# Feedback Conversations: Creating Feedback Dialogues with a New Textual Tool for Industrial Design Student Feedback

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**Abstract.** In this paper, we describe how a study of a large database of written university teacher feedback in the department of Industrial Design (university level) led to the development of a new conceptual framework for feedback and the design of a new feedback tool. This tool structures teacher feedback into very targeted and well-defined feedback conversations with the student. Essential aspects of this paper focus on the translation of related work in the area of feedback mechanisms for higher education into a tailored framework for feedback in the area of Industrial Design, the translation of the existing corpus of data into indicators of feedback quality and how feedback is received and further on used by students in their learning process. Outcomes were used to develop the new tool for stimulating highly focused feedback dialogues between students and teachers. This tool is described in this paper. In the future, this tool will be used actively in Industrial Design education, also with the purpose of further investigating how the quality of written feedback evolves and redesigning educational processes around feedback tools.

## 1 Introduction

Feedback is a crucial way to facilitate students' development as independent learners [1]. Accordingly, students of the department of Industrial Design at the Eindhoven University of Technology (TU/e) frequently receive written feedback from their teachers, i.e., lecturers of Bachelor and Master learning activities.

### 1.2 Problem Statement

Despite the potential power of feedback [2, 3], there are concerns regarding the perceived lack of impact of written feedback on practice [3]–both from teachers and students. It is argued that written feedback is often unclear and deficient in quality [4], but also feedback moments are not well aligned with the overall educational processes. In the department of Industrial Design (ID), teachers and educational policy makers recognize the above concerns. Students are satisfied with the frequency of written feedback provided to them, however they are less satisfied with the quality of the

feedback provided. During a recent visit, an education accreditation committee found the written feedback to be too heterogeneous and diverse between and within students. Regarding the written feedback quality and form, it can be characterized by, for example, (1) confusing and unclear focus of feedback, and (2) not enough informative feedback that is personally specific and not general. As two final points of critique, written feedback comes often too late, and it is perceived as assessing the students' performance, not as feedback aimed at improving learning.

Thus, it is likely that feedback provided by lecturers and assignors is less powerful than intended, which clearly limits students in their possibilities for learning and developing their skills, attitude and knowledge [1]). What was intended as a lively feedback process, a dialogue between teacher and student, had, for structural, technical and also administrative reasons been reduced to a rather meager one-way process. Therefore, lecturers and assignors can strongly benefit from knowledge and insights on how they and others write feedback, how feedback inter-subjectively compares, and how students receive the feedback.

## 1.2 Objectives

This paper reports on the first phase in a larger project about large-scale data analysis of written teacher feedback. In this paper, we show how a framework and quality indicators were developed based on results from a preliminary study of written teacher feedback, and we describe a new feedback tool that was developed based on the framework.

The following detailed objectives are addressed:

1. Developing a framework that explicates what constitutes to the quality of feedback, can be used to analyze written feedback forms in a digital database and can be used for developing a tool to provide effective feedback
2. Translating the framework to indicators that can easily be derived from the larger feedback corpus – in an automated manner
3. Developing a tool facilitating fast feedback loops in written teacher feedback, enabling

   − feedback as open and personal conversations,
   − giving focus and direction to feedback,
   − allowing for feedback "pull", so the student is in charge of getting feedback as a useful "feature" of learning,
   − allowing for quality assessment of provided written feedback,
   − generating richer feedback process data, how the tool is used and how it improves feedback.

Against this background a project was started to perform a large-scale analysis of teacher feedback in the Industrial Design department, addressing more specifically also the challenge of mining semi- or unstructured free-text feedbacks of teachers of various professional and cultural backgrounds. This involves tackling the amount of data provided, which clearly calls for automated analysis, or at least very good filter-

ing in a pre-processing step before manual analysis. Also, the encoding of information given in individual feedbacks needs to be translated to a common framework that then will be used to provide common indicators of feedback quality.

Through this study we intend to contribute to the fields of learning analytics and educational data mining, but most to the growing body of research on feedback mechanisms and feedback quality assessment in higher education with a specific focus on Industrial Design. In this study, therefore, the following research questions will be answered:

- What feedback framework is useful as a category system for analyzing written feedback forms in a digital database?
- Which quality indicators, that can easily be derived from the larger feedback corpus–in an automated manner, can be translated from the framework?
- How can a feedback tool be designed that serves the purposes of
  - empowering students,
  - stimulating feedback dialogues,
  - directing and focusing student feedback,
  - allowing for quality assessment of provided written feedback, and
  - generating richer feedback process data.

In the remainder of the paper, related work is introduced, before the main conceptual framework it is presented and discussed how general feedback literature can be translated towards this framework. After that, quality indicators will be briefly explained and discussed. In the second main part of this paper, a new feedback tool is introduced that implements both framework and data collection according to the performance indicators, and aims at addressing the requirements mentioned above. The paper concludes with a discussion and outline of future steps.

## 2  Related Works

Reviewing the broad literature on feedback shows that consensus exists on the main elements of feedback definitions. The concept of feedback originates from cybernetics. Ramprasad [5] was the first social scientist to define feedback. He defined feedback as providing information about the actual level of performance and the reference level of performance, which is used to alter the gap. Sadler [6] and Black and William [1] took the definition of Ramprasad as a starting point for their work and acknowledged the importance of goals for providing feedback and teachers and students awareness of this importance. Hattie and Timperley [2] confirmed that feedback is a process that closes the gap between the current and desired situation. They also added the element of agency to the definition of feedback and defined feedback as follows: information provided by an agent (teacher, peer, book, self) regarding one's performance or understanding. This definition implies that feedback can be provided by an external source but also by a person itself. Also, it is implied that information provided by an agent is only considered as feedback when it leads to learning. In practice, however, teachers frequently provide feedback that intents to contribute learning but in practice does not results in learning. Therefore, Shute [7] added the element of

intention to her definition of feedback and acknowledged the communication aspects in her definition [8]. Finally, feedback can be provided orally and in written form. Thus, in general feedback is considered as an information process, provided by an agents with the intention to foster thinking or performance.

Although reviewing the literature of feedback shows that consensus exists on the main elements of feedback definitions, different conceptualizations of feedback seem to underlie these definitions. In a review, De Ridder, Stokking, McGaghie & Ten Cate [8] investigated what feedback in clinical education is. Three underlying concepts were found, defining feedback as 'information'; as 'reaction', including information, and as a 'cycle', including both information and reaction. Feedback as information has a message content as its focus. Crucial to feedback as a reaction is interaction in which information is provided and received. Feedback as a cycle contains information and interaction features but also a consequence of the message. The cycle conception of feedback corresponds to the dialogue conception of feedback. Recently, this conception of feedback is seen as more and more important for effective feedback [9]. However, empirical findings show that it is difficult to give written feedback characteristics of a dialogue [10]. Written feedback is often unclear and deficient in quality and more effort should be put in improving how feedback is formulated [5] (no follow-up, response or monitoring). To improve the formulation of feedback an understanding of how teachers actually write feedback is important. Surprisingly, there are hardly any empirically based category systems available, which are funded in (both theory and) practice and are suitable for analysis in the context of data mining. Fortunately, prevalent models of feedback also provide important directions for developing a category system. One of the prevailing models of feedback is the model of Hattie and Timperley [2]. The authors developed a theoretical model based on their meta-analysis of evidence of the effects of feedback on learning. The authors defined feedback as information provided by an agent regarding aspects of one's performance of understanding. Hattie and Timperley state that effective feedback answers three questions: 'Where am I going?', How am I going?' and 'Where to next?' Answers to these questions provide students with the knowledge about what their learning goals are, how their current understanding or performance relates to these goals and which activities can be undertaken to reach these goals. These questions can be targeted at different levels. These levels are; task, process, regulation and self. Feedback at the task level is used to verify whether something is correct or wrong or how well something is done. Feedback at the process is feedback focused on information processing and processes needed to understand the task. Feedback at the self-regulation level is focused on how students plan, monitor, direct and regulate their thoughts and actions. Finally, feedback at the self is about personal aspects of learning and about positive and negative evaluations of a student. It is important that feedback is focused at the adequate level. Then, feedback will have the most powerful effects on learning. Ideally, the feedback addresses the task level first, the process level next and finally the level of regulation. To target feedback at the adequate level, teachers need to differentiate between these three levels.

Differentiating between different levels of feedback is important, but there is more that constitutes to the effects of feedback on learning: Many researchers consider the form giving of the feedback important as well. Several modalities contribute to the form of feedback. Firstly, the specificity of feedback is important. To be effective,

feedback needs to be specific enough to direct the students' learning. Too specific feedback leads to a too narrow focus and often to reproductive forms of learning. It is therefore important that the feedback is specific but not too specific [7]. Secondly, the amount of positive and negative remarks is a key consideration. Generally, teachers have a tendency to be critical and to focus their feedback on aspects of the students' learning that need further improvement. However, it is important for teachers to balance both the cognitive and motivational aspects of feedback [9]. Thirdly, it is important that teachers consider how concrete they make their comments. Using concrete and clear wording is mainly focused on behavioral terms. Formulating words too concrete, again, might lead to reproduction, and a lack of conceptualization, creation of meaning, and knowledge transfer. More abstract language stimulates students to think, conceptualize, and make meaning, but too much abstraction prevents students from grasping the essence and getting the message across. Again, it seems important not to use too abstract wording and find the right balance. Finally, it is important that the feedback is not too limited. Writing short feedback gives students often the feeling that teachers do not pay enough attention to them, which can demotivate students–especially if they are used to comparatively more extensive feedback by other teachers. Furthermore, limited feedback runs the risk of being unclear and being unspecific with negative consequences for the student's learning processes. On the other hand, being too elaborate prevents students from grasping the essence and understanding the feedback. Elaborate feedback runs the risk of being too specific and distracting from the actual message of the feedback, and loosing the notion of being actionable.

The related work described so far relates to feedback in general. In literature, relatively little attention is devoted to written feedback. An important exception is the work of Nicole [11]. Nicole makes ten recommendations for written feedback [11, p. 111].

- Understandable: Expressed in language that students will understand.
- Selective: commenting on two or three things that the student can do.
- Specific: pointing to examples in the student's submission where the feedback applies.
- Timely: provided in time to inform the next performance.
- Contextualized: framed with reference to the learning outcomes.
- Non-judgmental: descriptive rather than evaluative, focused on learning goals not performance goals.
- Balanced: pointing out the positive as well as areas in need for improvement.
- Forward-looking: Suggesting how students might improve subsequent performance.
- Transferable: focused on processes, skills and self-regulatory abilities.

These recommendations for written feedback can be considered as quality indicators for good feedback. Although these indicators slightly overlap with the model of Hattie and Timperley [2] with modalities of feedback [8], and are not formally distinct in themselves, the indicators are useful in the context of this project. This will become clear in the next section in which, we will condense the selected findings from related research and our own requirements into a conceptual framework that will be used throughout this and further studies.

## 3 Conceptual Framework

The framework presented in this section was derived from – and is still strongly linked to – an extensive body of research on teacher feedback in higher education. The framework will guide the further process of analyzing teacher feedback in the specific context of Industrial Design and a competency-based learning system, but this framework will also point at missing data and insufficient quality measurement that we also strive to improve in the course of this larger-scale project.

### 3.1 Method

The conceptual framework for feedback in the area of Industrial Design was conceived using an iterative process of going back and forth between theoretical perspectives on feedback and practical perspectives on feedback. The process was started with a first exploration of the data that was available, how it was organized and how it could be made accessible to answer more specific queries regarding feedback quality, feedback reception and its use in subsequent student work. After that, a literature review on feedback, written feedback and (written) feedback in higher education was undertaken (without a specific focus on Industrial Design). Next, a framework was derived from the combination of related research, own reflections and available data. This framework was intended to explicate what constitutes to the quality of feedback, to be useful for analyzing written feedback forms in a digital database and the starting point for developing a tool to provide effective feedback. Following, the framework was translated in a digital tool for the purposes shown above.

### 3.2 Results

The resulting framework is comprised by an integration of the model of Hattie and Timperley [2] which argues that effective feedback is focused at the right content of learning and provides feed-up, feed-back and feed-forward and the form giving modalities of feedback. Thus the framework consists of: (1) content and (2) form giving. The recommendations of Nicole [11] are used as guidelines for describing categories of form-giving aspects, for evaluating the completeness of the content and form-giving aspects, and as inspiration for additional measures for learning.

### Content

The first important aspect of our framework is the content of learning. To define the content of learning we constructed a matrix, in which the vertical axis was constituted by the levels of feedback of Hattie and Timperley [2] and important concepts from the educational model of Industrial Design (overall competence of designing, identity and vision).

Consequently the following topics are distinguished:

1. Task: comments focused on the goal, standard, ideal situation or indicating whether something is right or wrong
2. Process: comments focused on the information processing and approach a student undertakes
3. Self-regulated and directed learning: comments focused on the orientation, planning, self-assessment, reflection, monitoring regulation and direction of (further) learning
4. Overall competence of Designing: comments addressing the overall competence of designing
5. Identity: comments focused on the students personally, motivating and affective aspects of learning but also on whom the student considers him/herself to be as a professional designer or who the student wants to become as a professional designer.
6. Vision: comments focused on why the student wants to be a certain designer and frames what the student wants to learn. These comments can relate to values and beliefs and inspire and motivate the student to develop.

The horizontal axis in this matrix was constituted by different phases of task-oriented learning [12, 13]. Generally, all aspects of a learning activity are prepared, executed, and finalized. For instance, take the first row: Task. During the task-preparation phase, a student is planning and orienting on the task, during the execution the student is performing the task, and during the ending a student is evaluating and reflecting on the task preparation, task performance and results. This reflection is then ideally the basis for a next task's planning phase. Thus, the matrix consisted of 18 cells, which all can be filled with a detailed description.

Using the quality indicators resulted in descriptions of all 18 cells. The following is a description of providing feedback on the task level during the preparatory phase:

"The coach comments on the characteristics of the task and possible goals (the student puts forward)."

Providing feedback on the identity level during the ending phase is described as follows: "The coach comments on the students' evaluation and reflection on the importance and meaning of the task-preparation and performance for him/herself (as a designer) and provides suggestions for improving the importance and meaning of the task-performance for him/herself (as a designer) in future situations."

The matrix can be used by teachers to provide feedback and by students to ask and generate feedback. The different cells of the matrix make teachers and students aware of all topics feedback can be generated, provided and asked for. The matrix provides teachers and students with a fine-grained tool for observing and diagnosing learning needs and for providing and directing written comments quite focused, specific and precise. In line with the model of Hattie and Timperley [2], the matrix will contribute to the effectiveness of feedback.


**Form giving**

The second important aspect is the form giving of feedback. This aspect pertains to how the feedback is communicated. The form giving aspect encompasses the following scales:

- Valence: Positive–negative
- Focus: Specific–general
- Level: Concrete–abstract
- Elaborateness: Limited–elaborate

There is not a fixed recipe to make the form giving of feedback effective. It depends on the intentions of the teacher, whether the intentions of the teacher are recognized by a student and also how a student perceives, experiences and reacts to the specific wording of the feedback. It is also affected by characteristics of the specific situation and context, influenced by the goals of the learning activity and on the phase of the learning process. or instance, a teacher can choose to give overly negative, and very abstract feedback in the first phases of a project to push the student to work harder and reflect deeper, or the teacher could provide more positive and general feedback at the of a project to give student a positive feeling about her growth and achievements.. Based on the indicators of Nicole [11], we argue that the remarks need to be balanced, clear, understandable and elaborate enough but not too elaborate. Combining scales and quality indicators from Nicol [11], leads to the following descriptions:

### Positive–negative

- Mainly pointing out areas for improvement or critiquing. The feedback is mainly negative.
- Mainly pointing out the positive.
- Pointing out the positive as well as areas for improvement. The feedback is balanced in terms of the negative and the positive.

### Specific-general

- Almost no reference to instances in the students' submission where the feedback applies. There is a lack of specificity.
- Too frequent references to instances in the student's submission where the feedback applies. The references distract the reader from the lessons to be learned. The feedback is too specific.
- Reasonable and relevant references to instances in the student's submission where the feedback applies. The mean messages are made clear and specific but not too specific.

### Concrete–abstract

- The feedback is mainly phrased in common sense; there is a lack of use and reference to theoretical concepts.
- The feedback is mainly phrased by means of theoretical concepts. There is a lack of clear and understandable language. Theoretical concepts are insufficiently concretized.
- The feedback is sufficiently clear and understandable and framed in theoretical concepts.

### Limited–elaborate

- The amount of words used to write the feedback is too limited.
- The amount of words used to write the feedback is too elaborate.
- The amount of words used to write the feedback is not too limited and not too elaborate.

**Completeness of the framework**

The conceptual framework developed so far does not include the feed-up and feed-forward principles from Hattie and Timperley [2] and does not recognize Nicole's quality indicators: timely, non-judgmental, contextualized, forward-looking, and transferable [11]. These aspects need to be addressed by asking the right questions and using the right instructions when asking teachers and students to write their feedback. The questions need to include where students are (feed back), where students would like to go to (feed up) and how students will get there. In the instructions it needs to be emphasized that there needs to be a reference to what is already known or previous work. Also instructions for the question needs to emphasize that the answer needs to be framed in learning outcomes and that suggestions for improvement need to be made.

# 4 Metrics

Given the framework as presented above, this section explains how the concepts will be translated to metrics of feedback quality that can be directly applied to written feedback texts and feedback tool usage behavior. In this sense, we will approach the framework concepts from the view of actual teacher feedback and incrementally define the metrics.

While in the past feedback was provided in forms that were pre-generated, then filled by teachers, and finally fed into a large database [14], the newly developed feedback tool works in the form of feedback conversations between student and teacher. Each conversation consists of entries written by both, often starting with the student's specific request for feedback on a particular achievement. What was in the past a mix of different free-text fields for global comments, quality of deliverables, competency development, design process phases, attitude and advice for the student's future learning activities, now is a structured set of feedback conversations. The structure is consequently given by the abovementioned framework for qualitative written feedback.

For the scoring of the different indicators, single feedback conversations can be analyzed, but also multiple conversations for the same course (and teacher) can be combined in the analysis. This segmentation of teacher feedback content-wise can be complemented by segmentation by teachers, so particular feedback styles of individual teachers can be analyzed.

## 4.1 Content

Looking at the content of actual teacher feedback, the majority of feedbacks touch the same points content-wise: All teachers are supposed to comment on certain aspects of student learning and growth during a semester. This means that, given a moderately

structured text input, algorithms can check for the occurrence of specific words and, in a second step, look at heuristics of word relationships that indicate whether the content of the feedback expanded on all relevant content areas (see above). For instance, for the student's competency development, the text would score high on the specific metric if all relevant competencies are mentioned and they are embedded in relatively large chunks of text. In the future, more advanced text mining approaches will able to construct ontologies of competency-related word formations, which then can influence the score as well.

### 4.2 Form giving

The form giving of textual feedback is more difficult than looking for specific word and combinations of words: the form giving strives at a deeper understanding of the content: the semantics of what was expressed. There are, however, approaches to derive sentiments from text excerpts that indicate whether a piece of text is generally positive, negative or neutral [15, 16, 17].

For other metrics in the form giving of feedbacks, the occurrence or non-occurrence of keywords is, again, quite informative: abstract wording can be automatically spotted as well as the mentioning of concrete student deliverables in the feedback can indicate rather general or specific feedback. Similarly, teacher feedback often contains personal aspects, which can be extracted from by leveraging the formal structure or from free-text parts that focus on forward-looking (future-oriented) attitude and advice aspects.

Text quantity is of course comparatively easy to determine: the more the teacher writes in specific feedback sections and the more elaborate the writing is, the higher a respective metric will be scored in the end. However, these parts often contain generic text pieces that are given as feedback to all students in a course. While this is important information for the student's final assessment, individual parts are more constructive and informative for the individual learning process and the continued development. That means, different feedbacks for the same learning activity need to be compared and text-matching algorithms will help indicate how many generic parts the teacher feedback contains, and where and to what extent the teacher goes into specifics and details about an individual student's achievements.

In summary, both content and form giving are assessable to a certain extent using the given metrics, which can be partly automatically derived from a database of teacher feedbacks, and partly need manual post-processing.

## 5 Feedback Tool

Resulting from the findings and based on the newly developed framework, a novel feedback tool was conceived that is based on a matrix outlining on which moments during students' learning activities feedback can be provided, which questions need to be answered for providing feedback, and which quality criteria the feedback needs to

adhere to. All this should facilitate fast cycles in written teacher feedback that will give written feedback its constructive and informative purpose, and will let assessment and judgmental aspects reside in the background.

Starting from the requirements outlined in Section 1.2, the new tool will be explained.

## 5.1 Feedback as conversations

In classes or workshops organized at our Department feedback is given very effectively as a verbal conversation between student(s) and teacher(s). Such verbal feedback has a different plasticity: it is less definitive and potentially imposes less hierarchy than written and submitted feedback. The receiving party can ask questions for clarification or elaboration, but also clarify or even defend. All these aspects are easily lost with written feedback, especially if the written feedback is managed and channeled through forms and administrative processes.

The feedback tool strives at keeping the advantages of feedback conversations and, at the same time, bring in the quality of documentation and book keeping, which allows for feedback to be re-read and reflected upon. In the tool, feedback conversations are displayed as messages between student and teacher or coach, similar to popular messenger tools (see Figure 1). The individual feedback entries can be enriched with file attachments, and they can generally be characterized as (1) requests for feedback, (2) feedbacks, (3) clarifications, and (4) follow-up. This visual representation of written feedbacks as conversations takes away the definite character and increases fluency of communication between both parties.

## 5.2 Giving focus and direction to feedback

The analysis of teacher feedback as mentioned above showed that when giving feedback teachers often mix feedback for different aspects, neglect important development aspects, and give vague feedback that is not actionable (and sometimes not even understandable).
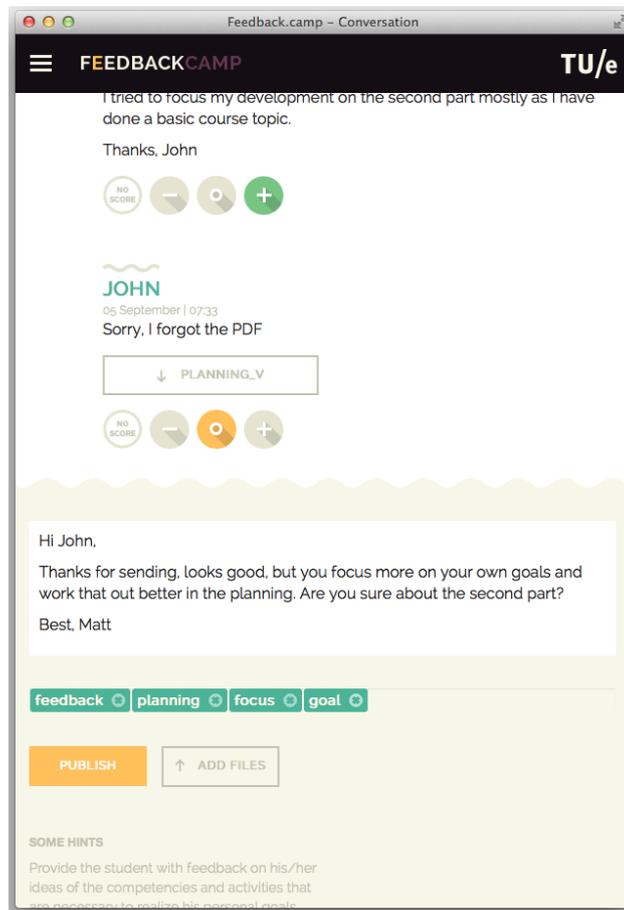
**Figure 1: Feedback conversations help lower thresholds**

To remedy this cause of students' frustration with written feedback, the feedback tool does not allow for "wholesale" feedback about an entire learning activity. Instead, every learning activity has specific "feedback aspects" (see Figure 2), for which a feedback conversation can be started. These aspects are different for different types of learning activities, and they are shown throughout the feedback conversation user interface (e.g. projects and assignments).

When authoring feedback conversation entries, let it be the original request from students, or feedback, or elaboration, both students and teachers are given hints what to think about when writing feedback, readily shown next to the authoring area. These hints directly relate to the feedback aspects and will give different suggestions. This way, we hope to reduce the occurrence of "writer's block" and forgetting of essential aspects. As another help for busy teachers, related feedback conversations are linked in the authoring view, so inspiration can be easier found, but also recurring questions can be answered more efficiently.

Finally, breaking up the feedback for an entire learning activity into smaller chunks, allows for better understanding how the student could balance her activities better, and the interface explicitly shows focus areas with a lot of feedback and, contrasting, blind spots, where feedback is still lacking. The final user interface of the feedback tool simplifies the "management" of many ongoing conversations of a student with different teachers, or of a teacher with many students, by indicating waiting, unread entries and draft entries that need to be submitted to the student.
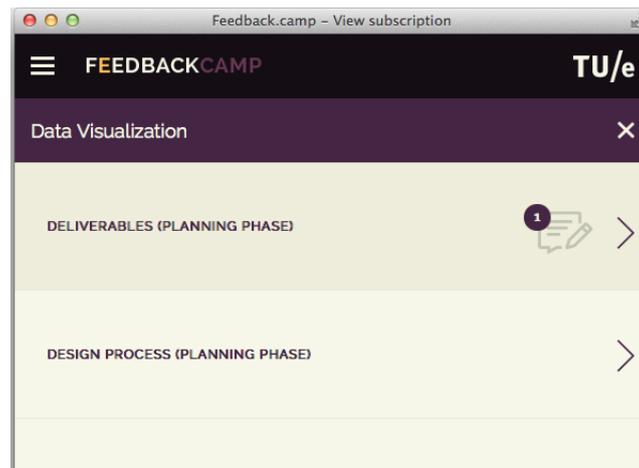


**Figure 2: Concrete feedback aspects for focus and accuracy**

### 5.3 Allowing for feedback "pull"

An essential point of the feedback tool is to allow for ad-hoc feedback and putting the student in charge of getting feedback, essentially "pulling" it from the teacher instead of waiting for feedback that in busy times often comes too late to help. Timely feedback indeed is key to learning [7]. The feedback tool supports notifications (by email), but also encourages its users to keep the written feedback conversation entries rather short and concise.

### 5.4 Allowing for quality assessment

The feedback quality and the improvement thereof is the major driver of this research project. And, as such perceived feedback quality is quite subjective and context-sensitive, the feedback tool allows for indicating how helpful and relevant the feedback is. It is a challenge to package these meta-feedback instruments properly and integrate them well into the overall user interface, without turning the feedback tool into an assessment tool by focusing too much on such scores. This way, both teachers

and students can adjust the content and presentation, for instance, by shortening descriptions in feedback requests (students), attaching contextual material (also students), or by choosing simpler wording in the written feedback (teachers). In addition to such directly obvious shortcomings of feedback requests that can be corrected easily, in the first pilot phase, students needed to be reminded of focusing on the specific aspects of feedback for the learning activity. For example, they oftentimes sent deliverables in for feedback, but omitted planning for future deliverables, motivations and reflections about deliverables.

Apart from subjective measure of feedback quality, given the conceptual framework and the metrics mentioned above, the feedback tool generates data that can be objectively analyzed. Text mining approaches help summarizing the often-verbose written feedback given over time [18, 19, 20] and condensing this into several essential lines that cover the feedback conversations relating to a particular aspect of the learning activity. On the other hand, text classification can help extract relevant metrics, for instance, about sentiments in the provided feedback, or about the choice of words indicating a more specific or general (or actually both for balanced) feedback.

As a direct means to improvement the accuracy and also general relevance of the feedback, several hints were included in the user interface of the feedback tool. These hints are context-sensitive and depending on different aspects of a feedback for a learning activity as well as the timing of the feedback within the learning activity: in the planning phase, different hints will be shown than when the activity is in progress. This should trigger both teachers and students to focus on the information needs at the moment, and not to fall back into old patterns of to generic and vague feedback.

## 5.5  Generating richer feedback process data

To better understand written feedback practice at large scale in the whole education program, we instrumented the feedback tool to produce high-quality data about how the tool is used and how it improves feedback (as measured by perceived feedback quality). The collected data allows understanding periods of frequent feedback activities, and also periods of relative silence.

The rather narrow focus of the feedback aspects within learning activities, allows for better comparing feedback content between learning activities, teachers, and students.

Finally, having a better overview of how educational efforts are spent in feedback giving (and receiving), will allow for improving the learning activities, for instance, by providing better teaching materials, related reading material, centrally answering frequently asked questions (FAQs), and informing teachers what aspects of the content have been well understood, and which aspects need further elaboration–this, while the activity is still in progress, not as an afterthought.

The feedback tool has been developed fully, and is currently in pilot testing phase. Future steps with the tool will involve broader integration into the education program, wider adoption by students and teachers, and studying generated data on feedback practices and processes.

## 6  Discussion

In this paper we have described a framework that explicated what constitutes to the quality of feedback. Following the framework was translated in indicators that can be derived from the larger feedback corpus in an automated manner. Finally, based on the framework, an interactive feedback tool was developed. The tool will help teachers and students structure frequent, timely and focus feedback into conversations that, while improving the general level of feedback quality, will also yield better data about feedback practices and processes.

**Framework**

The framework is funded in relevant literature on feedback and reflects the prevalent conceptions of what constitutes to good feedback in literature. Surprisingly, it appeared that there are little category schemes available for (formatively) assessing the quality of written feedback. Consequently we needed to turn to general feedback literature, which does not make a distinction between verbal (oral) and written feedback. The question rises whether the general principles and ideas on effective feedback that do not distinguish between verbal and written feedback are directly applicable to both. It might be that qualitatively good feedback in face-to-face situations differs from qualitatively good written feedback. At least the circumstances and the communication process is different resulting in limited possibilities for (natural and spontaneous) interaction on feedback provided and placing more demands on the quality and explicitness of all the information provided. It is reasonable to assume that the intentions of lecturers with the feedback provided are more easily recognized and opportunities created for explicating them. In short, it is difficult to make written feedback dialogical.

**Metrics**

The metrics are not yet tested and further development will most likely show that some of the metrics cannot be as sharp as desired, or even need to be changed or abandoned. Still, the translation of teacher feedback literature to the conceptual framework and then further towards text-based indicators is a promising step for a highly automated analysis of the large-scale corpus of teacher feedback data.

**Feedback tool**

In this study we described the development of a new tool. With this tool we intended to stimulate conversations,  to provide focus and direction to the feedback, to allow for feedback "pull", , and to allow for quality assessment of provided written feedback

.. It is not possible to conclude whether these goals have been realized already. Information from the pilot is necessary to reach these conclusions. Although it is not easy to predict how things turn out in practice we can speculate about the extent to which goals will be realized. The goals of empowerment and dialogues are certainly realized through the current design. Students themselves are responsible for sending feedback requests. This makes students owner of the learning process. This will likely lead to empowerment and enhanced self-directed learning. The framework also provides a tool for both teachers and students to make their feedback requests more focused. The possibility of having dialogues is also present. Itt remains to be seen whether the tool will be easy implied in the learning process of students and the teaching practice of lecturers and coaches. It possibly takes time to get used to the tool and to learn to use and apply the focused feedback questions. In the end the success of the tool is predicted by teachers and students perceptions of usefulness of the tool. In other words, the benefits for both students and teachers need to outweigh the costs of investment of time and effort. In this respect, the pilot will be informative.

## 7 Conclusions

Based on an analysis of teacher feedback data in the domain of Industrial Design and extensive related work on feedback quality assessment, a conceptual framework and a set of metrics have been developed and introduced in this paper. Furthermore, a new feedback tool has been designed that follows the structure of the framework in how feedback conversations between student and teacher are facilitated. We can conclude that it is possible to translate the framework into metrics of feedback quality and consequently into a tool that can directly improve feedback quality, but also provide a better basis of data for future analysis.

Analyzing textual teacher feedback in an automated way is still a difficult task as it attempts to quantize nuances of elaborate feedback, intricacies of language, intended ambiguities and humor into metrics that are directly comparable and also assessable. This relates back to the title of the paper: analyzing teacher feedback can be seen as feeding an administrative, controlling monster ever hungry and using generated data in a threatening way, but also as a large-scale effort to improve teacher feedback thoroughly and to prove that the improvements are effective and beneficial.

An aspect that is currently not assessable using the feedback corpus or early data generated by the feedback tool is how students perceive and work with the teacher feedback. While analysis with synthetic metrics is a good approach to derive more objective quality measures from educational big data, only student feedback on how helpful, rich, and insightful the teacher feedback can provide future directions for improving feedback mechanisms on a large scale.

Based on the findings, we intend to further investigate with the feedback tool how the quality of written feedback and starting conversations about this feedback will evolve in the next months. By using scoring functionalities also on the students' side, it is possible for teachers to discover how their written feedback is actually perceived by students and what aspects of their written feedback really contribute to students' learning. Ideally we aim at feedback conversations, in which personal feedback is not

only given and then received, but in which feedback is constructed in a joint process involving both (groups of) teacher(s) and students.

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