RETHINKING FEEDBACK IN A CONNECTED AGE

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Abstract

Feedback has long been identified as a core component in the learning process and remains a regular subject of academic research. It can be performed in several forms, for different purposes but the literature emphasizes the undeniable power of feedback on the achievement and development of learning outcomes.

This article presents a reflexion about current trends on feedback in higher education and seeks to contribute to deepening the theme and the diverse issues related, in a comprehensive and integrative perspective of the various aspects involved. Different approaches to the concept of feedback, the characteristics of effective feedback, strategies of successful feedback examples and best practices will be considered.

We will address recent issues in the literature on the power and challenges of providing feedback in a connected age through technology. There are few instruments that assess the frequency, type and impact of feedback in classrooms, however the enormous quantity of data produced surrounding the interactions in Virtual Learning Environments provides a valuable material to the Learning Analytics field that can be used to improve feedback practices. This research seeks to enhance the learning process over the analysis of dataset to provide informative feedback to learners and educators.

In addition, based on a reflexive approach supported by our professional experience performed in the *Moodle* platform we present some results of how feedback can be used to optimize mathematical understanding. We will also present a brief analysis of the data collected in a survey that seeks to increase the knowledge about students' perceptions regarding this issue.

Keywords: Feedback, formative assessment, analytics, mathematics, higher education.

1 INTRODUCTION

The importance of feedback on the achievement and development of learning outcomes has long been identified by teachers and remains a regular subject of academic research in higher education. Is crucial to formative assessment and to the development of effective learning ([1],[2],[3],[4],[5]).

Nowadays Virtual Learning Environments (VLE) are widely used in all degrees of teaching due to its great power in the improvement of teaching and learning process. The students' interactions in VLE produce an enormous quantity of data that can be used by Learning Analytics to understand and support learning processes. In VLE such as Moodle several alternatives to support feedback are possible.

The present work shows some types of feedback used in Mathematics formative tests developed in the Moodle platform at *MatActiva* project. This project arises in 2007 at Institute of Accounting and Administration of Porto (ISCAP) and uses the interactivity of Moodle to help students to improve learning and levels of success in the subjects of Mathematics [6].

A database of questions was created and organized into categories and subcategories, on several topics. The combination of questions in each category is randomized and it generates a high number of different formative tests that students can solve and submit online.

This paper is structured in the following way: section 2 presents a literature review about different approaches to the concept of feedback, the characteristics and strategies to successful feedback integrated in the technology age and the Learning Analytic field. Section 3 describes several kinds of feedback available in Moodle. We apply to Learning Analytics field using the data collected from Moodle Report to provide feedback to teacher in validating database questions. Furthermore, the feedback by question provided to students in formative tests is analysed. We conclude with some considerations in Section 4.

2 LITERATURE REVIEW

A large amount of research recognizes the importance of assessment for the various actors involved in the teaching and learning process: students, teachers and those who are responsible for the development and accreditation of courses in higher education [7]. As a regulatory process of teaching, assessment provides information about students' learning and allows adjusting procedures to achieve the curricular objectives.

There are two major forms of assessment: formative and summative, each with different objectives and purposes. By summative assessment we should understand the measurement of what students have learned at the end of an instructional unit. The goal of summative assessment is to determine if students have achieved specific competencies [8]. Some authors use the term *assessment of learning* and refer to its slightly utility in supporting learning since feedback becomes available only after the learning activities. It stands in contrast to formative assessment referred as *assessment of learning in progress* [9] to emphasize its regulating nature of the learning process. This kind of assessment measures performance compared to goals and is used to give guidance to learner's improvement. In [10, p. 158] is highlighted the role of the information provided by formative assessment to "better shape teaching and learning".

Closely linked with assessment is the feedback concept. Research suggests that formative assessment is an effective strategy for enhancing student learning and that effective feedback leads to learning gains ([9], [11], [12], [13], [14]).

In this work, we are particularly interested in deepening the subject of feedback in higher education. Although it is a very important issue to the development of effective learning ([1],[2],[3],[4],[5]) the number of studies carried out in higher education is small when compared to other sectors [5].

In the nineties [15, p. 53] use the term feedback in a broad sense to refer to "any information that is provided to the performer of any action about that performance". Few years later, [13, p. 81] define feedback as "information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding". More generally [16, p. 25] writes, "feedback is information about how we are doing in our efforts to reach a goal", and establishes criteria for effective feedback. This author considers that helpful feedback should be goal-referenced, tangible and transparent, actionable, user-friendly, timely, ongoing and consistent.

Considering good feedback practices [11, p. 205] clarify the concept as "anything that might strengthen the students' capacity to self-regulate their own performance" and identify seven guiding principles. Good feedback pratice

- helps clarify what good performance is (goals, criteria, expected standards);
- facilitates the development of self-assessment (reflection) in learning;
- delivers high quality information to students about their learning;
- encourages teacher and peer dialogue around learning;
- encourages positive motivational beliefs and self-esteem;
- provides opportunities to close the gap between current and desired performance;
- provides information to teachers that can be used to help shape teaching.

[13] distinguish four levels of feedback according the focus: feedback about the task (intend to clarify and reinforce aspects of the learning task), about the processing of the task (focuses on what a student can do to proceed with a learning task), about self-regulation (how a student can monitor and evaluate the strategies used), and about the self as a person (focuses on personal attributes). It should be noted the connection between levels and the tasks' nature and that the level at which feedback is directed influences its effectiveness. So, it is of greatest importance to drive feedback to the right level in order to assist students' comprehension and engagement. According to these authors, to be effective, "feedback needs to be clear, purposeful, meaningful, and compatible with students' prior knowledge and to provide logical connections" [13, p. 104].

[17] characterize several types and timing of feedback. With regard to the former the author identifies three types: knowledge of results (KR), knowledge of correct response (KCR) and elaborated feedback (EF). Concerning time [17] discriminates between *immediate* and *delayed* feedback and point out the differences among the two. While immediate feedback is provided right after a student response to an item, delayed feedback varies in degree and it may be after a student finishes a test or

a few hours or days later. In computer-based environment the concept of delayed feedback is defined as “all feedback that is not delivered immediately after completing each item” [18, p. 23].

The importance of the timing of feedback is reported by numerous studies ([19],[20]) and if the feedback is not timely it may become irrelevant to the students [21]. Recent research suggest that students value more immediate feedback [22].

Investigating students’ perspectives on some aspects of feedback delivery, such as timeliness, legibility and feedback format (written, oral), as well as students’ use of and engagement with feedback, [21, p. 26] concludes that individual verbal feedback was most effective followed by email written feedback and written feedback on the cover sheet. Less conclusive are other forms of feedback, namely “group feedback on the Learning Network, group feedback in a seminar or lecture, feedback from peers, or discussion of work in groups”. Students in this study consider feedback timely only if it does not exceed two weeks. Both immediate and delayed feedback can be useful, dependent on the user, task and the learning context ([23],[24]).

Although some guidelines to effective feedback exist, that there are no universal type for all learners and learning outcomes [17].

In the higher education context the concept of *feedback from peers* has recently emerged as one way of engaging students actively with feedback processes. The idea is “that students evaluate and make judgements about the work of their peers and construct a written feedback commentary” [25, p. 103]. The authors emphasize peer feedback as an important alternative to teacher feedback able to enhance students’ learning, however without overloading the teacher.

[25] point out several reasons for the effectiveness of *feedback from peers*: students use language that is more accessible and closer to peers, different perspectives promotes knowledge when multiple peers are involved and the feedback received can be directly applied to update the task being quickly incorporated.

Virtual Learning Environments (VLE) are widely used in all degrees of teaching involving various subjects. Higher education institutions are using VLE to reach a great amount of students in different geographical areas and courses. A growing number of higher education institutions uses computer-based educational systems to e-learning or b-learning and the enormous quantity of data produced surrounding the interactions in VLE provides a valuable material to a new research field, called Learning Analytics (LA). LA has emerged in the last years and is gaining interest in different areas [26]. The focus of interest in LA to educators is how this data can be used to improve teaching and learning [27]. Here the feedback concept enters as a cycle: the feedback obtained through the data is used by teachers to analyze the process and then incorporated to provide students with more effective feedback. The vast amounts of available data can be used to improve feedback practices using, for instance, Google Analytics or/and using information retrieve from a Learning Management Systems (LMS) like Moodle [28].

Computer-based environments make available several kinds of activities and tests and allow providing students with feedback immediately since it is automatically given after students’ response. Several feedback alternatives are possible, namely indicating if an answer is correct or incorrect, providing the correct answer, supplying hints to achieve the correct answer, examples or explanations [29]. Useful feedback offers to students specific comments about errors and provides suggestions for improvement within a model of self-regulated learning. Furthermore, encourages students to focus their attention on a specific task rather than on getting the right answer [30].

Investigating the effect on students’ learning outcomes of providing different types of feedback in a computer-based environment, [24] concluded that more elaborated feedback (e.g. providing an explanation) produces larger effect than simple feedback regarding only the correctness of the answer. This effect was most noticeable in mathematics comparatively to social sciences, sciences and languages.

3 FEEDBACK ANALYSIS

3.1 Moodle feedback to teachers

In this section we show an example how this kind of information can guide teachers in the construction of questions/quiz and improve the feedback practices. In Table 1 we see information retrieved from Moodle about six multiple-choice questions belonging to the same category (Matrices) from the

MatActiva database[1]. The first column display the Question name, the second and third columns present two measures provided by Moodle Report.

Table 1. *Information retrieved from Moodle Report.*

Question name	Facility Index	Discrimination Index
Matrix 01	63.12%	63.19%
Matrix 02	71.43%	59.12%
Matrix 03	72.38%	55.28%
Matrix 04	-9.17%	-18.13%
Matrix 05	6.67%	45.57%
Matrix 06	29.63%	60.33%

The Facility Index (FI) can be defined as a "measure of the difficulty of an item, with a high value indicating an easy item and a low value indicating a difficult item" [31, p. 3] and MoodleDocs defines this index as "the mean score of students on the item" [32].

Table 2. *Facility Index interpretation [32].*

FI (%)	Interpretation
5 or less	Extremely difficult or something wrong with the question
6 – 10	Very difficult
11 – 20	Difficult
21 – 34	Moderately difficult
35 – 64	About right for the average student
65 – 80	Fairly easy
81 – 89	Easy
90 – 94	Very easy
95 – 100	Extremely easy

The Discrimination Index (DI), is "a measure of how the candidates perform on this question as opposed to another measure of performance" [31, p. 5]. MoodleDocs defines this index as "the correlation between the weighted scores on the question and those on the rest of the test. It indicates how effective the question is at sorting out able students from those who are less able" [32]. In questions with high DI "good" students should get right answer and "bad" students should miss the answer.

Table 3. *Discrimination Index interpretation [32].*

DI (%)	Interpretation
50 and above	Very good discrimination
30 – 50	Adequate discrimination
20 – 29	Weak discrimination
0 – 19	Very weak discrimination
Negative	Question probably invalid

[31] suggests that:

- is desirable that Facility Index range between 15% and 85%
- the Discrimination Index should always be positive, unless there is good reason to suppose that the assumption of unidimensionality (all questions are testing a single content area or skill) has been violated
- negative Index Discriminations with a valid criterion should always be regarded as suspect
- the higher the correlation the better the Index Discrimination and the better the question.

[1] We choose those questions as illustrative example.

Observing Table 1 and taking into account previous considerations, the indices of question 04 stand out. So, follow the consensus about the score in those items, it is necessary to analyse what is wrong with it: lack of some information, some problems with LaTex equation (in Math questions), problems with interpretation, lack some word, etc. After verify those aspects, if nothing is wrong this question must be eliminated from the database.

The low FI in question 5 demonstrates the high degree of difficulty of this question. Although it is very difficult, the discrimination is near the good discrimination which demonstrates the importance of using the two indexes together. Question 6 is a balanced question, moderately difficult with a very good DI.

3.2 Moodle feedback to students

3.2.1 Feedback for a Quiz in Moodle

Moodle enables instructors to create quite a few different kinds of feedback for a quiz. We can say that there are two types of feedback: Overall Feedback (OF) and General Feedback (GF).

✦ *Overall Feedback*

This kind of feedback uses a feature called Grade Boundary. The OF feature can be created for the entire quiz that changes with the student's score, that will automatically display a general message to students after they have completed an attempt at the quiz. The text that is shown depends on the grade the student got.

The quiz setup area has five preset areas for OF, and all or none of them can be utilized. The two default boundaries are 100% and 0%. Any feedback in the first area, without creating other internal boundaries (i.e., 90%, 75%, 50%), would then apply to all students that completed the quiz.

For example (see Fig. 1), if you entered:

Grade boundary: 100%

Feedback: "Muito bem! Pode prosseguir para o Teste Diagnóstico - Nível 3", translated into English by "Well done! You can continue for the next level -3"

Grade boundary: 75%

Feedback: "Bom! Continue pois pode melhorar o seu desempenho e prosseguir para o Teste Diagnóstico - Nível 3", translated into English by "Good! You can still improve your performance, but you continue for the next level -3"

Grade boundary: 50%

Feedback: "Não deverá prosseguir para o nível seguinte. Para atingir os objectivos mínimos precisa de estudar um pouco mais", translated into English by "You shoudn't proceed to the next level. To achieve minimum goals you need to study a little more"

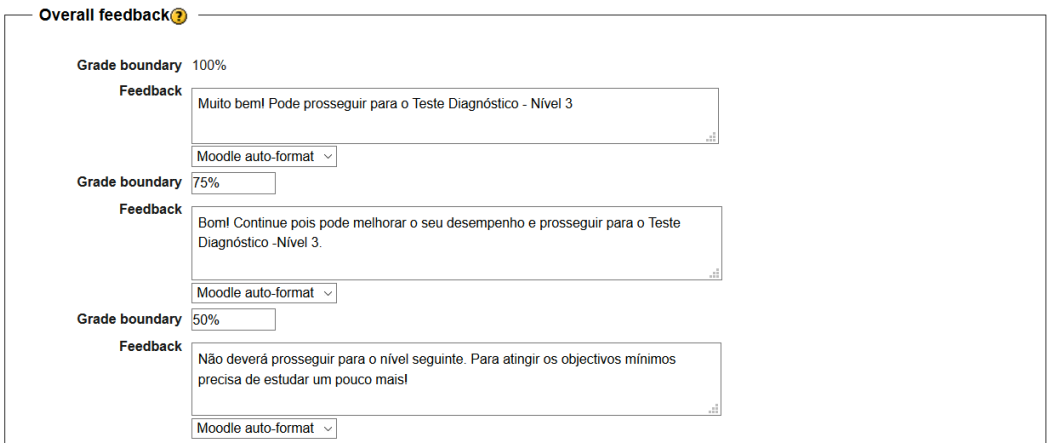

Figure 1. Screenshot of an Overall feedback with grade boundaries of a Diagnostic Test from MatActiva Project.

In this example, only one choice from four options is correct and all other answers are incorrect. In the bottom of the page (see Fig.3), under Combined Feedback for any incorrect response, we can use this feedback to show the solution, step by step, if the student selects one of the incorrect responses. This feedback gives a suggestion of how the question can be solved.

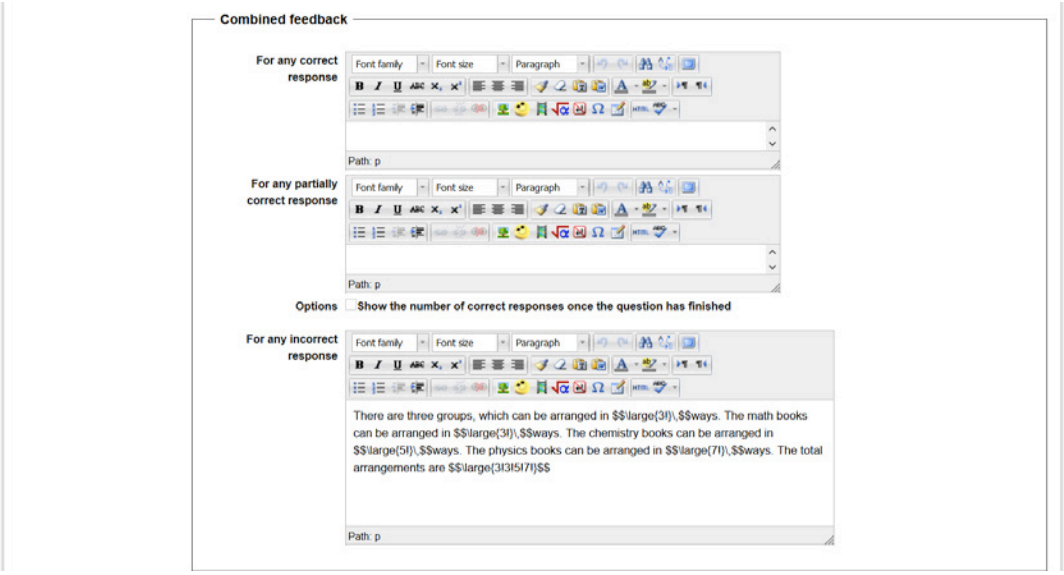

Figure 3. Screenshot of a combined feedback from a multiple-choice question in Moodle.

Feedback for a Numeric Question

In a numeric question (see Fig. 4) we only have the GF and this one can explain how to solve the question, step by step. This feedback is displayed to the students after they have answered the question, independently if they have a correct or incorrect question. So, if the student guessed the answer, or has a wrong answer or solved the problem using a different method, with this kind of feedback which explains the solution can help student to learn how to solve it.

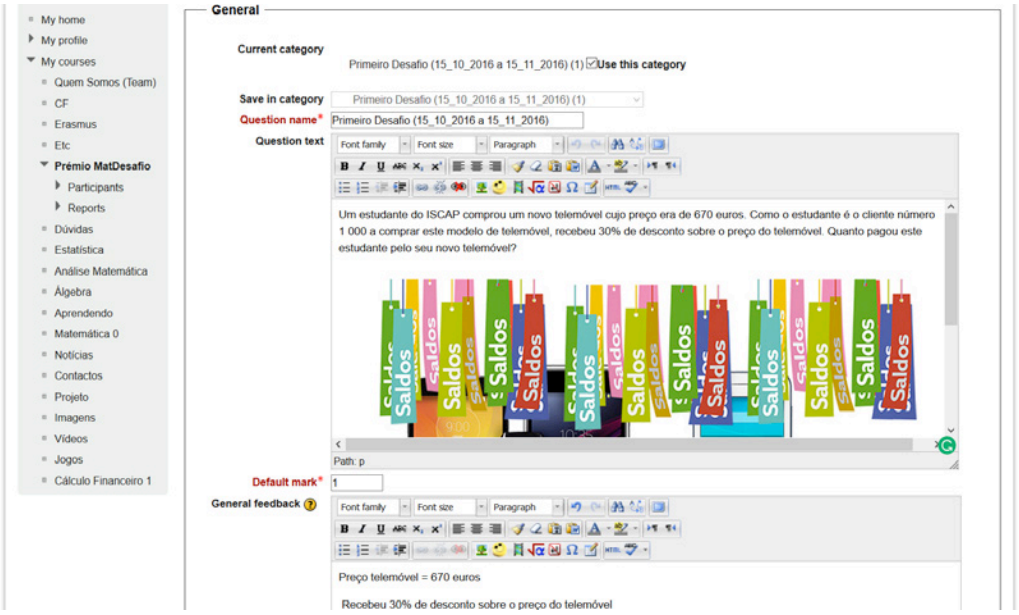

Figure 4. Screenshot of the general feedback of a numeric question in Moodle.

3.2.2 Moodle MyFeedback Report

The *Moodle MyFeedback* report is being developed as part of a University College London (UCL) project to improve access to assessment feedback by both students and staff. This combines

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