Enhancing Students Multivariable Calculus Learning Through Online Formative Feedback

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Abstract. Feedback is a major component of formative assessment and thus can be said to have a high influence on student learning experiences. It is used to inform students of their strengths, weaknesses, and strategies so that the gap between their current knowledge and understanding and the desired standard of achievement can be narrowed. However, research shows that students are less encouraged to engage in the feedback process mainly because of their difficulty in relating to and reflecting on feedback comments. In this paper, we look at how to support the provision of formative feedback through e-learning tools. Our aim is to increase the acceptance of feedback and to reinforce the quality of feedback through the way the feedback is communicated to students. This study describes how communication activities promote deep learning.

1. Introduction
Today’s rapid technological developments have changed the way people live and work. In teaching and learning, technology is changing pedagogical practice and revolutionizing teaching delivery methods. Higher education institutions are required to move part or all of their teaching, learning and assessment activities online [1]. This is in line with one of the main goals of technology-supported higher education, namely to make students more actively involved in the learning process [2].

One important pedagogical factor to consider when designing online learning in higher education is to create a learning environment where content and assessment are integrated into the learning experience and knowledge building [3]. There is a close symbiotic relationship between teaching, learning, and assessment [4] where assessment is fundamental in the teaching and learning process. What is assessed defines what is taught and how it is learned. The assessment process will shape learning practices and influence learners' views on the value of engagement in learning [5].

Although formative and summative assessments are important [6], there are always debates related to both [7]. Summative assessment is said to dominate the teaching process in higher education at the expense of formative assessment [8]. For this reason, Koç et al. [9] suggest the development of instructional assessment activities that not only assess the final product or performance but also provide continuous feedback about learners' learning.

In the context of learning at Medan State University, a curriculum based on the Indonesian National Qualifications Framework has been applied to the lecture process since 2017. Previously, the assessment domain and learning tools were managed independently by lecturers in related subjects including multivariable calculus courses. Lecture standards covering aspects of knowledge, skills, and attitudes where student competence is fostered through six tasks (routine assignments, critical book
Reports, critical journal reports, idea engineering, mini research and projects) require lecturers and students to meet deadlines. The new policy where there is a formative assessment arrangement is seen as more challenging for both faculty and students and is therefore important to investigate.

This curriculum aims to produce graduates with character in which knowledge and skills are always led by attitudes. Although the institution has provided an Online Learning System, SiPDa platform, that makes it easy for lecturers and students to achieve this goal, it cannot be denied that the assessment of the six assignments still adds to the increase in lecturer workload along with the increasing number of classes and students. As a result, most lecturers tend to focus more on the structure and development of the module than to be preoccupied with matters related to the status of student learning progress and development. Whereas the progress and development of student learning is the main goal of formative assessment [10-12]. In addition, assessment and formative feedback are still largely controlled by lecturers, as identified by Nicol & Macfarlane-Dick [13], feedback is conceptualized as a transmission process. On the student side, observations based on the researcher's personal teaching experience revealed that there was an increased feeling of fear of failing a course and repeating it. In this view, the problem to be solved through the proposed research is a practical educational problem that requires practical research-based solutions, namely formative assessment practices and ineffective feedback in a blended learning environment.

2. Methodology
The feedback activity tool in SiPDa was used to provide formative feedback for the assessment of the Multivariable Calculus course taught in the second year of the undergraduate mathematics program. As part of the assessment for this course, 45 students were asked to conduct several small-scale literature reviews on one of two Multivariable Calculus topics: Partial Differentiation and Iterated Integrals. In essence, this task aims to build students' understanding and competence in analyzing multivariable functions behavior. Students were asked to do a literature search; to apply differential and integral techniques to multivariable functions; to judge evidence deductively; and evaluating alternative proposals. Students were also directed to use online discussion forums to clarify their findings.

During the first three weeks of the course, one session was devoted to briefing about course work and creating an online discussion forum. A number of statements that correspond to each of the criteria and grading used in the assignment assessment are designed. This list of statements is then attached to a set of guidelines. The feedback guide is then emailed to students by ensuring the student's understanding that the grade given is a temporary subject for external assessment and verification, not a final assessment.

3. Results and discussion
There are some encouraging and promising signs that online feedback is seen by students as an effective and efficient feedback mechanism. These indications include:

- All students access the feedback activity tool. The notes recorded by the system show that all students accessed their online feedback form.
- Statistics stored by the system show that a large proportion of students (62%) revisited the feedback activity tool before the midterms. This indicates that students perceive feedback as a valuable source of information for their exam preparation.
- Students welcome online formative through the feedback activity tool. This is shown in a number of posts made by students in discussion forums.
- The feedback activity tool also appears to be an efficient and fast communication mechanism and helps students understand their feedback and the marks assigned to them.

The main reason for conducting this case study is the dissatisfaction of lecturers and students with the way the feedback has been given so far. In the past, the feedback was just a comment at the end of a report but was not specifically related to predetermined criteria. Even if there is a grade, students cannot determine the basis on which to consider the assessment. Students feel that the assignment of
Grades to them is done arbitrarily. Because of the length of time for submitting report cards and the date of submission are usually set near the end of the semester, students do not get feedback before taking the exam. So that the feedback is no longer relevant as a factor that affects subsequent student performance.

The process designed in this study has increased the speed and efficiency of providing feedback as we provide students with the opportunity to reflect on what they have learned from the course through self-assessment and using criteria and guidelines. The main challenge in using an online formative feedback system is the amount of time it takes to compile the feedback. In addition, providing detailed, personalized and timely feedback takes a lot of time and effort, especially for classes of larger sizes. The number of students who are directly related to the lecturer's workload, which is getting heavier, can reduce the quality of the feedback. On the other hand, feedback is central to student learning. Although feedback activity tools have been deemed effective and efficient in supporting formative assessment activities, detailed feedback and personalized comments require considerable manual work. For this reason, reducing the workload for lecturers is very important and we are studying a number of techniques that will be incorporated into the system.

4. Conclusions
Improving Calculus Multivariable learning can be done by providing high-quality formative feedback and ensuring that all students engage with it. Our data suggest that the positive experience is attributable to timely, motivating, personalized, manageable, and relate directly to the assessment criteria in feedback. In addition, to ensure that students engage with the feedback content, effective communication methods are needed. In addition to supporting the students' learning process by feedback, the study also remarked on the way the communication activity fostered deep learning. These results strongly encourage us to explore its effectiveness. We are exploring the further development of this tool through the exploitation of another web technology.

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