

# The Pattern Language of Incremental Grading

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Assessing students' work while at the same time supporting their learning is prone to some challenges such as big bang grading, low self-assessment skills, little ownership of learning process, poor time management, inability to see grading as useful for feedback, and often workload peaks for instructors after final deadline. In this work we describe the approach of "Incremental Grading", which has the core practice that students assess their own work based on pre-defined criteria and incrementally request grades until the final deadline. We describe this approach as a collection of related educational design patterns—a pattern language—consisting of existing and newly identified patterns. Educators (of different fields) can configure it to address these challenges when designing or adapting courses in their own environment.

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## 1. INTRODUCTION

Students who follow educational programs are usually finishing these programs with a certificate, such as a college degree, a bachelor, or a master certificate. These certificates show they reached the learning objectives and have passed all required elements of the program. A common way for showing these achievements is by using grades for the different elements of the program. A grade is an indicator of the level of achievement, usually ranging from insufficient to excellent or in simple cases pass/fail.

While these grades may be necessary to determine the student's progress in the program and their final achievement, they may not be seen as adequate motivators for students who simply want to pass the course with a sufficient grade (because they need to) instead of desiring to learn something in first place [Docan 2006]. If teacher's feedback is offered to improve the learning, but does not have impact on the grades, then it can be seen as less valuable to the students. When they ignore this feedback, they miss a good opportunity for deeper learning and see their experience as merely a predetermined path they must follow in order to accomplish their passing grades rather than an inspiring and thought-provoking experience. The often bureaucratic atmosphere in higher education [Magala and Zawadzki 2017] seems to increase this effect rather than putting the focus on learning. It is also problematic for the teaching staff, as they have to focus on grading the student's work in first place (and in a fair manner) instead of focusing on helping students develop lifelong learning skills.

As educators, we observed in our careers a couple of recurring challenges which are still present in current course designs:

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- Grading vs. feedback* - When we provide only a grade after some work has been finished, this does not encourage students to improve. They often experience this only as a way to look back on what they've done, rather than as a way to look forward towards improvement. But informative feedback, with time to improve, is more effective for learning and increases intrinsic motivation [Butler and Nisan 1986]. However, our experience is that if we provide such feedback without making it explicitly relevant for getting better grades, students don't often respond to it.
- Big Bang grading* - Grading at the end of a course is necessary, but is assigned at a time when students are tired and ready to move on. This doesn't allow students to know where they stand during the course, the results of such final grading might be a surprise and in many cases disappointing. It provides useful information only to students who have a desire to continue improving once they leave the course.
- Low self-assessment skills* - Unless students truly care about the future following the course, they are often unsure about the quality of their work and rather wait for the professor to assess it. Yet, lifelong learning requires one to understand where and how they need to improve.
- Little ownership of learning process* - When students struggle to learn, they may be likely to pass the responsibility, and even blame, to the instructor. Many students find it too challenging to determine for themselves when and how to learn.
- Procrastination (aka Students Syndrome, poor time management until deadline approaches)* - When facing a large assignment, busy students may approach it as they do in smaller assignments: they postpone working on it until the deadline approaches, usually resulting in incomplete work of not-as-good quality as it could have been (due to time pressure).
- Heavy workload peaks for instructors after deadline* - Big bang grading of large projects at the end of the semester or specific deadlines when significant products are due along the way creates a high, exhausting workload for grading instructors.

As we cannot easily change the environment in current (higher) education, we were looking for a way to redesign it within the current constraints that grading is required and a variety of assignments and assessment forms is used for grading in a course or semester.

In this paper we present an approach which addresses the above mentioned challenges, which we term "Incremental Grading". The core idea is that students assess their own work using pre-defined criteria. Whenever they believe they've achieved a certain quality level, they request grades and provide justification for how they believe they have fulfilled the requirements for the requested grade. The students can request grades whenever they want (until the final deadline), on new work products and also on assignment elements that were previously graded and have been improved or corrected. This way, the requests also serve as feedback (combining grading and feedback) and help the students with directing their own learning. The number of grading requests could be limited if there are other opportunities to get feedback from the teacher. However, it is also possible to allow students to send requests as often as they want. Our experience showed that this does not lead to an explosion of grading requests (and hence the workload for the teachers); rather, the justification and evidence for the requested grades serves as a natural hurdle to just hand in something and see what happens.

We have applied Incremental Grading for a part time semester on object-oriented software engineering, but we believe that it also can be applied in various environments as long as there are one or more graded assignments that last over a longer period and have clearly defined assessment criteria (e.g. RUBRICS). It's applicable for both cumulative and proportional (in terms of percentage) grading.

Most elements of Incremental Grading are well known approaches in education. However, the combination of these elements in the proposed configuration has been shown to address the aforementioned challenges in our application in a promising way. We decided to describe this approach as a collection of related patterns—a pattern language, hereby making use of several educational design patterns. Patterns in general originate in architecture [Alexander et al. 1977] and also have been applied successfully in various areas of education such as MOOC-Design [Warburton and Mor 2015], Lecture Design [Köppe et al. 2015], Technology-Enhanced Learning [Goodyear and Retalis 2010], or Pedagogy in general [Bergin et al. 2012]. In the presented approach, existing patterns are combined with some newly discovered

patterns that haven't yet been documented and which will be summarized in this work and described in detail in future work.

The remainder of the paper is structured as follows. In section 2, we introduce the pattern language of Incremental Grading. This is followed by a summary of our experiences with the concrete application of Incremental Grading in a course on Object-Oriented Software Engineering at HAN University of Applied Sciences in the Netherlands. The paper concludes with a summary and outlook on future work. In the appendix, we'll give an overview of all patterns that are part of the pattern language and also provide a summary of all other referenced patterns which are not directly part of the pattern language.

## 2. THE PATTERN LANGUAGE OF INCREMENTAL GRADING

In this section we will describe which patterns are elements of the pattern language and how they are configured and interact with each other. This is shown in the form of pattern sequences (or scenarios) which belong to one of these three different categories of patterns:

- Core** - patterns in this category are essential for implementing Incremental Grading
- Enhancing** - these patterns enhance the positive effects of Incremental Grading when applied in combination with the core patterns
- Supported** - these are patterns which are supported through the application of Incremental Grading, either as specific implementation of them or by enhancing their positive effects

Figure 1 provides an overview of the mapping of all patterns to the categories. In the next subsections we stepwise introduce the patterns and their relations.

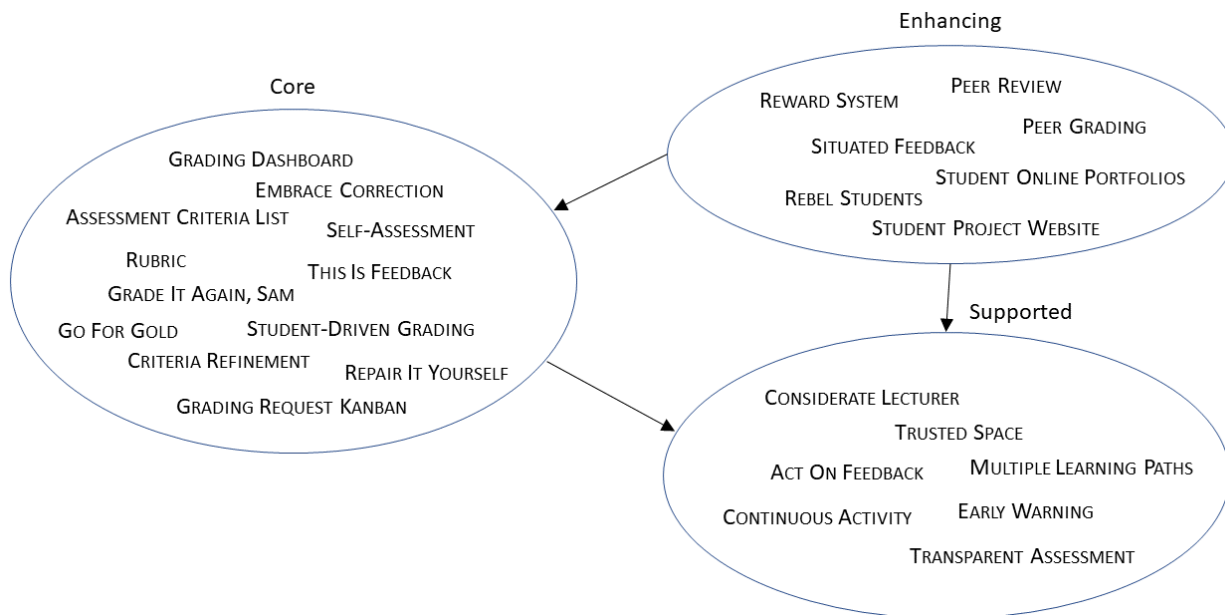


Fig. 1: Overview of pattern language

## 2.1 The core of Incremental Grading

### Core part 1

Basis for Incremental Grading is a well defined ASSESSMENT CRITERIA LIST. The criteria should be specific enough for concrete assessments of student work, likely after performing CRITERIA REFINEMENT. The refined criteria should also be available, e.g. in the form of RUBRICS. These can be used by the students for a SELF-ASSESSMENT of their own work.

Whenever students decide that they have fulfilled (some of) the criteria they can perform a STUDENT-DRIVEN GRADING. They can do this at any moment (in a limited or unlimited number, but before the final deadline), hereby giving them the full responsibility for their progress. This way, they incrementally work on their achievements towards passing the course.

It is important to note that students are encouraged to not wait until they have their final version, but to primarily submit partial solutions (according to the defined criteria). That way they get feedback on their work more frequently and they have time for acting on the feedback.

When handing in a grading request, the students include (1) for whom the grades are requested, (2) for which assignment, (3) for which criteria and/or rubrics the grades are requested, (4) what the concrete requested grades are (per rubric/criterion), (5) a justification for the requested grades, and (6) the actual evidence (such as documentation, source code, diagrams etc.). Elements (5) and (6) will be especially useful for helping students develop their self-assessment skills. Teachers then will assess the request, making use of the provided information. The result of this assessment will be one of these options:

- Full accept - the students gave a sufficient justification for the requested grades and the provided evidence matches the quality level as described in the RUBRICS.
- Partial accept - the students requested more than one grade and not all of them were accepted.
- Not accept - the request was completely rejected, because justification and/or quality of evidence were not matching with criteria for requested grades.

Pattern Name	Summary
ASSESSMENT CRITERIA LIST [Bergin et al. 2015b]	Clearly communicate to students what the criteria for assessment are.
CRITERIA REFINEMENT [Bergin et al. 2015b]	Refine assessment criteria to a detailed level.
RUBRIC [Bergin et al. 2015b]	Rate each Refined Criteria on a sheet and aggregate the mark.
SELF-ASSESSMENT (future work)	Assessment criteria are given (e.g. as RUBRICS) and students rate themselves using these criteria
STUDENT-DRIVEN GRADING (future work)	Give students the responsibility for determining the quality of their work and what the grade for this (part of the) work is. Let them justify and provide evidence for the determined quality and the corresponding grades. When accurate, then the students earn the grades.

### Core part 2

After the grading request has been assessed, the students will get the result of the assessment. If the request is not fully accepted, then a short justification has to be provided explaining why the students have not met the criteria for the requested grade. This is ideally not presented in the form of a todo-list, but should focus on the missing quality of their deliverables. This way the students have to think for themselves about what they need to do in order to fulfil the criteria, which fosters deeper engagement with the quality aspects of their work.

One question that arises is how to handle grading requests where the quality of the work is actually on a higher level than the requested grade. Instead of just giving the higher grade, it is useful to accept the requested grade and explicitly provide feedback that the students should examine the next quality level closely and determine what is needed

to reach it (or likely to discover that they already have reached it). If the teacher would just give the higher grade, the students are not encouraged to provide evidence themselves, but will likely just request a lower grade and wait and see what they actually get. Of course, this would be easier for the students, but very likely also lowers the desired effects of STUDENT-DRIVEN GRADING.

All accepted grades are also included in the GRADING DASHBOARD. This dashboard presents the current status of a student in an overview, including all grades for all assessment criteria (the RUBRICS) of the course. This means that the early elements in the dashboard are either empty or contain the lowest possible grade. Each time a grading request is accepted, the students will see the progress in their dashboard. This way, they are able to direct their own learning by choosing the elements they want to focus on next.

It is important to note that students will likely experience their first grading requests as failure if they are not fully accepted and do not get the requested grades. This is because they are more familiar with grading systems in which they receive a grade which indicates whether they failed or passed (sometimes with a one-time repairing option). Therefore, it is important for the instructor to explain that in Incremental Grading, grading requests are also feedback moments and the absence of a grade, due to a “reject” option, provides a great opportunity for learning. When partially accepted or rejected, the feedback should not only point to the present flaws, but encourage the students to pay more attention to the quality aspects of their work, e.g. through discussing with them the differences between the quality levels they thought to have achieved and the actual level (based on the rubrics). This will likely help them to improve their self-assessment skills. It should become natural to EMBRACE CORRECTION of their current work and to repair the present flaws (REPAIR IT YOURSELF).

Pattern Name	Summary
EMBRACE CORRECTION [Bergin et al. 2012]	Give the students the chance to improve their work.
GRADING DASHBOARD (future work)	Present the current status of the student's grading in an overview dashboard.
REPAIR IT YOURSELF [Köppe et al. 2015]	Let students correct their wrong or incorrect solutions, so that they understand better how to do it right.

### Core part 3

It is essential to make clear to the students that this process produces not only a grade, but THIS IS FEEDBACK and they have the option of making changes and requesting that the teacher GRADE IT AGAIN, SAM before the final deadline without any negative consequences. Therefore, this is a valuable process to support their learning.

In the case of accepted requests, these offer a good opportunity for feedback even when the highest possible grade was acquired according to the quality level of the work. The feedback then could focus on the missing quality aspects which are necessary for reaching the next quality level. This can encourage improvement of the current work, even if a sufficient grade has already been received—something which is not done often in education, but is very helpful for deeper learning. Encourage the students to GO FOR GOLD!

Pattern Name	Summary
GO FOR GOLD (FUTURE WORK)	Encourage the students to continue improving their work, even—or especially—when they already acquired a sufficient grade for it.
GRADE IT AGAIN, SAM [Bergin et al. 2012]	Permit your students to change and re-submit an assignment for re-evaluation and re-grading, after you have graded it and provided feedback.
THIS IS FEEDBACK [Warburton et al. 2016]	For learners to act on feedback they first need to recognize when it has been given.

Figure 2 gives an overview of—and shows the relations between—all core patterns of Incremental Grading.

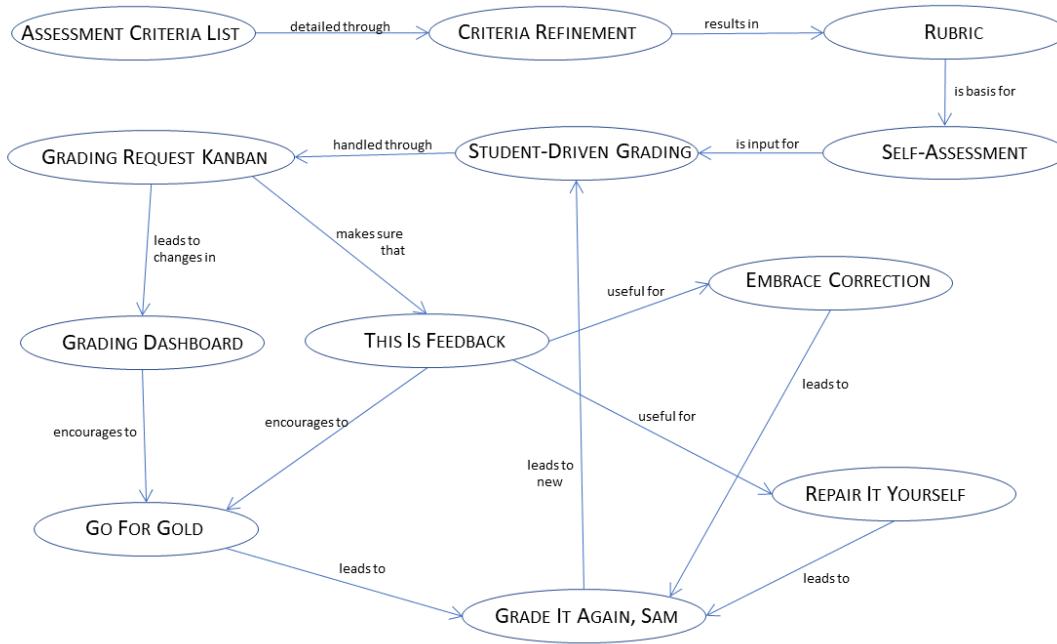


Fig. 2: Core patterns of Incremental Grading

## 2.2 Patterns for enhancing Incremental Grading

### Enhancing part 1

In addition to the grades, a REWARD SYSTEM can motivate the students to continue working on the assignments in order to strive for higher quality (and hence higher grades). Instead of focusing only on their own work, students can also perform PEER REVIEWS to learn from others as well and to help others with their feedback. These reviews can also include PEER GRADING, based on the defined criteria. The results of such grading can easily be used as basis for STUDENT-DRIVEN GRADING, adding even more value for the students.

Pattern Name	Summary
PEER GRADING [Bergin et al. 2012]	Make it possible for students to provide part of the grade for other students.
PEER REVIEW [Warburton et al. 2016]	Develop your students as autonomous and self-regulated learners by asking them to review each other's work and provide feedback (similar to PEER FEEDBACK).
REWARD SYSTEM (future work)	Make all students' achievements—smaller and larger ones—visible to them in an open, ongoing, rewarding and systematic way.

## Enhancing part 2

Students can build up a STUDENT ONLINE PORTFOLIO, which will allow information/assignment results to be easily available for both students and teachers. It may be possible to give feedback directly in the portfolio (as SITUATED FEEDBACK) and grading requests also can easily be included (e.g. a wiki-type solution such as Confluence). When working in groups on projects, a STUDENT PROJECT WEBSITE can contain all relevant information on the project work and linked from the portfolio and the grading requests.

Since Incremental Grading approaches assessments in a way that is different from what is familiar to most students, based on their earlier experiences in education, you can expect that there will be some REBEL STUDENTS. Accept this and help the students become accustomed to the shift of responsibility by explaining the advantages in allowing them to set the constructive interactions with the teacher. There may also be some rebel teachers since this approach changes the way teachers interact with students and the responsibilities everyone has. For both the hesitant students and faculty, it may be persuasive to show the the value in regular feedback with the goal of improving the overall grades.

Pattern Name	Summary
REBEL STUDENTS [Köppe et al. 2017]	When students rebel, don't resist. Open up the space for them to reconstruct the learning experience.
SITUATED FEEDBACK [Köppe et al. 2017]	In order to help students master a certain competence or skill, you design a procedure involving MULTIPLE DRAFTS that receives feedback from teachers situated directly within the given text or product that the student develops.
STUDENT ONLINE PORTFOLIO [Bergin et al. 2012]	Provide a means for students to publish their best work, perhaps on the web. The more public this can be, the better it is.
STUDENT PROJECT WEBSITE [Köppe et al. 2017]	Encourage (or require) your students to setup a website that informs others about their project. The website could state the goals, show team members, inform about the work in progress and milestones. The final outcomes should be presented there as well.

## 2.3 Patterns which are supported through Incremental Grading

### Supported part 1

Receiving feedback following a grading request makes it a delivery moment of value for the student, hence encouraging a CONTINUOUS ACTIVITY. The open and constructive feedback on the grading requests leads to TRANSPARENT ASSESSMENTS (its clear to the students how their grades are determined as they have to do this themselves) and a 'TRUSTED SPACE. Regular grading requests from the students help the teacher to become aware of where the students stand, what difficulties they have, whos not making progress etc., all valuable input for acting as a CONSIDERATE LECTURER.

Pattern Name	Summary
CONSIDERATE LECTURER [Köppe et al. 2015]	Pro-actively ask students on their progress, observe how they perform and react on what you observe in a constructive manner.
CONTINUOUS ACTIVITY [Köppe 2011]	Include regular delivery moments of appropriate artifacts to motivate and engage the students to be active over the whole time of the assignment. These artifacts should be of value for the students.
TRANSPARENT ASSESSMENT [Bergin et al. 2015a]	Ensure that your assessment scheme is visible to your students, from the criteria to the actual tools you use to apply them.
TRUSTED SPACE [Warburton et al. 2016]	Create a space which helps supports deep learner engagement in shared review, dialogic and critiquing processes and hereby creates trust.

## Supported part 2

It is likely that some students will (initially) overestimate their own progress; in these cases, the feedback on the first grading requests can also serve as an EARLY WARNING. As the students get feedback often and early, it is also more likely that they will and can ACT ON FEEDBACK (as opposed to feedback that is given at the end of a course).

When assessment criteria are defined, this opens the possibility of BRING YOUR OWN ASSIGNMENT. Students (and teachers) can check if it is possible to meet the criteria with the assignment. With the focus on the quality criteria for grading and assessment, it can become less prescriptive how these can be achieved. This allows for MULTIPLE LEARNING PATHS.

Pattern Name	Summary
ACT ON FEEDBACK [Warburton et al. 2016]	Close the feedback loop by making sure you allow time for students to act on the feedback they have been given.
BRING YOUR OWN ASSIGNMENT [Köppe et al. 2017]	Students are less motivated to work on offered standard-assignments, so have them work on assignments they proposed themselves.
EARLY WARNING [Bergin et al. 2012]	Give students an early warning when you see that they are headed for trouble or fall behind.
MULTIPLE LEARNING PATHS [Köppe et al. 2017]	Design your course to allow alternative paths, combining hybrid interactions in different ways, for reaching the learning objectives to account for diverse learner circumstances and preferences.

### 3. INCREMENTAL GRADING IN PRACTICE

#### 3.1 Design and Execution

The full pattern language of Incremental Grading was applied for the development and first execution of a semester on Object-Oriented Software Engineering (OOSE) at HAN University of Applied Sciences in the Netherlands. This semester is part of a part-time bachelor program on Software Engineering and runs for 19 weeks. It was developed according to ASSESSMENT-DRIVEN COURSE DESIGN [Bergin et al. 2015b], starting with the definition of the learning objectives, the assignment forms, and the assessment criteria.

There are in total 8 assignments, where 7 are longer-running and applicable for Incremental Grading (the last one was a written exam). All assignments have assessment criteria described in rubrics. Per assignment, there are 1-8 different weighted criteria, all with 5 quality levels. These quality levels are mapping to grades 1, 4, 6, 8, 10 on a scale from 1 (lowest) to 10 (highest), the grade for passing is 5.5. For most assignments the students could make use of the compensation rule: the minimal required quality level was 4 given that the weighted average of all assignment elements is 5.5 or higher. Figure 3 shows an example with the rubrics for the case study assignment (translated from Dutch).

Assessment dimension	Name Criterium	Weight	Min	10	8	6	4	1
B_Case1-1	functional requirements	20	4	all functional requirements complete, unambiguous, comprehensible and testable described	all important functional requirements described OR comprehensible/unambiguous and testable	most of the important functional requirements described, mostly comprehensible and testable	many requirements are missing or are not completely understandable or mostly not testable	essential requirements are missing or are not comprehensible or are not testable

Fig. 3: Rubrics example from case study assignment



In the next step the deadlines for all assignments were defined and the moments when the assignments are introduced. Figure 4 shows this planning: relative to the time-line (showing the weeks), the blue circles symbolize the deadlines and the yellow ones the moment of assignment introduction. In the time between these moments (the straight lines between the circles), the students were allowed and encouraged to apply STUDENT-DRIVEN GRADING and send in grading requests. The planning was also published in the E-Learning environment so students were able to see the planned workload for a certain week, but it also gave us an overview of how realistic this workload is.

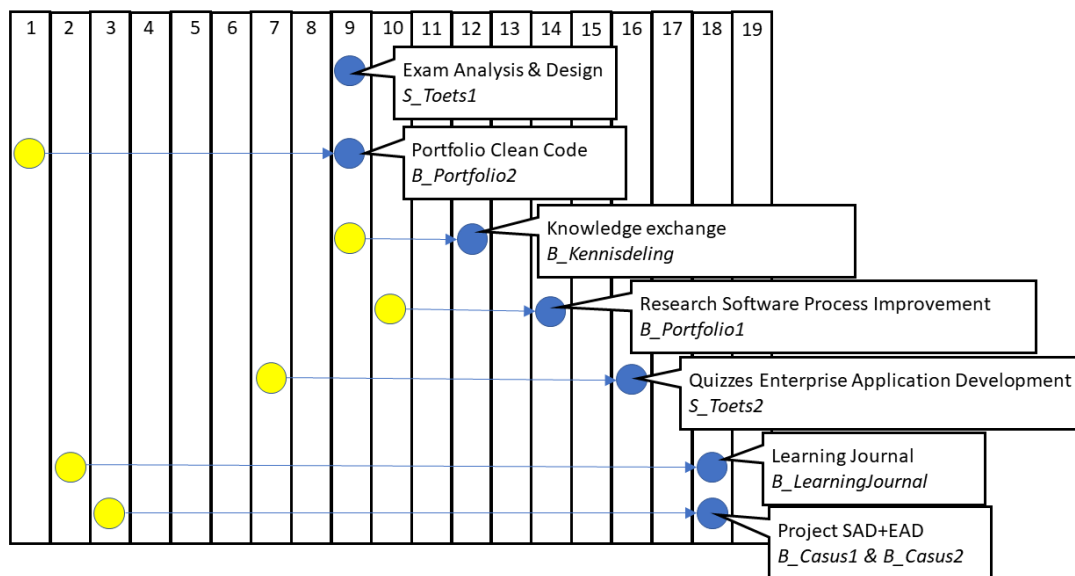


Fig. 4: General assignment planning, the top element was a written exam (hence no starting point) and the bottom element comprises two assignments (two aspects of one larger project)

For the grading requests, a template (shown in Figure 5) was provided that the students had to use for providing the required information:

- (1) for whom,
- (2) which rubric/s,
- (3) which grade/s requested,
- (4) justification for the grade/s,
- (5) a link to work/evidence, and
- (6) how to submit the request.

We used a Jira board for GRADING REQUEST KANBAN. Students had to add issues in the todo-column, including a link to their original grading request. Teachers then picked up the oldest issues and reviewed them. After review, the issue was moved from the teacher's column to done. This board was also openly visible for the students, hence giving them a good idea of how long it likely will take until their grading request will be handled (based on the number of earlier not-handled issues). Figure 6 shows a screenshot of the board.

The results of a handled grading request were added to the student's individual grading dashboards. These dashboards include all assignments, all rubrics, and the grades per rubric. Colours gave an easy indication of the progress: in the

Created by Jelle [redacted] last modified on Nov 30, 2017

Naam	@Jelle [redacted] en @Jens [redacted]
Opdracht	Domeinmodel
Welke rubrics	B_Casus1-2
Onderbouwing per rubric waarom bepaald niveau bereikt is	8 <ul style="list-style-type: none"><li>Alle functionele eisen, zoals opgesteld in de functionele requirements, zijn als domein toegevoegd</li><li>Zowel de must have's als de should have's zijn opgenomen in het model</li><li>Het model is compleet met alle relaties en beschrijvingen daarvan</li><li>Daarnaast is er sprake van documentatie voor alle elementen waarin de keuzes worden toegelicht</li></ul>
Referenties naar bewijs/producten (links)	<a href="http://94.124.143.61/confluence/x/FoCY">http://94.124.143.61/confluence/x/FoCY</a>
Indienen	Creer een nieuwe taak op <a href="http://jira.icaprojecten.nl/secure/RapidBoard.jspa?rapidView=481">http://jira.icaprojecten.nl/secure/RapidBoard.jspa?rapidView=481</a> met een link naar deze Confluence pagina

Fig. 5: Grading request template (in Dutch)

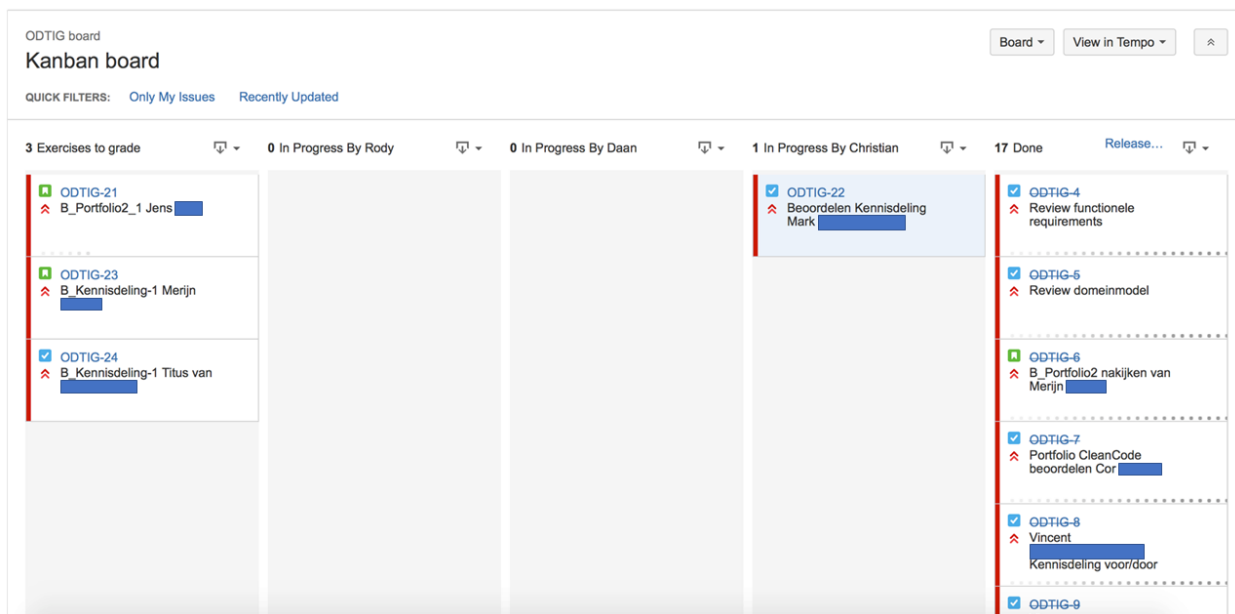


Fig. 6: Kanban board with grading requests

beginning all cells with grades were dark red (mapping to the lowest grade) and during the semester, more and more of the dashboard became green (from light to dark). The dashboards were Excel-sheets and were published in a public Dropbox-folder.

In every review of a grading request, the link to the updated version of the dashboard was added to the review so that students could easily access it. Figure 7 shows an (anonymized) example.

Semester: OOSE-DT		Student: Bjorn											
EVL	Toets											voldoende	
Software Analysis & Design	S_Toets1	S_Toets1-1.1	S_Toets1-1.2	S_Toets1-1.3	S_Toets1-2.1	S_Toets1-2.2	S_Toets1-3					Eind	5,8
	B_Casus1	B_Casus1-1	B_Casus1-2	B_Casus1-3.1	B_Casus1-3.2	B_Casus1-3.3	B_Casus1-4	B_Casus1-5&6				Eind	1
Distributed Application Development	B_Casus2	B_Casus2-1	B_Casus2-2.1	B_Casus2-2.2	B_Casus2-3	B_Casus2-4.1	B_Casus2-4.2	B_Casus2-4.3	B_Casus2-5.1	B_Casus2-5.2		Eind	1 N
	S_Toets2	Basic	Presentation	Domain	Data							Eind	1 N
Software Process Improvement	B_Portfolio1	B_Portfolio1_1	B_Portfolio1_2.1	B_Portfolio1_2.2	B_Portfolio1_2.3	B_Portfolio1_3	B_Portfolio1_4	B_Portfolio1_5				Eind	6,4
	B_Portfolio2	B_Portfolio2_1	B_Portfolio2_2	B_Portfolio2_3								Eind	8
Craftsmanship	B_Kennisdeling											Eind	1
	B_LearningJournal	B_LearnJour_1	B_LearnJour_2	B_LearnJour_3								Eind	1 N
											Eind	3,08	

Fig. 7: Dashboard example

### 3.2 Experiences

The approach of Incremental Grading was introduced in the second week of the semester. The students got an explanation of the main idea and our reasons behind applying this approach in this semester (as it was different from their experiences in other semesters). We showed them how they are expected to hand in grading requests and where they can find the rubrics for assessing their own work. Unfortunately, we did not practice the use of the rubrics or discussed them in more detail as we assumed that these are clear enough for the students. The results show that this was not completely the case (we'll come back to this later).

During and at the end of the semester, data were collected in both formal and informal ways. The formal data include: data on all grading requests and their handling, the grading dashboards, and a questionnaire taken shortly after the semester. The informal data are based on direct interactions with the students and informal feedback given by the students during conversations or email exchanges.

According to the initial enrollment list, we expected 28 students to take part in the OOSE module. However, only 23 students actually started the semester and 6 of these dropped out due to personal or organizational reasons. 17 students finished the semester, of which 14 with a passing total grade. The 3 students not passing the course had a sufficient total grade, but had not fulfilled all minimum requirements so that the compensation possibility did not apply.

In total, 127 grading requests were handed in. 73% of them were fully approved (all requested grades matched the justification and evidence), 15% were partially approved (only some of the requested grades were approved), and 12% were fully declined (including 7 declines based on improper use of the template or missing information in the request). The distribution of the grading requests per week is shown in Figure 8. This shows that 60% of the review work for the teachers was done before the last week. At the moment of the deadline passing (end of week starting on 22/01/18), there were only three open grading requests left. 14 grading requests were handed in for reparation and 2nd chances (during the week starting on 29/01/18), so there was only a small peak in the last week before the deadline. Note that the deadline for most assignments was set to one week before the semester ends. The peak could become even less if the deadlines would be more distributed throughout the semester.

After receiving declined or not fully approved grading requests, students could either request a lower, more realistic grade or improve their work and request the same or even a higher grade. 53% of the students requested lower grades and 47% requested the same or higher grade. In the latter case, it means that students improved their work (EMBRACE CORRECTION and REPAIR IT YOURSELF). 4 students did GO FOR GOLD and requested higher grades after already having passing grades approved.

week	#GR	approve	part. approve	decline
09/10/17	2			2
16/10/17	2	2		
23/10/17	2	2		
30/10/2017 (hol)				
06/11/17	1	1		
13/11/17	4	2	2	
20/11/17	3	1	1	1
27/11/17	4	3		1
04/12/17	5	5		
11/12/17	6	4	1	1
18/12/17	2	2		
25/12/2017 (hol)	2	2		
01/01/2018 (hol)	6	5	1	
08/01/18	8	3	3	2
15/01/18	20	16	4	
22/01/18	46	33	6	7
29/01/2018 (2nd)	14	12	1	1

Fig. 8: Grading request distribution

It is interesting that the percentage of full improvements is slightly higher in the second halves of each individual student's grading requests (55%). This could be interpreted as a light improvement of the self-assessment skills of the students during the semester, but needs to be explored more thoroughly. We also observed that the students initially had trouble with interpreting the RUBRICS, leading to more declines. This could be improved in the future through introducing the rubrics earlier in the semester and practicing of how to use them for assessment.

The data does not support the fear we heard from colleagues that the option to submit grading requests whenever and as often as the students want will lead to a high numbers of requests. It became clear that students worked on the assignments (or parts of it) until they were convinced that they reached a certain quality level and did not request grades for unfinished work.

A questionnaire was taken in the first week after the semester, the results are shown in Figure 9. 13 students filled in the questionnaire, 3 of them forgot to fill in the question on the back side (hence lower totals for the last questions).

The results show that Incremental Grading was mostly seen positive. However, some students clearly disliked it. Possible reasons (based on informal discussions) are that they have trouble with taking the responsibility for their own learning instead of having the teacher telling them exactly what to do. Furthermore, self-assessment is not experienced as pleasurable.

It becomes clear that students still did not recognize the reviews of their grading requests as feedback. This needs to be more emphasized in future executions (THIS IS FEEDBACK). And even though the students had the possibility to ask for the feedback in a direct way from the teachers, not only via grading requests, the students did not make use of this very often.

It's also obvious that the quality of the rubrics is essential and how the students learn using the rubrics for their self-assessments. In this first execution, the rubrics were not explicitly introduced and there was no practice of how to use/interpret them. This needs to be more included in future executions, e.g. by having students assess some products similar to their own using the rubrics or by discussing the different quality levels in class.

The results also show that the GRADING DASHBOARD was experienced as helpful and that the use of colors was motivating. One student did send a direct message to one teacher after a grading request was handled (which resulted in a grade change in the dashboard, but not a color change to green in the cell due to an error in auto-formatting) asking if the color of the cell also could be changed. The dashboards were also experienced by the teachers as helpful, as they

	full disagree	disagree	neutral	agree	full agree
I liked the style of assessment (Incremental Grading with Grading Requests).	2	2	0	6	3
I'd like to see Incremental Grading applied in other semesters too.	1	3	2	5	2
I'd like to have been receiving more feedback.	1	1	3	5	3
Having a Grading Request not approved did not feel bad.	1	6	2	2	2
I would have preferred to be assessed by the teachers instead of having to do it myself.	0	3	4	4	2
I tried to get assessment parts done as fast as possible so that they can be graded.	1	2	2	5	2
The rubrics were easy to use.	1	6	3	0	3
The rubrics were sufficiently clear and well described.	3	6	1	2	1
Based on the rubrics, I was able to assess my own work well.	0	2	4	6	1
After a grading I always looked at my dashboard.	0	2	0	4	4
The colours in the dashboard were unnecessary, they didn't add much to the grading.	3	3	1	1	1
The dashboard helped me to keep an overview.	0	0	3	4	3

Fig. 9: Results questionnaire

gave a clear overview of where students stand and how they perform. Based on this information, some students were directly asked about their progress if they performed less than their peers (CONSIDERATE LECTURER). The dashboard also opens possibilities to anonymously collect and share all students' progress so every student can compare her progress to the rest of the class with some kind of trend line or planning.

Returning to the initial problems outlined above, we can summarize our experiences as follows:

- Grading vs. feedback* - not solved well; students saw grading requests mostly still as grading only, not as feedback.
- Big Bang grading* - most students worked incrementally on the assignments and had a good picture of where they stood and what still needed to be done.
- Low self-assessment skills* - a light indication that these have improved slightly; more evidence is needed here.
- Little ownership of learning process* - partially solved; some students actively made use of the possibilities for taking control of when and how they learn; the dashboard was mostly experienced as helpful tool.
- Procrastination (aka Students Syndrome)* - some students made extensive use of the STUDENT-DRIVEN GRADING and started working early and regularly on the assignments, handing in grading requests whenever they had a part finished. However, some students stuck with their old habit and started working on the assignment as the deadline started to approach. It therefore worked well for some students, but not all.
- Heavy workload peaks for instructors after deadline* - this is certainly solved, but slightly increases the time the lecturers must be available throughout the term.

One question that was raised at semester end was the issue of whether Incremental Grading also scales and is applicable for larger student groups as well. We believe that it does, but we have no proof for this. The amount of work for each of the 3 teachers involved in this semester was comparable to the amount of work if the semester would have been executed in the usual way (which involves two of the teachers in the same semester using standard grading at the end, so they can compare both executions).

#### 4. SUMMARY AND FUTURE WORK

Even though we only can present early data, we believe that Incremental Grading is a promising approach to address the challenges mentioned in the first section. By describing it as a pattern language we hope to help educators with applying and adapting the approach in their own environment. It is also possible to select just a few elements (or patterns), but we think that the configuration of all of them generates a valuable educational experience for both students and teachers and supports learning in a motivating way. However, given the challenges in our first instance, we recognize that this certainly requires changing mindsets. The students need to let go of the idea that it is only the teacher's responsibility to assess their work and take more control of their own learning. On the other hand, the teachers also need to let go of the idea that only they determine the quality of student's work; students can do that themselves (which is also beneficial for their learning). Some teachers might feel uncomfortable with an experienced loss of control, but our experiences clearly show that this is not the case. Even better, it becomes much easier to keep an overview of students' progresses and therefore help them in a more timely manner.

Besides evaluating more thoroughly how Incremental Grading affects the above mentioned challenges, there is a chance that applying this approach has impact on other aspects of education as well. Open questions for future research could be: How does Incremental Grading affect the motivation of students? How does Incremental Grading affect student collaboration? Does limiting the number of allowed grading requests have an effect on the results? How do interim deadlines affect the outcomes of Incremental Grading?

There are plans to execute Incremental Grading for a second time in the upcoming semester. Some changes to the execution will be made (better introduction of rubrics, more focus on the feedback-aspects, etc.) and data will hopefully show if these changes lead to better results. In addition, one of the co-authors will use a portion of this approach, for the first time, in one of her upcoming courses. As technical support for this approach is essential, we also started to explore ways of combining existing tools which are present in many Learning Management Systems in order to offer a low-effort infrastructure which can be easily adapted by other educators.

We also like to encourage other educators to apply this approach or parts of it in their own environment and to share their experiences. We're interested in the applicability of it in other domains than software engineering and in other educational environments than higher education in the Netherlands.

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## 6. APPENDIX

The following table lists all patterns of the Incremental Grading Language in alphabetical order. Some of these patterns are new and will be described in detail in future work.

Pattern Name	Summary
ACT ON FEEDBACK [Warburton et al. 2016]	Close the feedback loop by making sure you allow time for students to act on the feedback they have been given.
ASSESSMENT CRITERIA LIST [Bergin et al. 2015b]	Clearly communicate to students what the criteria for assessment are.
BRING YOUR OWN ASSIGNMENT [Köppe et al. 2017]	Students are less motivated to work on offered standard-assignments, so have them work on assignments they proposed themselves.
CONSIDERATE LECTURER [Köppe et al. 2015]	Pro-actively ask students on their progress, observe how they perform and react on what you observe in a constructive manner.
CONTINUOUS ACTIVITY [Köppe 2011]	Include regular delivery moments of appropriate artifacts to motivate and engage the students to be active over the whole time of the assignment. These artifacts should be of value for the students.
CRITERIA REFINEMENT [Bergin et al. 2015b]	Refine assessment criteria to a detailed level.
CUMULATIVE GRADING (future work)	Let students accumulate points toward a total for the course, with grade breakdowns for different point totals known in advance.
EARLY WARNING [Bergin et al. 2012]	Give students an early warning when you see that they are headed for trouble or fall behind.
EMBRACE CORRECTION [Bergin et al. 2012]	Give the students the chance to improve their work.
GO FOR GOLD (future work)	Encourage the students to continue improving their work, even—or especially—when they already acquired a sufficient grade for it.
GRADE IT AGAIN, SAM [Bergin et al. 2012]	Permit your students to change and re-submit an assignment for re-evaluation and re-grading, after you have graded it and provided feedback.
GRADING DASHBOARD (future work)	Present the current status of the student's grading in an overview dashboard.
GRADING REQUEST KANBAN (future work)	Use a Kanban board for handling grading requests in a timely and transparent manner.
MULTIPLE LEARNING PATHS [Köppe et al. 2017]	Design your course to allow alternative paths, combining hybrid interactions in different ways, for reaching the learning objectives to account for diverse learner circumstances and preferences.
PEER GRADING [Bergin et al. 2012]	Make it possible for students to provide part of the grade for other students.
PEER REVIEW [Warburton et al. 2016]	Develop your students as autonomous and self-regulated learners by asking them to review each other's work and provide feedback (similar to PEER FEEDBACK).
REBEL STUDENTS [Köppe et al. 2017]	When students rebel, don't resist. Open up the space for them to reconstruct the learning experience.
REPAIR IT YOURSELF [Köppe et al. 2015]	Let students correct their wrong or incorrect solutions, so that they understand better how to do it right.
REWARD SYSTEM (future work)	Make all students achievements'—smaller and larger ones— visible to them in an open, ongoing, rewarding and systematic way.
RUBRIC [Bergin et al. 2015b]	Rate each Refined Criteria on a sheet and aggregate the mark.
SELF-ASSESSMENT (future work)	Assessment criteria are given (e.g. as RUBRICS) and students rate themselves using these criteria
SITUATED FEEDBACK [Köppe et al. 2017]	In order to help students master a certain competence or skill, you design a procedure involving MULTIPLE DRAFTS that receives feedback from teachers situated directly within the given text or product that the student develops.
STUDENT-DRIVEN GRADING (future work)	Give students the responsibility for determining the quality of their work and what the grade for this (part of the) work is. Let them justify and provide evidence for the determined quality and the corresponding grades. When accurate, then the students earn the grades.
STUDENT ONLINE PORTFOLIO [Bergin et al. 2012]	Provide a means for students to publish their best work, perhaps on the web. The more public this can be, the better it is.
STUDENT PROJECT WEBSITE [Köppe et al. 2017]	Encourage (or require) your students to setup a website that informs others about their project. The website could state the goals, show team members, inform about the work in progress and milestones. The final outcomes should be presented there as well.

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**Table VIII – continued from previous page**

Pattern Name	Summary
THIS IS FEEDBACK [Warburton et al. 2016]	For learners to act on feedback they first need to recognise when it has been given.
TRANSPARENT ASSESSMENT [Bergin et al. 2015a]	Ensure that your assessment scheme is visible to your students, from the criteria to the actual tools you use to apply them.
TRUSTED SPACE [Warburton et al. 2016]	Create a space which helps supports deep learner engagement in shared review, dialogic and critiquing processes and hereby creates trust.

The following table gives an overview of all referenced patterns in the paper which are not directly part of the presented pattern language.

Pattern Name	Summary
LEARNING JOURNAL [Köppe et al. 2017]	Promote reflection and a sense of learning community by asking learners to post regular short texts, where they share and reflect on their personal learning experience.
PERFORMANCE SHEET [Bergin et al. 2015b]	Undocumented assessment criteria are both unfair and impossible to apply. Rate each Refined Criteria on a sheet.