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Case- and problem-based group assignments and the effects of formative feedback

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Introduction

In a common setting of teaching process, the mutual interactions between the students and the teacher can be illustrated as continuous stream of information exchanges by utilizing teaching materials, lectures, assignments, presentation and evaluations. According to the teaching portfolio and predefined ILOs (intended learning outcomes), the ultimate objective of the teaching process would be to improve the experiences of both parties - teachers and students – in a positive notion, meanwhile, maintaining high evaluation marks, with minimum inputs of resources. Among many prerequisite resources in a teaching process, time is the one of the most important factors, which can determine the quality of teaching and learning outcomes from the teachers' point-of-view. The balance between research and teaching is tedious to achieve and time-consuming process is inevitable. In this sense, it is critical to manage good quality of teaching with high quality research to maintain the research group more recognized in a field of science, which can tremendously stimulate the teaching process with obtained authority and attractive forces for students in the classroom as well.

Here I describe how the burdensome of teaching process can quickly be optimized by using web-based formative feedback process, which can minimize time resource, while providing high quality information to students in their learning process. The course title is: Reactions and Synthesis in Medicinal Chemisty for MSc students (2 blocks, 15 ECTS, 48 students, 2 teachers). The group assignments were designed to serve as case-based (Wassermann, 1994) and problem-based learning (PBL) materials to create

active-learning process. The provided feedback (Hattie & Timperley, 2007) is mostly through Absalon (web-based platform) to facilitate the interactions and to avoid the physical barrier between students and teachers. The evaluation was performed via oral examination for 30 minutes. Due to the time limit, this report is based on the evaluation of 3 students who have already examined before the actual exam week.

Course Description

Contents: The topics are: Transition-metal catalyzed reactions including cross-coupling reactions; Stereospecific aldol-additions; Chiral auxiliaries; Pericylic reactions including click-chemistry; Rearrangements; Fragmentations; Radical reactions including carbenes; Microorganisms and enzymes in synthesis; Methods for the resolution of racemic mixtures: Classical resolution, enzymatic resolution, spontaneous resolution and methods for determination of optical purity; Microfluidics in synthesis; Solid-phase supported reagents for synthesis; Case stories from the medicinal industry: What is an invention? Scalability problems.

Intended Learning Outcomes (ILOs)

Competencies: Be able to analyze a complex synthetic problem and plan a feasible synthesis. Be able to analyze scientific papers and patents dealing with synthetic problems and be able to spot inconsistent claims.

Skills: Apply the acquired knowledge on organic synthesis on a given target molecule. Be able to translate known methodologies to new problems.

Knowledge: Have an in depth knowledge of modern synthetic organic synthesis according to the content of the course.

Evaluation: 30 minutes without preparation time. The subject of the evaluation is one of the assignments with which students had already dealt. (7-point grading scale).

Workload: lectures 26 h, theory exercises 52 h, preparation 333 h, exam 1h, total: 412 h.

Outlined Methods

The investigation was designed to know how ‘problem-oriented’ teaching would influence Intended Learning Outcomes (ILOs) based on level of student activities. The students have diverse background (university, country,

education level) and therefore, it is hard to formulate a unified direction of the lessons. It is of utmost importance to enhance ILO under any circumstances, and one of our solution is to utilize 'problem-oriented' teaching method. Each week, we display one target (to retrosynthesize) based on the teaching materials of the week. The teaching materials is highly related to the target molecules, and therefore, the students are well equipped with motivation and basic knowledge. The assignments will not be graded but are supposed to be handled with feedback. The selected group consisted of three international (visiting) BSc-level students, who are not familiar with current teaching setting. The course is for MSc-level students therefore, it was expected that this particular group might underperform compared to the average of students.

Challenges to face

In many cases, teaching can be tedious due to the repetitive procedures in assignment grading and teaching materials for students as well as for teachers. In this course, as shown in the course description, the students are obliged to submit their assignment bi-weekly, and each assignments are heavily associated to the topics of classroom teaching session, therefore, the classroom teaching and the assignments are more coherent. However, there are many expected challenges in the process:

Formation of the Project Groups: In the project (assignment group) the students are allowed to choose their own group, therefore, the groups are tend to be formed based on previous friendships and acquaintances. Also, there are many students who couldn't find an adequate project group (at the current course set, we found 3 students), therefore, teachers had to interfere and force them to form a group. Eventually, it turned out to be positive, however, initial stress on the students could lead to drop-out or other personal consequences, of which should be taken care.

Collaboration Dynamics: The teachers have no information regarding the dynamics of each groups, in terms of discussion culture, work load, structure of collaboration and how they deliver the project. These may affect the learning outcome from the projects, however, it is technically difficult to follow up and manage in detail.

Formats of Feedback: The formats of feedback that has been used in this course is mainly texts in on Speed Grader. Other forms of feedback (drawings, graphics, additional literature) is also possible and it has been

tried out. The feedback is mainly non-prioritized feedback as a continuous, line-by-line comments on assignments pdf. In the end, summary of teacher's feedback was given with remarks (it's ok (D), good (C), very good (B), excellent (A)). The main purpose of the given feedback is: to improve student's ability to communicate in a language in organic chemistry, where many forms of communication in industry and academia happen by drawing chemical structures and reaction mechanisms. The challenge is the deviation of quality of students, therefore, the formats of feedback was divided two main groups: for beginners and intermediate to lead both groups to competent level of organic chemists.

Effects of Feedback: the project will be delivered via online platform (Absalon) as a pdf format only and the feedback process will be performed using 'speed grader'. This web-based system allows students and teachers to interact real-time without any barriers. Given feedback can be a next topic of discussion with students using the same platform. However, some students are not used to work with online formats, therefore diminishing the effect of feedback significantly. As a teacher, it has been announced and advertised to students to work with the online formats to encourage the participation rate. Also it is found to be difficult to follow up hot much the given feedback has been used by the students since the interaction is semi-anonymous throughout the whole process. An intermediate face-to-face consultant would be desired but it was not realized many times due to the time and space restrictions.

Considering the current fixed setup at the classroom teaching and assignment, and the above-mentioned challenges, the web-based feedback process was performed as thorough as possible to maximize the outcome of the project group assignment. It is noteworthy here that the MSc-degree students in organic chemistry section are subjected to two main passages of curriculum: 1) 1-year class room teaching and 2) 1-year thesis research project (Figure 11.1, Rienecker, Jørgensen, Dolin, and Ingerslev (2015)).

Therefore, the importance of the classroom teaching in the line with the research competence of students can not be underestimated. The current group assignment and feedback process was also aimed to improve the competence of potential research activities as an individual researcher, therefore, the provided feedback includes detailed information regarding 1) grammar skills, 2) chemical structure drawing skills, 3) chemistry jargons, and 4) non-prioritized comments on minor mistakes. Although self-esteem of students can be affected by this, the teachers decided to refurbish it as much as possible at the beginning of the course period to enhance the ef-

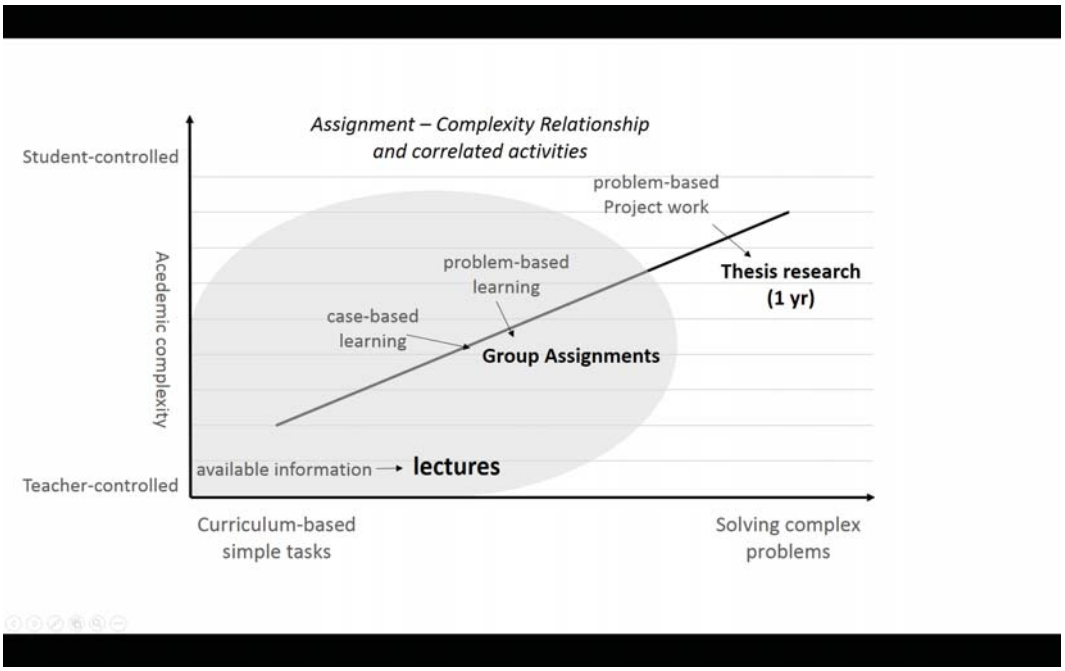

Fig. 11.1: Assignment-complexity relationship and correlated students' activities in Department of Chemistry, MSc students (Orgnic chemistry section). (Adapted from Ch 4.3 Case-based learning, L. Krogh, D. Stentoft, J. Emmersen, P. Musaeus, University teaching and learning, 2015, Samfundslitteratur)

ficiency and also to provide comfortable environment in the end of course period, where more difficult and important intended learning outcomes are placed on.

Results

As shown in Figure 11.2, the interface on Absalon is highly user-friendly and intuitive to use. Along with the assignment, multiple tasks are feasible, to add comments, highlight, strike. A plagiarism detector can be also introduced, however it was not used in this study. The interface allows users to be connected virtually with additional possibilities to add multimedia files. Although it is not attempted, it would be a good addition to upload video or audio files as feedback materials.

A designated group (international BSc students) are subjected to submit bi-weekly assignment on Absalon in the MSc-level course in the Department of Chemistry. Although the group consists of BSc students, the reports

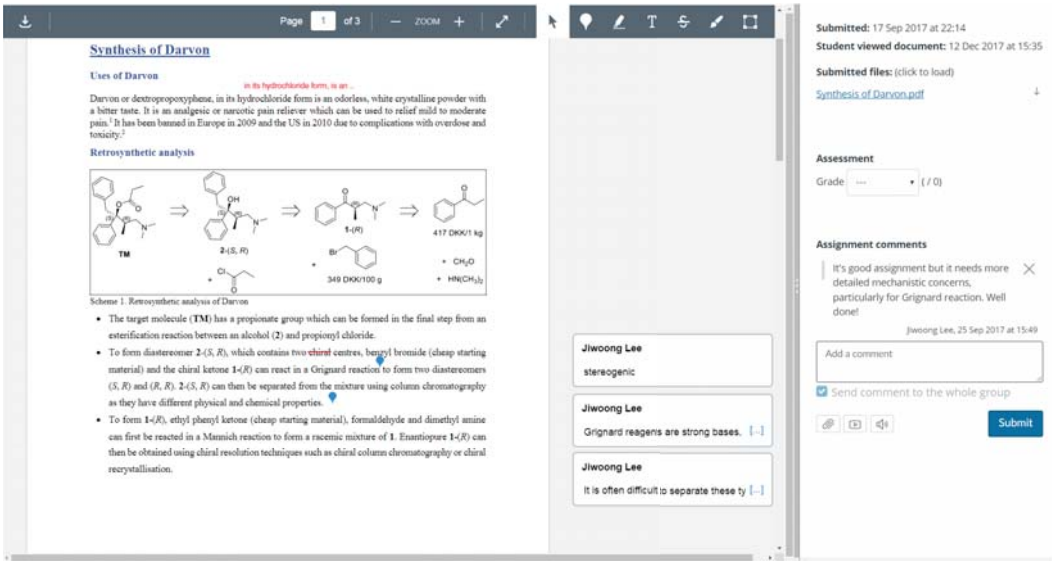

Fig. 11.2: Snapshot of Speedgrader system. A submitted assignment on the left side with line-by-line comments. The interface allows you to add graphical comments. Final remarks can be added on the right side, where further discussion with students is possible.

showed good level of chemistry knowledge in the first assignment beside minor mistakes and misunderstanding in certain key points. The summary of feedback was formulated to be very simple and positive, starting high-priority feedback: general remarks. First two assignment were in the level of B-D grades, however, the quality of report quickly increased to A-B with deep understanding in the topic, good quality of English writing in chemistry language (Schimel, 2012), and high-level of presentation skills. It was observed that much of only-positive comments gave lower quality of reports for the next assignment round. It was assertive sign that the provided feedback was used by the students and the course of learning could be changed, and controlled to improve the intended learning outcomes. One of the important ILOs is to improve creative ideas, in parallel to a traditional case in the assignments.

In the last assignment, the group presented an original idea to access a pharmaceutical active ingredient. Additionally, two students of the group received high marks (10 from 7-grading system), which showing that the majority of students of the group successfully achieved high standard of ILOs.

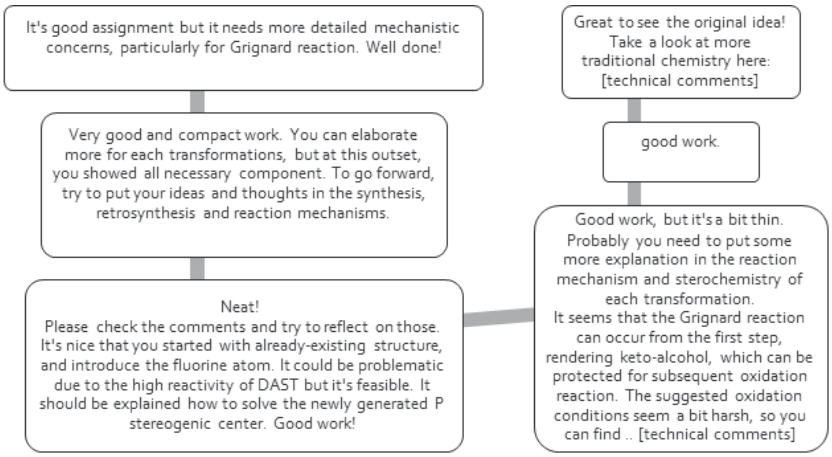

Fig. 11.3: Summarizing comments on assignments from a group. Starting from left-top, by providing formative feedback, the group achieved high standard of assignment in the end of the course (right top).

Discussion and Conclusion

Here I showed how to balance formative and summative feedback in online-based platform. This was critical to increase the student's abilities to identify the problem sets and to tackle the problem with appropriate scientific background as quick as possible with high communication opportunities with teachers. To achieve ILOs, the key challenges were set to enhance the average level of competency in solving the problem set. Also, this challenge could be associated with the learning outcomes and active learning processes, since the problem-solving process in a group is indeed an active participating process. The sample group showed high quality of reports throughout the assignments, with the help of positive and formative feedback. Line-by-line comments were helpful strategy and Absalon system greatly reduced the time spent on the grading. Also, the web-based system allows students and teachers to have less activation barrier for active participation and communication. Finally, in the case of group assignments reports it was found to be effective to use formative feedback rather than summative feedback, to enhance competency of the students while preventing diminishing self-esteem of groups of students.

The sample group successfully achieved high marks in the evaluation. It would be highly interesting expend this sample group to the whole class, with an organized feedback structure for categorized student groups. Peer-

feedback system was attempted, however, it was not successful due to the lack of intense instruction from teachers at this juncture.

In conclusion, I found that online-based feedback system is beneficial to save time for grading group assignment and also to improve the competency of students in developing required skills sets in the course. Careful follow-up of a particular group of students showed that positive and formative feedback can lead to successful achievement with the ILOs, based on the final evaluation. Further studies in more detailed analysis and structured evaluation would be highly interesting, which will be performed simultaneously within my teaching and supervision.

Future Perspective (based on the peer-feedback)

The written feedback should not be an answer sheet for students while encouraging students to find the answers by themselves. It will need more fine-tuning of the structure of the formative feedback. The online-feedback platform can actually saves a significant amount of time for teachers by preventing the time-consumed by non-academic processes (printing, delivery, meetings, writing). It was suggested that the online-feedback system could be connected to laboratory courses and MSc-thesis evaluation.

After evaluation of the course period, few students argued that the online-system gave negative effect on their learning process due to the fact that the students were not familiar with it. This should be resolved by introductory lecture on Absalon in practice, probably in the very beginning of the course. Also, it should be noted that the online-feedback should be more carefully structured since those students may not follow it as much as traditional methods.

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