effective, it should ensure that students engage with the content provided. Formative feedback can be communicated to students in a number of different ways, both traditional and electronic. Traditional tactics include handwritten comments on students' assessed work and print-outs of word-processed feedback forms which are returned back to the students. These traditional ways of communication do not seem to be efficient since they suffer from the problem of not reaching the student. Electronic feedback methods range from simple techniques such as emailing comments to students to more sophisticated tools that allow tutors to place comments and annotations to electronically submitted work. Electronic feedback methods are increasingly used by teachers since they enhance feedback production, delivery and communication (Race, 2001).

Despite the indisputable importance of feedback and the strong and consistent research outcomes on its effectiveness in the educational process and the promotion of learning, ample evidence in the literature (Bailey, 2009; Chanock, 2000; Winter et al, 2004) suggests that students do not collect formative feedback. It has certainly been the authors' experience that every semester there is a large and persistent percentage of students that do not collect the accompanying feedback of marked

assignments. Research (Hounsell, 1987; Chanock, 2000; Winter et al, 2004; Carless, 2006) that has been conducted in order to determine why students are dissatisfied and do not collect formative feedback identified reasons that pertain not only to the quality and quantity of the feedback comments but also to students' lack of motivation (in case of bad performance) and the suitability and aptness of the feedback's communication method. While numerous electronic tools are available, the effectiveness of formative feedback could be maximised if it was communicated to the student's learning space, an environment where all learning material and resources of a particular lesson reside. A Learning Management Systems (LMS) constitutes such an environment. An LMS could be perceived as a student's desktop and thus, it would be more effective if the feedback was delivered on the desktop of the student. However, open source LMSs like Moodle and Claroline, do not seem to include an efficient, build-in functionality for providing formative feedback.

This paper describes an Online Feedback System (OFES), a web-based tool that provides formative feedback. The system envisages to be an effective mechanism for communicating formative feedback and to facilitate students' motivation and engagement in the feedback process. OFES was developed as a standalone web application that operated under an academic intranet. Its effectiveness, however, would be maximised if it was integrated into a learning management system, work that is currently in progress. The rest of the paper is structured as follows. Section 2 examines formative feedback and quality characteristics, reviews common electronic feedback methods and explores the provision of formative feedback by open source learning management systems. In section 3, we then present our solution for facilitating the communication of formative feedback, describe the design principles, implementation and architecture. Section 4 presents a case study and evaluation of the system, the results of which encourage us to pursue the integration of OFES into a learning management system. Finally, in section 5 we discuss limitations and future enhancements of the proposed system.

2. Theoretical framework

Effective and high quality feedback has been identified as an integral part of the learning process (Ramsden, 2003; Black, 1998). Extensive research, not only underpins the importance of feedback in enhancing achievement levels, but also emphasises the obligation of academic institutions to effectively integrate feedback in the learning experience (Yorke, 2003). While feedback can be provided to students at various contexts (e.g. class discussions, teacher's answers to questions), the formal feedback process commences with the production of student work as a result of a formative assessment. This section explains the quality characteristics of feedback given on formative assessment, reviews various methods of communicating formative feedback to students and discusses the support for feedback in learning management systems.

2.1 Formative feedback and quality attributes

Feedback given as part of formative assessment enables learners to consolidate their strengths, identify their weaknesses (Brown, 1997) and guides them about the necessary actions in order to achieve the learning outcomes (Sadler, 1989). However, in order to promote learning and lead to a higher level of achievement in cognitive and skill outcomes, formative feedback should have a range of qualities. (Race, 2006; Irons, 2008; Juwah et al, 2004; Shute 2008) discuss and review these key quality attributes and explain that feedback needs to be:

- **timely:** feedback is more effective if it is provided timely since students can still recall how they addressed each assessed task (Race, 2006). Timely feedback is also important because it allows students to apply it to future learning and assessments. It is also important that the feedback timeframe is clearly communicated to the students.
- **motivational:** feedback may have positive or negative effect on student motivation and self-esteem. It affects students' personal feelings which, in turn, affect their engagement in the learning process (Juwah et al, 2004). As a result, formative feedback should be empowering and constructive in order to aid student motivation and encouragement.
- **individual/personal:** each student has unique strengths and weaknesses. As a result, in order to be effective and enable students to improve their competences, formative feedback must fit each student's achievements. It needs to be personalised and tailored to individual students' strengths and weaknesses.
- **manageable:** feedback should certainly be detailed enough to ensure that students understand their strengths and weaknesses. Nevertheless, over-detailed feedback forms and too many

comments can result in confusing students and making it hard for them to separate the important feedback. Consequently, feedback should be manageable and allow students to easily interpret and benefit from the feedback they need the most (Race, 2006).

- directly related to assessment criteria/learning outcomes: assessment criteria establish clear and unambiguous standards of achievement and must be related to the learning outcomes of a course. Since assessment criteria constitute what students had to achieve, formative feedback should explain the extent to which a student achieves each separate assessment criterion, identify knowledge gaps and address specific errors and preconceptions.

Students' reception of feedback is very important (Yorke, 2003). Students with positive mindset can perceive feedback as opportunity for further development while students with a negative attitude may be discouraged. As a result, quality formative feedback should also be effectively communicated to students in order to aid motivation and ensure that students engage with the content of the feedback.

2.2 Feedback and ICT

There exist numerous alternative ways for communicating formative feedback to higher education students. A comprehensive review of these methods is described in (Race, 2001; Irons, 2008) in which techniques are categorised into traditional and electronic. Common traditional methods include giving back to each student the submitted assignment with handwritten comments, having individual face-to-face feedback meetings, or explaining model solutions in the classroom. While these methods have their own advantages and disadvantages, see (Race, 2001), electronic solutions are increasingly used by tutors since they integrate a number of benefits. These benefits include speeding up the delivery of feedback, assisting the effectiveness of reception of feedback and generating appropriate evidence for the quality of feedback (Race, 2001). Section 2.2.1 describes three common electronic feedback techniques and communication methods of formative feedback and presents a brief analysis of their ability to support or enhance the quality characteristics of feedback. Section 2.2.2 identifies deficiencies and discusses the aptness of these three communication methods.

2.2.1 Common feedback techniques and communication methods

- **Word-processed Feedback Forms:** Use of pre-prepared proformas is a common technique for providing formative feedback. Such forms can be used to provide students with individualised feedback which is often related to a number of assessment criteria. Furthermore, a well-structured form can assist students in managing and interpreting the feedback comments. On the other hand, a disadvantage of this feedback communication method is the difficulty of reaching the student. Unless sent by email, a tutor has to print the feedback forms and await an in-person meeting (e.g. in class or during office hours) to hand in the forms to the students.
- **E-mailing Comments or Feedback Forms:** E-mail can be a simple but effective way of communicating formative feedback to students. This communication method solves the problem of reaching the student and supports individualised feedback as tutors can e-mail to each student feedback comments or a personal pre-prepared feedback form. Feedback comments within an email may be difficult for students to interpret and manage compared to a structured feedback form. Furthermore, e-mail is a very common activity in higher education and students may not treat feedback as seriously as printed feedback (Race, 2001).
- **Electronic Annotations on Students' Work:** A number of software packages enable tutors to write comments (annotations) 'on top of' student work which, of course, has to be electronically submitted. These include 'track changes' and commenting tools of word-processing packages, electronic whiteboards and more recently, plagiarism detection systems like TurnItIn.com. Annotated versions of student work can then be saved and either printed or e-mailed to students. While this formative feedback technique allows tutors to provide personalised feedback that relates to a specific piece of work, it is difficult to relate it to assessment criteria or learning outcomes.

2.2.2 Discussion on electronic feedback methods

There exists a number of ICT tools that can be utilised in the provision of formative feedback. Depending on particular contexts (traditional classroom teaching, blended learning, distance learning) and the type of the formative assessment, tutors can employ one or more combinations of traditional and electronic feedback methods. Type-written comments, feedback forms and annotated student work are three common electronic techniques for producing feedback. Nevertheless, this feedback is

then communicated to students with two primary methods: either in-print or via email. The extent to which these feedback techniques and communication methods facilitate the provision of quality feedback is arguable since they integrate differently the timeliness, motivation, personalisation, manageability and relation to assessment criteria quality attributes of feedback.

2.3 Learning management systems and formative feedback

Learning management systems enable the effective delivery, management and administration of courses. These rich, student-centered learning environments are increasingly being used by higher education institutions since they have the potential to greatly enhance the learning experience of both on-campus students and those studying at a distance. LMSs facilitate learning by providing a centralised location where learning material reside and through integrated tools that enable various teaching and learning activities such as communication and collaboration with peers and lecturers, self-assessment and progress tracking. In other words, LMSs provide a learning space that can be perceived as the 'desktop' of the student. Formative feedback constitutes an instrumental aspect of learning and should, therefore, be integrated in the student's learning space.

Most widely used open source LMSs today provide support primarily for the management of formative assignments. Integrated tools can support instructors by enabling them to easily setup assignments and access student submissions while students are assisted in the task of online assignment submission. The composition, however, of formative feedback by instructors and its effective communication to students is not properly supported. An examination through EduTools (EduTools, 2010) of the available feedback tools provided by open source LMSs yields poor appraisals for the quality of provision of feedback on students' formative assignments. While Moodle, ATutor, Claroline, ILIAS and other widely used open source LMSs include mechanisms for producing and communicating feedback, the capabilities and efficiency of these mechanisms are quite limited. One category of LMS tools that can support the provision of formative feedback to students is online assessment in form of quizzes consisting of multiple-choice, true/false and fill-in-the-blank type of questions. This kind of tools, allow tutors to include pre-defined formative feedback which can be immediately seen by the students. Other types of assessment such as projects, essays and presentations, require tools that enable lecturers to create feedback/assessment forms. This functionality is rather limited in open source LMSs, most of which provide just a single text area where a tutor can write feedback comments. Since, however, student engagement with feedback is considered central to their learning, innovative ways of composing and communicating formative feedback through learning management systems should be explored.

3. OFES tool

OFES is a web-based tool that was developed with the aim of attracting students' attention in the feedback process. Located under an academic intranet and accessed through a standard web browser, OFES was part of a module's website that resembled the 'look-and-feel' of any standard course in a learning management system. More specifically, the website also contained tools for online asynchronous discussion (forum), self-assessment (quizzes), announcements, document and lecture notes management etc.

OFES initially enables tutors to construct a feedback form template for a specific formative assignment. This template can then be utilised to create and compile feedback comments and grades for each student. Once the tutor completes the assessment process, students can view their feedback and performance through a personalised and motivational environment that timely communicates the feedback in a manner that is manageable and in direct relation with the assessment criteria. This section describes the support provided to tutors, the design principles for the students' personal feedback space, the techniques used for facilitating the quality attributes of feedback and the overall architecture of OFES.

3.1 Tutors support for the composition of formative feedback

OFES enables the setup of a feedback form template through a user-friendly interface in which the tutor selects and specifies a number of mandatory and optional elements. As seen in figure 1, the interface for setting up a feedback form is divided into four parts:

- the first part includes basic information about the tutor (name and email).

- the second part requires details about the formative assignment. These details include an assignment title and number, as well as, details about the academic session in which the assignment was given.
- the third part allows the tutor to write the assessment criteria. Students' work will be evaluated against these specific criteria which should be clearly communicated to students in the assignment handout. This part of the feedback form's setup is dynamic since a tutor can dynamically add criteria by clicking the "Add Another Criterion" button. Furthermore, a tutor may choose to provide an individual mark for each assessment criterion. Enabling this option activates textboxes in which the tutor can type the percentage of the contribution of each of the assessment criteria towards the total final mark.
- the fourth and final part of the feedback form setup allows the tutor to specify four extra parameters. The parameter "Enable automatic late submission penalties", if checked, triggers a build-in algorithm that enforces the late submission penalty policy followed at the author's institution. More specifically, there is a 5% reduction in the mark that would have been awarded for each day that has passed between the original submission date and when the work is handed in, for a maximum of 7 days. The second parameter relates to plagiarism. If checked, the tutor will have to provide for each student, information from an external plagiarism detection system, such as percentage of matching content, which may result in the reduction of a student's mark. The final two options "Enable motivational images" and "Allow students to view class performance statistics" are explained in sections 3.2.2 and 3.3 respectively.

Figure 1: Feedback form template setup interface

Having completed the process of setting the parameters and creating a feedback form template, the tutor can proceed to fill out a feedback form for each individual student. Student names and identification numbers are already inserted in the system in a manner similar used in most learning management systems. OFES can display an alphabetical list of registered students (figure 2) through which a tutor can easily invoke a specific student's feedback form by clicking a corresponding "Edit" link. The specific list also informs the tutor about the assessment status (completed or pending) for each student. Once the assessment process has been completed for all students, a tutor can allow students to see their feedback and performance by clicking the "Enable Feedback to Students" button.

PRACTICAL 1 ASSESSMENT			
Student ID:	Student Name:	Assessment Status:	
CS22295	Aleksov Olga	COMPLETED	[Edit]
CS22121	Antoniadis Georgios	COMPLETED	[Edit]
CS22432	Belovska Mariana	PENDING	[Edit]
CS22197	Chervenkov Alex	COMPLETED	[Edit]
CS22322	Christoforidis Petros	PENDING	[Edit]
CS22348	Djordjevic Anton	PENDING	[Edit]
CS22274	Fotiadis Nikolaos	COMPLETED	[Edit]
CS22652	Georgiadou Natasa	PENDING	[Edit]

Students cannot view feedback at the moment.

ENABLE FEEDBACK TO STUDENTS
DISABLE FEEDBACK TO STUDENTS

Figure 2: Assessment status student list

As discussed in section 5, all the above functionalities of OFES provide just basic support for a tutor and many enhancements are possible. The primary aim of OFES, however, was student engagement in the formative feedback process and, as a result, the emphasis was placed in creating a motivational and stimulating feedback environment for the student.

3.2 Design principles of the student feedback space

Receiving feedback is inherently related to emotion (Higgins, 2000). This is especially true in the case of bad performance where students may feel embarrassment, guilt, anxiety, lack of confidence, confusion, discouragement etc. Therefore, in order to engage students in the feedback process, one must consider students' feelings and tactics for stimulating motivation. Student motivation is a quality that pervades all aspects of learning and, as a result, it is closely associated with the success or failure of any e-learning system.

While the primary design principle of OFES is the facilitation and integration of the five quality attributes of feedback into an online environment, Keller's ARCS model (Keller, 1987; 1988) was used as the underlying motivational strategy. According to the ARCS model, motivation in the learning process is promoted and sustained through four elements: Attention, Relevance, Confidence and Satisfaction (ARCS). OFES facilitates the quality attributes of feedback by incorporating these four elements in the overall design of the system in the following ways:

- students' attention is gained and maintained are through affective stimuli and the use of a small amount of humor
- relevance is established by using concepts that are related to students' experiences and by structuring feedback in a way that directly relates to the assessment criteria
- confidence is instilled by establishing an overall positive setting in order to establish the students' belief in their ability to achieve and by making students aware of performance requirements and evaluative criteria.
- last but not least, student satisfaction is nurtured by providing a sense of achievement through extrinsic rewards for the learning experience and by assuring the equity of these rewards so that they match student achievements.

The following section explains the specific techniques that were used to facilitate and integrate the five quality attributes of feedback (personalisation, motivation, timeliness, manageability and direct relation to assessment criteria) into a motivational learning environment.

3.2.1 Personalisation

OFES provides students with a personal feedback space, access to which requires authentication (through the academic intranet). This secure personal space individualises the system and enables

tutors to provide detailed and personalised feedback. Furthermore, it also ensures privacy since students can only view their own feedback. After a successful login into the personal feedback space, a student is presented with the screen depicted in figure 3 below.

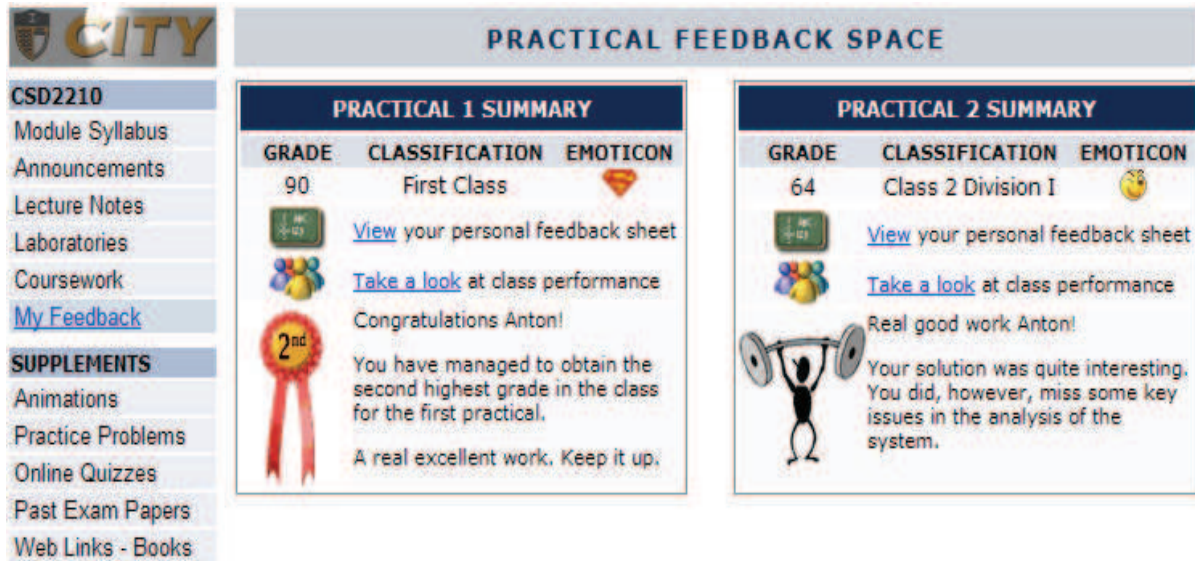


Figure 3: Summary of performance

The above system screen is a personal performance summary of a student's formative assessment. Each summary consists of the assignment's grade and classification, as well as two motivational elements which are explained in the next section. It also provides a student with the ability to access personal feedback comments and class performance statistics.

The second technique used in the attempt to create a more personalised environment relates to how the student is addressed. In an effort to ensure an effective and affective way of communicating the feedback, the student is addressed throughout the system by the first name. This closes the distance between a tutor and a student and demonstrates a pastoral care for the student and an overall friendlier setting. The tutor can choose where exactly to add the student's first name, a functionality that is achieved by typing the predefined message [Student_First_Name]. Last but not least, we use the term "My feedback" in order to access OFES (figure 3). This is done in order to give a sense of ownership that the feedback is tailored for each student specifically.

3.2.2 Motivation

Since one of the primary aims of the OFES tool was to encourage engagement in the feedback process, providing a highly motivational feedback environment was one of the most challenging but also most important tasks. OFES had to be used as a leverage to motivate students to engage and remain in the learning process and to encourage them to view their current state of understanding and competences and reflect upon them, regardless of performance.

OFES attempts to incorporate motivational qualities and establish positive emotions through the use of graphics that are to some extent humorous. Research studies that investigated the connection between humor and learning indicate that humor can increase student motivation and attention, and reduce stress (Flowers, 2001; Hativa, 2001). In addition, positive emotions build students' self-confidence (Race, 2006) especially if a student's performance is weak. The personal performance summary depicted in figure 3 includes two images and a motivational message. These currently predefined images are automatically retrieved and displayed depending on the performance of the student. The first image is an emoticon. These representations of a facial expression are very popular since they are used in chatting and messaging applications on the Internet. The second image is an animated graphic that acts either as a reward for good performance (e.g. a shining trophy or gold medal) or as motivation for improvement (e.g. a man working out or lifting weights) for performance that was weak. Lastly, the motivational message aims to encourage students in taking an appropriate course of action, such as to try harder or visit the tutor. These motivational techniques were very appealing to students as discussed in section 4.

3.2.3 Direct relation with assessment criteria

As discussed in section 2.1, feedback needs to be in direct relation with assessment criteria. This relation can be facilitated by the structure of the feedback form. OFES generates for each student a personal feedback form (figure 4) that consists of three sections. The bottom section enables students to save or print the feedback form or email the tutor. The middle section contains an area where the tutor provides constructive comments on the overall effort and performance of the students, as well as, details about the submission and the student's mark. The top section of the feedback form presents pairs of assessment criteria and tutor's feedback. This pairing technique attempts to make it easier to the students to relate the given feedback with specific assessment criteria. Last but not least, in case assessment is divided by the criteria, the system optionally enables tutors to set the grade of each individual assessment criterion.





DATA STRUCTURES AND ALGORITHMS			
PRACTICAL FEEDBACK FORM			
STUDENT NAME: Tsigularov Anton			SESSION: FALL 2006
Assessment Criterion or Learning Outcome	Percentage	Awarded Grade	Feedback Comments
Assessment Criterion 1	25%	55	Detailed comments related to the specific assessment criterion or learning outcome
Assessment Criterion 2	20%	72	Detailed comments related to the specific assessment criterion or learning outcome
Assessment Criterion 3	20%	63	Detailed comments related to the specific assessment criterion or learning outcome
Assessment Criterion 4	35%	67	Detailed comments related to the specific assessment criterion or learning outcome
OVERALL COMMENTS			
Dear [Student_First_Name], Overall comments about the assignment can be typed here.			
Days Late: 0	Late Submission Penalty: None	TurnItIn: Submitted	FINAL MARK: 65
SAVE FEEDBACK FORM 	Instructor: Thanos Hatziapostolou		
PRINT FEEDBACK FORM 	Email the Instructor		
CLOSE THIS WINDOW 			

Figure 4: Student personal feedback form

3.2.4 Manageability

OFES integrates the manageability quality of feedback in terms of simplicity and user friendliness. Its intuitive visual interface comprises of clearly arranged components which can be browsed through unambiguous navigation options. Furthermore, the feedback form is composed of well-defined sections that are properly organised. These design characteristics attempt to minimise student disorientation and perplexities and enable them to easily identify and interpret the feedback.

3.2.5 Timeliness

Clearly, the time that it takes to provide formative feedback to students is in the hands of the tutor. The ability of OFES to enhance the timeliness of feedback is perceived from two viewpoints. Firstly, students are immediately informed when the feedback is ready. This is achieved through an automatic e-mail that is sent to the students when the tutor completes the assessment procedure. Secondly, once feedback becomes available, students can easily access it at any time. This constant availability and easy access to the feedback is very important since students can use it for future assessments.

3.3 Class performance statistics

While OFES was designed to be a personalised feedback mechanism, data that may be of interest to all the students should be supported. An example of such data is class performance. Information about class performance provides students with the ability to assess their performance relative to that of their peers. Class performance is presented in two different methods (figure 5). The first method depicts a bar-chart that categorises performance by classification and also includes details such as the number of assignments submitted, average mark and late submissions. The second view is a sortable list of student identification numbers, grades and related emoticons.

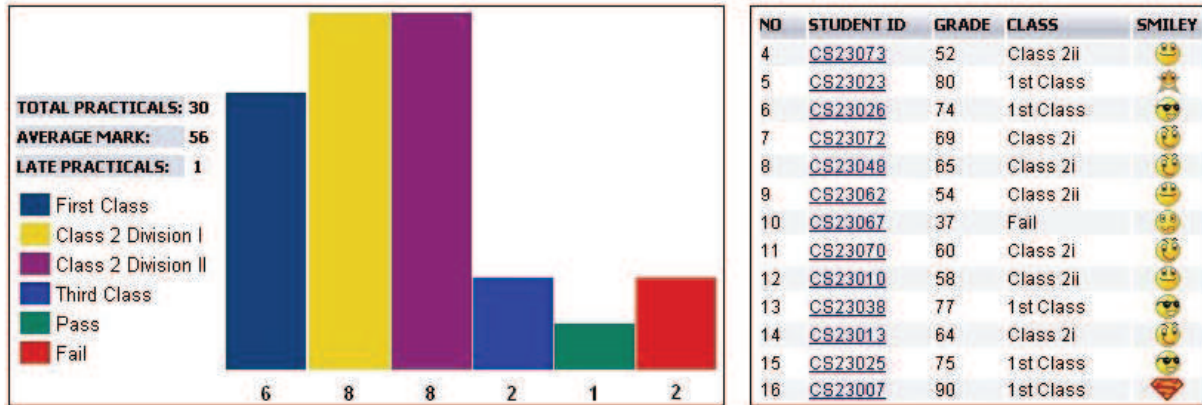


Figure 5: Class performance statistics

3.4 OFES architecture and technologies used

OFES is a conventional, web-based application. Its architecture encompasses a presentation layer (web browser), an application layer (web server) and a data layer (database server). The web browser is used as a user interface mechanism and except support for Javascript, it does not require any plug-ins or additional components. All functionality resides in the web server which communicates with the database server in order to store or retrieve data. The database server (MySQL) stores information about the students (names, identification numbers, email addresses and passwords), the image library, the elements and structure of feedback form templates and finally, students' grades and feedback comments.

OFES operates under an academic intranet which requires students to login by providing a username and a password. The username is used to uniquely identify each student, enable personalised feedback and ensure security. The technologies that were used for the implementation of OFES include the PHP scripting language for the application's functionality, HTML 4.01 and Cascading Style Sheets (CSS) for the interface and presentation and Javascript for validation purposes.

4. Case study and evaluation

OFES was first used to provide formative feedback for the assessment of Data Structures and Algorithms (DSA), a second level unit for the BSc in Computer Science. This unit is primarily assessed through an individual project-based assignment which covers a significant number of the learning outcomes of the unit. In order to successfully complete this assessment, students have to demonstrate competence in all six levels of the cognitive domain identified by (Bloom, 1956), namely knowledge, comprehension, application, analysis, synthesis, and evaluation. The assignment aims to build students' understanding and competences in analysing, designing and implementing quality software. Such skills are required not only for subsequent assessments of the unit, but also by other units in the BSc programme, as well as, students' professional career. As a result, such an important formative assessment requires quality feedback. However, having taught the unit for four consecutive years (2001-2004), we realised that students were not motivated to engage in the feedback process. Despite the personalised and detailed feedback forms that were prepared, every semester there was a large percentage of students that did not collect or did not pay the required attention to accompanying feedback. This issue drove us to search for alternatives ways for producing and communicating feedback which, in turn, led to the development of OFES.

The OFES tool was used in 2005 in a class of 46 students and in 2006 in a class of 34 students. In 2007, we migrated from an academic intranet to an open source learning management system. This migration temporarily ceased the operation of OFES. While concrete evidence regarding the effectiveness of OFES would require long qualitative and/or quantitative analysis, during the two years of its operation there were some encouraging and promising signs that OFES was perceived by the students as an effective and efficient feedback mechanism. These indications include:

- All students accessed OFES. Records kept by the system during 2005 and 2006, revealed that 100% of the students accessed their personal online feedback forms, as well as, the information about class performance.
- Statistics kept by OFES also revealed that a significant number of students (35% in 2005 and 32% in 2006) revisited OFES before the final exams. This might be perceived as an indication that students considered the feedback a valuable source of information regarding their exam preparation.
- OFES appears to be warmly welcomed by the students. The appreciation of the system and the way that it operates is demonstrated by a number of anonymous posts that students made in the unit's discussion forum. Some of these comments include: *"very motivational feedback"*, *"I will try to get a superman next time"*, *"programming is not as easy as body-building, but I will certainly try harder"*.
- OFES also appears to be an efficient and prompt communication mechanism and helped students understand their feedback and the mark allocated to them. This indication comes from the lecturer's end-of-semester students evaluations. During the two years that OFES was used, a greater number of students believed that they received their marks and feedback in a timely manner and understood the mark allocated to their work. This is signified from a sharp increase in the fields "timing of marks and feedback" and "clarity of marking" in the lecturer's evaluations.

The above encouraging indications suggest that the integration of OFES in a learning management system would probably have a positive impact on students' motivation and reception of formative feedback. The development of OFES as a module that can be seamlessly integrated into the college's open source learning management system (Claroline) is work that is currently in progress.

5. Discussion and enhancements

OFES was developed having as primary goals to effectively communicate formative feedback and to engage students in the feedback process. While the system is considered successful in meeting its primary goals in motivating students to engage in the feedback process, the fact that it was developed to meet the needs of a specific unit inherently limits its parameterisation and leaves room for many improvements. The following table summarises a list of key improvements for both instructors and students users of OFES.

Table 1: Possible OFES enhancements

Improvements for instructors	Improvements for students
support the creation and use of rubrics support feedback for groupwork assignments parametrisation of the marking scale and late submission penalty rules parametrisation of motivational images and messages	enable reflection on feedback through private online communication with the lecturer separation of feedback comments according to strengths and weaknesses for each assessment criterion

While all the above enhancements are straightforward, the major challenge in using any formative feedback system is the amount of time that is required to compose the feedback. It is true that producing detailed, personalised and timely feedback requires considerable time and effort, especially for large classes. Heavy workload of higher education academic staff and increased student numbers may lead to reduced details and an overall compromise in the quality of feedback. On the other hand, feedback is central to student learning. As a result, innovative and efficient tools that can support the educator in the activity of formative assessment are required. OFES allows an instructor to easily setup assessment criteria and personal feedback forms. However, the detailed feedback and personalised comments require considerable manual labour. Reducing instructor workload is very important and we are exploring a number of techniques that will be incorporated in the new version of the system.

6. Conclusions

Providing high quality formative feedback and assuring that students engage with it facilitates and promotes learning. Quality formative feedback needs to be timely, motivating, personalised, manageable and in direct relation to assessment criteria. In addition, in order to ensure that students engage with the feedback content an effective communication method is required. The effectiveness of the communication method can also be appraised against the quality characteristics of feedback. This paper presents OFES, a web-based tool for the provision of formative feedback. OFES attempts to be effective in motivating students to engage in the feedback process. In order to achieve this goal a number of techniques were explored in order to create a personalised and motivational online environment that timely communicates feedback in a manner that is manageable and in direct relation with the assessment criteria. OFES was utilised to provide formative feedback to a second level unit of an undergraduate programme in computer science. During the two years of its operation, a number of indications suggest that the tool was successful in increasing student motivation and reception of feedback. These indications have strongly encouraged us to consider the deployment of OFES as a module of an open source learning management system in order to fully explore its effectiveness. We are currently exploring this integration, as well as, further developments of the tool through the exploitation of Web 2.0 technologies.

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