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Automatic feedback, self-regulated learning and social comparison: A case study

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Abstract

Formative assessment is one of the main challenges facing MOOC research and practice. Providing timely and personalized feedback to large cohorts of learners poses issues in terms of scalability and sustainability. This paper puts forward a proposal for automated feedback well suited for assessing non-declarative knowledge. The proposed feedback strategy consists in displaying a comparison of responses and behaviors of individual participants with descriptive statistics reflecting the same data for the entire cohort. To investigate the usefulness and potential of this feedback strategy, quali-quantitative data were collected during a MOOC on learning design. Self-reported data about usefulness (for both responses and behaviors) were statistically above the mid-point of the scale, with no significant difference between the two types of data. Suggestions on how to improve this feedback strategy were also drawn from interviews with subjects.

Keywords: Social Comparison; Automatic Feedback; Learning Analytics; Self-Regulated Learning

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Introduction

The role and importance of assessment in learning processes is undisputed, given that the information that assessment yields can be used by learners, teachers and policy makers alike to improve those very processes (Gardner, 2012; Gibbs & Simpson, 2005). With the shift in the way scholars conceptualize learning in formal and informal contexts from knowledge transmission to a self-regulated or self-directed knowledge-building process, much more attention is now being focused on formative assessment (Boud, 1995) than on summative assessment. Formative assessment has been defined as "assessment that is specifically intended to provide feedback on performance to improve and accelerate learning" (Sadler, 1998, p. 77). The concept of formative assessment is often set against that of summative assessment, which aims to produce a measure of what students have learnt at the end of the learning process. Typically, this measure takes the form of a mark or judgement of the degree to which outcomes from the process compare to a standard and is mostly for the purposes of accountability and certification (Alvino & Persico, 2009). Several authors agree that where efforts to promote self-regulated or self-directed learning are concerned, it is formative assessment and its related concept of formative feedback that are most important (Grion & Serbati, 2019; Nicol & Milligan, 2006; Tonelli, Grion, & Serbati, 2018).

Self-Regulated Learning (SRL) has been defined as the process through which an individual actively and consciously controls their own learning in terms of cognition, motivation and affect, and behavior (Zimmerman, 2001; Pintrich, 2004; Persico & Steffens, 2017). Learning among professionals increasingly relies on the individual's control of their own learning, up to the point that – besides making decisions about how and when to learn - they decide in full autonomy *what* they want to learn.

In recent years, summative and formative e-assessment has attracted the attention of many researchers (Pachler, Daly, Mor, & Mellar, 2010). The push behind this interest has come from both a theoretical-methodological direction, regarding the need for a better alignment of assessment practices with pedagogical innovation, and

the pragmatic sphere, wherein the global scale of distance education has highlighted the need to provide sustainable, though individualised, feedback to large cohorts of online course participants. This is one of the main challenges facing Massive Open Online Course (MOOC) research and practice (Hew & Cheung, 2014; Admiraal, Huisman & Pilli, 2015). Regardless of the pedagogical approach adopted, MOOCs rely heavily on the self-regulated learning skills of their participants (Admiraal et al., 2015), who are expected to monitor their own learning and actively engage in their own assessment. With the rise in popularity of MOOCs, researchers have started to focus on how to leverage Learning Analytics (LA) tools for producing effective, scalable and sustainable feedback (Liyanagunawardena, Adams, & Williams 2013; Raffaghelli, Cucchiara & Persico, 2015). LA tools facilitate monitoring of the learning progress by visualizing individual performance regarding the course objectives. These tools are built in such a way as to comply to the seven principles of good feedback practice formulated by Nicol and Macfarlane-Dick (2006). These establish that good formative feedback (1) helps clarify what good performance is; (2) facilitates the development of self-assessment (or internal feedback); (3) delivers high quality information to students about learning; (4) encourages teacher and peer dialogue about learning; (5) encourages positive motivational beliefs and self-esteem; (6) provides opportunities to close the gap between current and desired performance; (7) provides information to teachers that can be used to help shape the teaching.

Overall, the methods adopted to assess learners' performance and provide them with feedback include automatic tests, e-portfolios, and approaches that leverage learners' ability to produce internal feedback (Nicol, 2019) through comparison with peers' performance or course objectives (e.g., learning dashboards, badges) (Cucchiara, Giglio, Persico, Raffaghelli, 2014; Manganello, Pozzi, Passarelli, Persico, Dagnino, 2021). One such method is peer review, an extremely popular and widely investigated practice (Suen, 2014). As it turns out, the power of peer review is not much in the effectiveness of the feedback learners receive, but rather in the reflection process triggered by the activity of assessing someone else's work after having engaged in the same type of

task (Li, Liu, & Steckelberg, 2010). However, while the potential of peer review in Technology Enhanced Learning Environments has been thoroughly investigated (Amendola & Miceli, 2018; Tseng & Tsai, 2007), other forms of peer learning triggered by formative feedback based on comparison with peers' performance recently attracted attention (Li & Grion, 2019; Serbati & Grion, 2019; Davis, Jivet, Kizilcec, Chen, Hauff, & Houben, 2017). This type of feedback is particularly useful when there is no "standard" against which learning outcomes can be compared, because not only is there no right or wrong response to the assessment task, but there is not even a basis for considering performances better or worse.

These are cases where online learners need feedback that triggers reflection on the course content and helps them develop their competence by comparing their work or beliefs to those of their peers. Forum discussions involving tutors and peers can be beneficial. However, when large cohorts of course participants are involved, such discussions can be chaotic; following a multitude of different threads can be discouraging, dispersive and time consuming for both participants and tutors. In addition, in some MOOCs, people enroll in the course at different times, often with different learning aims, and work through it in highly different ways. This is frequently the case when MOOC participants are adult, self-regulated professionals.

In this paper, we present the case of in-service teachers participating in a MOOC on Learning Design (LD), with special focus on how participants develop their own SRL competence as well as that of their students. In order to foster the teachers' reflection on these subjects, the course entailed frequent online discussions, a hands-on design activity with a LD tool (Pozzi, Asensio-Perez, Ceregini, Dagnino, Dimitriadis, & Earp 2020), and the compilation of three different surveys proposed to participants at different stages of the course. The aim of this study was to investigate perceived usefulness of the above-described feedback strategy, which here consisted in showing participants how their own answers to the three surveys and their use of the LD tool were positioned with respect to those of the participant cohort.

More specifically, the research questions addressed in this exploratory study were defined as follows:

RQ1. What is the perceived usefulness of feedback based on comparison of the individual answers to the three course surveys with descriptive statistics concerning the whole cohort? And what is the perceived usefulness of feedback based on comparison of individual use of the LD tool functionalities with descriptive statistics concerning usage by the whole cohort?

RQ2. Are there differences between perceived usefulness of these pieces of feedback (comparison of answers vs comparison of tool use)?

RQ3. How could the potential and usability of this feedback be improved?

Context of the study

The MOOC

The context of the study was a three week long MOOC on Learning Design entitled "Cenni di Progettazione Didattica" (Italian for "Basics of Learning Design"), with special focus on how to develop students' SRL skills (https://newdev.eduopen.org/eduopenv2/course_details.php?courseid=75). The MOOC was run on the EduOpen platform (Limone, 2016) and attracted 324 enrolments, with 93 active participants. The MOOC was part of a broader training path entitled "Teach different! Methodologies, tools, activities (Didatech)" involving a sequence of MOOCs addressing in-service teachers.

The aims of the "Basics of Learning Design" MOOC were to: Deepen participants' competence in Learning Design by drawing on their personal experience (Mor, Craft, & Hernández-Leo, 2013; Asensio-Pérez et al., 2017); introduce participants to systematic approaches to Learning Design; introduce the concept of SRL; foster reflection both on their own SRL strategies and on approaches for developing students' SRL skills in Technology Enhanced Learning Environments. In order to foster in-service teachers' reflection on these subjects, the course entailed a hands-on design activity with a LD tool called SRL-PP and the compilation of three surveys. Considering that the participants were professionals, we expected them to have their own learning goals with respect to the course content and a relatively high SRL capability.

Instruments of the MOOC

For the purpose of this study, we refer to five specific instruments adopted in the MOOC, specifically three surveys and two tools.

The three surveys were:

- A first survey intended to promote participants' meta-reflection on their own LD practices (LD Survey) set around the end of the first week of the MOOC;
- A second survey concerning their own SRL strategies (SRL-MQ; Littlejohn, Hood, Milligan, & Mustain, 2016), scheduled towards the end of the second week;
- A third survey (SRL for students) promoting all-round reflection on their own learning about SRL as a topic, scheduled at the end of the third week, that is at the end of the MOOC itself.

The actual data collected from these surveys are somewhat marginal with respect to the main purpose of this paper, which focuses instead on the usefulness of presenting participants with feedback on their own responses.

The two tools were:

- A tool for learning design, the SRL-PP, with specific functionalities to promote the design of teaching and learning activities intended to support SRL development. The SRL-PP is an adaptation of a tool for learning design called Pedagogical Planner (PP) (Pozzi et al., 2020) that has additional functions intended to foster the application of design principles for SRL development (Persico, 1997);
- A feedback tool in the form of a personal dashboard that was used to provide both feedback on the responses to the three surveys and LA-based feedback on participants' use of the SRL-PP. In the dashboard, participants were presented with their own results (item-by-item) for the three surveys and the behavioural analysis regarding the SRL-PP usage, compared to the average scored by course participants, and the minimum and maximum value. Participants were also asked to rate the usefulness of the feedback received on a scale from 1 (useless) to 5 (very useful), for each of the surveys and for the SRL-PP section.

Method

The MOOC involved 93 active participants (77.4% women). Out of these 93, 66 responded to the LD survey, 59 to the SRL strategies survey, and 56 to the SRL-for-students survey; data traces about usage of the SRL-LD tool were generated for 63 users. The feedback about survey responses and SRL-LD usage was provided all together at the end of the MOOC, and participants rated its usefulness just after they read it. As this happened at the very end of the Didatech training

Table 1. Dimensions of analysis, objectives and key questions explored during the interviews

Dimensions of analysis	Objectives	Key questions
Perceived Usefulness of the feedback received	Investigating the reasons for the rating attributed to feedback usefulness	(After the interviewee had been reminded of the rating they gave to the feedback) Why do you think the feedback was or wasn't useful? Can you recall any data from the feedback that were or weren't useful? Can you give examples?
Usefulness (in general) of feedback based on comparison with peers' responses	Investigating perceived usefulness of feedback based on comparison with peers' *responses* (in general)	Do you think comparison with peers' opinions and performance is a useful source of information to improve learning? Under what conditions?
Ease of Use	Understanding the reactions of the user to the way the feedback was represented	How long did it take to read the feedback provided? Was the tabular representation sufficiently clear and understandable? Would you have preferred this feedback to be expressed graphically (e.g., with diagrams - histograms, pies, ...) and/or verbally (with sentences instead of tables)?

path, only 31 participants (83.8 % women) rated the feedback strategy. To further investigate the research questions, we also conducted two semi-structured interviews with two course participants, the only ones who accepted to disclose their identity by volunteering to participate (M=1, F=1).

The interviews considered three different dimensions of analysis (see Table 1): The utility of the feedback method as perceived by the user; the general usefulness of feedback based on comparison with peers' collective responses; the reactions of the user arising from the experience of using the feedback tool (e.g., user experience, data visualization, ...).

The interviews were conducted remotely, recorded and lasted ~38' (USR1) and ~21' (USR2). The transcripts were analyzed following a thematic analysis approach (Braun & Clarke, 2006) to identify instances of content pertaining to our research objectives, as well as emerging themes and/or sub-themes.

Results

RQ.1 - Usefulness of the feedback

Data regarding the usefulness of feedback related to the surveys and the PP usage report were analysed using R 3.5.2 and R packages lme4 1.1-21, together with lmerTest 3.1-0.

In order to account for non-independence of observations, ratings on the usefulness of feedback were analysed using a linear mixed model which included the usefulness rating as a dependent variable, the object of evaluation (i.e., which survey/report the feedback referred to) as a predictor, and a random intercept for each participant.

Figure 1 represents the perceived usefulness of the feedback about the three surveys and the SRL-PP use. In order to answer Research Question 1 (RQ1), we computed estimated marginal means for the usefulness of feedback on each survey/report and tested them against the midpoint of the scale (3). All results were significant. Specifically, the usefulness of the feedback on the SRL-for-students survey was rated, on average, as 3.91 out of 5 [3.52, 4.30], $t(62.7) = 4.72$,

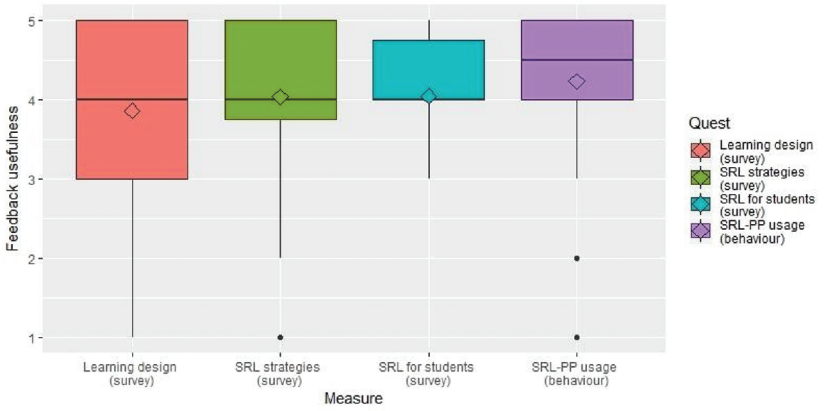

Figure 1. Box plot representing the perceived usefulness of the feedback.

Legend: Mean (rhombus), median (black line), interquartile range (box)

Table 2. Themes and sub-themes related to RQ.1 emerging from the interviews

Themes	Sub-themes	Significant quotes
Perceived usefulness of the feedback received	– Helping users in metacognition and explanation – Fostering further reflection – Providing users with a direct/explicit trigger for self-assessment	*[without this feedback] "I would have groped in the dark as I would have missed a comparison with the others... there were cases where I gave a lower rating than the others. I noted this, I drew my conclusions after the feedback. I looked for justifications after the feedback, right or wrong I do not know. It was a useful tool for metacognition, on our way of working too, [it's a] self-assessment task after all."* (USR1).
Usefulness (in general) of feedback based on comparison with peers' responses	Providing users with a benchmark against which to compare	*"It certainly is a useful tool: we (as teachers) also use feedback with our students, we always need feedback" (USR1)* *"Comparing myself with others was very useful [...] It was particularly useful in the context of a course on self-regulated learning "* (USR2)

$p < .001$). The usefulness of the feedback on SRL strategies was rated as 4.05 out of 5 [3.69, 4.41], $t(52.9) = 5.80$, $p < .001$). The usefulness of the feedback on the LD survey was rated as 3.90 out of five [3.54, 4.26], $t(51.5) = 5.01$, $p < .001$). Lastly, the usefulness of the feedback regarding usage of the SRL-PP was rated as 4.32 out of 5 [3.95, 4.69], $t(55.7) = 7.18$, $p < .001$).

As for the qualitative data analysis, the results of the interviews analysis related to RQ.1 are summarized in Table 2.

RQ.2 - Comparison between types of feedback

Using the same linear mixed model employed for answering RQ1, we estimated and tested differences in marginal means between the different measures (i.e., LD survey, SRL strategies survey, SRL-for-students survey, and design practice behavioral analysis). Results for each planned comparison, corrected for multiple comparisons using Tukey's method for comparing a family of four estimates (Tukey, 1951), are reported in Table 3. The only statistically significant difference is between the usefulness of feedback on the LD survey and the usefulness of feedback on the use of the SRL-LD tool ($p = .045$), although that between usefulness of feedback on the SRL-for-students survey and usefulness of feedback on the use of the SRL-LD tool approaches significance ($p = .085$).

Table 3. Comparison of perceived usefulness of feedback

Comparison	Estimate	t	df	p
SRL for students - SRL strategies	-0.14 [-.58, .30]	-.84	72.6	.836
SRL for students - LD survey	.01 [-.43, .45]	.07	72.8	1.000
SRL for students - SRL-PP design practice	-.41 [-.87, .04]	-2.40	73.1	.085
SRL strategies - LD survey	.15 [-.26, .56]	.98	72.8	.763
SRL strategies - SRL-PP design practice	-.27 [-.70, .15]	-1.69	73.5	.336
LD survey - SRL-PP design practice	-.43 [-.85, -.01]	-2.66	73.2	.045

RQ.3 - Ease of use and potential improvement of the feedback mode
Ease of use of the feedback was investigated through the interviews (dimension 3 of Table 1). The results of the interviews analysis related to RQ.3 are shown in Table 4.

Table 4. Themes and sub-themes related to RQ.3 emerging from the interviews

Themes	Sub-themes	Memorable quotes
Immediacy	Time spent reading the data	*"Very little, if you think about this type of tabular tool."* (USR2)
	Readability	"*The tabular representation was very easy to understand*" (USR2)
Potential improvement of the feedback	Data visualization	*"If possible, a graphical visualization would be useful. I'm thinking of a histogram format, with the question and the two values in comparison."* (USR2)
	Providing users with a (synchronous or asynchronous) debriefing opportunity	*"There was no focus at the level of other students, or a chat, synchronous, so there was no possibility to discuss with others."* (USR1)
	Providing users with a qualitative report integrating quantitative data	*"It was useful to have the numeric data, in the tabular format, because it is readable. It would have been useful to equip it with comments on performance, value judgments."* (USR1)

Discussion

This study examined the usefulness of a specific type of feedback provided to participants in a MOOC. The feedback was based on comparison between (a) individual answers course participants gave to three surveys and a summary of analytics data related to their use of the SRL-LD tool and (b) descriptive statistics representing the same data concerning the whole cohort of course participants. The main

hypothesis is that this kind of automatic feedback, based on social comparison theory (Festinger, 1954), has a formative value.

RQ.1 - Usefulness of the feedback
The study findings support the hypothesis that this kind of feedback is perceived as useful for all four types of data considered. This is confirmed by both the results of the quantitative analysis (feedback usefulness was always rated well above the midpoint of the scale) and those deriving from the analysis of the interviews, in which the feedback has been evaluated as a useful trigger for meta-cognition, self-assessment, and self-regulated learning. Furthermore, as highlighted by respondents, it provided course participants with a benchmark against which to compare themselves. As for the general applicability of this kind of approach to providing feedback, the interviewees were cautious. One mentioned the need to provide feedback to her students but did not explicitly refer to the possibility of using a similar approach in her own teaching, probably because our questions were focused on her role as MOOC attendee rather than as teacher

RQ.2 - Comparison between feedback usefulness
Receiving feedback on an "operational" professional practice may be more effective than receiving comparative feedback on an attitude or a belief. The quantitative comparison between the different feedback modes reveals that feedback on the actual use of the SRL-PP was more highly valued than that concerning answers to the surveys, even if the only significant difference was that between the LD survey and data on the actual use of the SRL-PP for designing. The non-significance of results from the other comparisons is possibly due to the small number of respondents (31), which only allowed us to identify a tendency in the results. The different response to the different types of feedback could be worth further study with a larger sample size.

An alternative interpretation of the significant difference between the perceived usefulness of the feedback based on the LD survey results and the SRL-PP LA data can be derived from observation of Figure 1. The boxplots are shown in the same temporal order in which the surveys were filled in by participants and seem to indicate a slight

increase in perceived usefulness of the feedback. This may be due to gap in time between when the feedback was provided and when the survey was filled in. Timeliness of feedback is an important variable for effectiveness (Nicol & Macfarlane-Dick, 2006).

RQ.3 - Ease of use and potential improvement in the feedback mode
The ease of use of the feedback tool was judged positively by interviewees (Table 4), particularly the schematic organization of the data in tabular format. They regarded consultation easy and immediate. As for the potential improvements in the instrument, they suggested using alternative graphic display formats (e.g., histograms or pies) to compare the individual performance/score with the average and enriching the level of information reported to the user. This could be done by integrating the feedback dashboard with qualitative information (either generated automatically by the system or provided by a tutor) and providing participants with a debriefing opportunity, in the form of a discussion forum devoted to the feedback received. The latter suggestion resonates well with Principle Four of good formative feedback practice (Nicol & Macfarlane-Dick, 2006), whereby good feedback should go in the direction of encouraging teacher and peer dialogue about learning.

Conclusions

We can conclude that this study confirms that the feedback provided based on the comparison of beliefs and behaviors of the individual participant versus that of the full cohort was judged to be useful, irrespective of the types of data being compared. Perceived usefulness of the feedback based on behaviors is higher than that based on surveys results, but this may be due both to the nature of the data and to factors concerning the study design, like the gap in time between survey compilation and feedback delivery.

This kind of feedback is particularly well suited to cases where it does not make sense to test declarative knowledge and there is no right/wrong knowledge, but only a range of different ideas and types

of performances that course participants can display. In these cases, what matters is what Nicol calls "internal feedback", and the role of "external feedback" is to stimulate the former. In our case, the aim of the MOOC was not for learners to acquire declarative knowledge, but rather to raise awareness and develop competence about Learning Design methods, and to promote awareness about the importance of SRL in MOOC attendees. Rather than trying to measure the effects of the learning process, this type of formative feedback is embedded in it, and is part of the learning process. Ideally, as suggested by one of the interviewees, it should have been followed by a discussion phase. However, the organizational constraints of the EduOpen MOOCs made this impossible. We believe such a discussion would have amplified the comparison effect of the feedback by stimulating reflection on other learners' reasons for their responses/actions. This would have helped participants to interpret the feedback in the way it was intended: Not as an indication of what are the "right" beliefs or behaviors, but rather a representation of the individual's position within the landscape of existing beliefs and behaviors. It should be noted that some of the principles of good formative feedback practice (Nicol & Macfarlane-Dick, 2006) are not applicable to our case. For example, Principles One and Six, respectively stating that feedback "should help clarify what good performance is" and "should provide opportunities to close the gap between current and desired performance", are difficult to apply simply because there is no such thing as "good" or "desired performance". However, at the same time, our data support the claim that the proposed kind of feedback facilitates the development of self-assessment based on internal feedback (Principle 2); and encourages teacher and peer dialogue about learning (Principle 4). Principle 3, according to which good feedback should deliver high quality information to learners about learning, is probably more closely linked to comparative data about behaviors rather than beliefs. Principle 5, stating that good feedback should encourage positive motivational beliefs and self-esteem, can be easily met if the data involved in the feedback are not the outcomes of a summative evaluation of some skill or knowledge but rather, as in our case, beliefs or practices that can vary from individual to individual. Finally, Principle 7, sug-

gesting that feedback should provide information to teachers that can be used to help shape the teaching, mostly depends on the data involved but, in most cases, statistical data concerning the beliefs and performance of learners on the subject domain being taught provide important indicators to learners and teachers alike.

To conclude, we should mention the study presents some limitations. First limitation is the limited number of MOOC participants who provided us with information about the usefulness of this feedback and the small number of interviews carried out, due to the fact that only two participants agreed to disclose their identity to be interviewed by the researchers. The issues of ease of use and potential improvements in the feedback mode would have benefitted from the opinions of a larger number of respondents.

Moreover, the evaluation of this feedback can be affected to some extent by the time elapsed between survey compilation or tool use and feedback provision. This is, however, difficult to avoid when MOOC participants are free to attend with their own timing and feedback is based on social comparison: In order to provide this type of feedback it is necessary to collect data from (almost) all participants and, as a consequence, for early participants feedback cannot possibly be timely.

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