Supporting reflective learning with online tools

P. Kiviluoma[1]
Senior University Lecturer
Aalto University, School of Engineering, Dept. of Engineering Design and Production
Espoo, Finland
E-mail: panu.kiviluoma@aalto.fi

A. Lähteenmäki
Professor
Aalto University, School of Electrical Engineering, Metsähovi Radio Observatory
Dept. of Radio Science and Engineering
Espoo, Finland
E-mail: anne.lahteenmaki@aalto.fi

J. Tammi
Staff Scientist
Aalto University Metsähovi Radio Observatory
Kirkkonummi, Finland
E-mail: joni.tammi@aalto.fi

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INTRODUCTION

In this paper results and experiences using different ways to support reflection in two courses at two technical schools of Aalto University are presented. We will explore, first, how to support students' reflective learning in a time-saving way, and second, ways of using self and peer assessment and "digitalized learning diaries" such as web questionnaires. The effects of supporting methods used will be evaluated, and both teachers' and students' perspectives on reflection will be considered with the aid of questionnaires and feedback collected from courses taught by the authors. This will form a solid base for future development of support mechanisms for reflective learning.

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[1] Corresponding Author
P. Kiviluoma
panu.kiviluoma@aalto.fi

1 REFLECTION

1.1 Purpose of reflection

Reflection in education means that the students are encouraged to become consciously aware of their actions during their studies in order to develop their self-knowledge and deepen their learning [1]. There seems to be consensus on the importance of reflection in higher education. In their review paper Kori et al [2] identified three different perspectives on reflection. In Dewey's [3] view, "reflection allows one to become conscious of and thoughtful about one's actions". Critical social theory [4] emphasizes "questioning existing assumptions, values, and perspectives that underlie people's actions, decisions, and judgements". According to Kantian approach [4], students "have to learn to make connections between their state-of-art knowledge and the domains of reality in which they are operating". Synthesising several theoretical approaches, Rogers [5] identifies various common elements for reflection, such as the need for engagement by the student; an unusual or perplexing experience or situation acting as a trigger for reflection; using the situation at hand as a background against which to examine one's beliefs, premises and responses; and the integration of the new understanding into one's experience.

1.1 Supporting reflection

Reflective learning should become an integral part of one's behaviour, motivated by the learner's own interest. In education, however, students are often obliged to "doing reflection" [6]. Typically learning journals, essays, or portfolios are used to achieve this. Whether the method is reflective writing or discussion, it requires a lot of resources and may become laborious for the teacher. Learning diaries need to be read, and students expect individual feedback.

Furthermore, reflection does not come naturally for every student. In a study with prospective teachers [7] it was found that more than 50% of the prospective teachers fell at either the low or low-medium level of reflection. Learning to use reflection requires instruction, guidance, and practicing [8].

If reflection is included in the assessment, these measures become even more important to make sure that all students have the correct understanding and tools for it [9]. In their article, Kori et al [2] analysed the recent studies related to the reflection support in technology-enhanced learning. In these studies videos, blogs and portfolios were used as technical support tools and it was shown that all these tools could have a positive effect on reflection.

2 METHODS

To capture students' perspectives on reflection, experiences from two courses were collected. The courses are *Astronomical View of the World* and *Mechatronics Exercises*. The participants are mainly engineering students but there are students from other disciplines as well.

2.1 Courses in this study

Basic information of the courses in this case study is presented in Table 1. The courses are described in more detail below.

Table 1. Courses in this study.

Course name	ECTS	Duration	Number of students
Astronomical View of the World	3	Spring semester	80
Mechatronics Exercises	5	Spring semester	90

2.1.1 Astronomical View of the World

Astronomical View of the World is a 3-credit cross-disciplinary course which is open to all students of the university, regardless of their field of study, and aimed mainly for bachelor level studies. Learning diaries are used as one of the assessment methods in addition to homework. Since the students come from all schools of the University, the assessment methods need to target learning and learning processes rather than the pre-existing knowledge of the students.

The course has been given four times. During the first time, students wrote a learning diary after each lecture (14 lectures). With almost 60 students at that time, this meant that the teachers had to read over 800 learning diary entries during the course, among other significant duties. For the next three years, the number of learning diaries has been deliberately decreased, and it is currently three. However, the number of students has increased to almost 100, and there are now only two teachers.

To decrease the workload of the teachers, student self and peer assessment has been used for assessment and feedback of the learning diaries. Nevertheless, the quality of the feedback is not always satisfactory or accurate enough, and teachers are missing the direct contact with student work. Ideally, teachers would receive student reflection and feedback every week, after each lecture, in a format that could be easily managed and quickly examined. A way to express and measure reflective thinking of the students without excessive writing and reading is therefore sought, while maintaining the versatility of reflection and without doing the thinking on behalf of the students.

2.1.2 Mechatronics Exercises

Mechatronics Exercises is a 5-credit, one-semester course offering a first opportunity for undergraduate students to build a functioning device of their own design. This course relies strongly on case studies and project work with hands-on approach. Students are typically highly motivated, partly because of their own project topics, and they usually exceed the planned work hours.

However, it would be important to bring about the students to become conscious of their actions and their consequences together with realizing how to apply their previous knowledge and skills in projects instead of just having fun building things. Students know how to carry out their plans but do not necessarily know what they are doing. While reflecting their actions, students can build the ever so important work life skills and create models for solving common engineering problems.

During the time frame of this study there were over 90 students and 28 projects at the beginning of the course under supervision of one teacher and one teaching assistant who was responsible mainly for the weekly lab exercises. Considering the standard project reporting, guidance, and other practicalities, reflective writing in traditional form was infeasible. Therefore it was tested if reflection could be invoked using a series of prompting questions in a form of questionnaires.

2.2 Student surveys

A number of surveys were done on both courses in this study. The questions were both closed and open to allow students to describe their expectations and give feedback on the courses.

2.2.1 Astronomical View of the World

A web-based survey (N=47) was conducted to evaluate how the students see the suitability and value of, first, self and peer assessment, and second, other experiments aimed at facilitating reflective thinking, such as a structured learning diary with guiding questions. Our ultimate goal was to find out how the students experience the impact of self and peer assessment on their own learning, and whether they notice any difference in the level of reflection in the learning diaries before and after peer assessment and learning diary experiments.

This was the first year when the students did all of the assessment themselves using peer review, either in groups or individually. The teachers only validated the students' assessments afterwards. We compared the results of the self and peer assessment survey to the results from the previous year when the teachers did most of the assessment work.

The learning diaries were written and assessed using three different methods: a free-format learning diary which was peer reviewed in groups in the lecture hall (method 1), a free-format learning diary which was peer reviewed individually online (method 2), and a structured learning diary with guiding questions which was peer reviewed individually online (method 3). The guiding questions narrowed the scope of the learning diary significantly, concentrating only on a few topics that the students chose to be the most important.

We asked the students to evaluate the methods individually and in relation to each other: which one they found *supported their learning* most, which one did they *like* most, which *took the most time*, and which they found most *motivating*. We also collected open feedback on the learning diary writing and assessment methods. These are particularly enlightening as they give detailed insight into the statistical results that are sometimes coherent and sometimes controversial, and therefore difficult to interpret. The results will be used for designing an online "digitalized learning diary" to be used on the course next year.

2.2.2 Mechatronics Exercises

A total of three questionnaires were carried out during the course; a start-up (N=90), a mid-term (N=82) and a final questionnaire (N=77). They were all realised using a web-based survey tool, Webropol. Students were told that these questionnaires were supposed to support their reflective thinking but no other instructions were given. No other methods for reflection were applied either.

In the start-up questionnaire the emphasis was on the students' skills in the subject matter but topics like the learning outcomes of the course and students own contribution to it were covered as well. The mid-term questionnaire was the real reflection encouraging questionnaire. There were total of 29 questions under topics *personal contribution*, *group* and *reflection*. Questions like "*I have taken new challenges to learn new things*", "*I can use the knowledge acquired in this course in the future*", "*My group has supported me in my learning*" and "*I can see a relation between my actions and learning outcomes*" were supposed to promote reflection. The mid-term questionnaire was scheduled in the middle of the course when the weekly

lab exercises were over and the project work was coming to the implementation stage. The final questionnaire focused on the students' perceptions on reflection and methods for supporting reflection.

3 SURVEY RESULTS

The surveys were composed of mainly closed questions (5 or 10 point scale). Statistics for online surveys were obtained using statistical tools of the survey software (Webropol). The results are presented using the same descriptors that were used in the questionnaires.

3.1   Students' approach to learning diaries and their assessment

On *Astronomical View of the World*, students' approach to self and peer assessment was measured and compared to previous results [10] to confirm their attitude when the assessment methods changed from teacher-centred to student-centred. Earlier the students tried peer assessment once in groups in a tutored teaching session but teachers did all other assessment work. This year the students did all the assessment using peer review either in groups or individually. The results are essentially the same for both years. The students feel mostly capable of self and peer assessment, and find them rather reliable as assessment methods. The students also feel that these methods affect their learning. The transfer of assessment responsibility from the teachers to the students did therefore not change their basically positive approach.

We used three different methods in writing and assessing the learning diaries, explained in section 2.2.1. The students agreed that all of the methods supported their learning, even though the free-format learning diary of methods 1 and 2 was clearly preferred (Fig. 1).
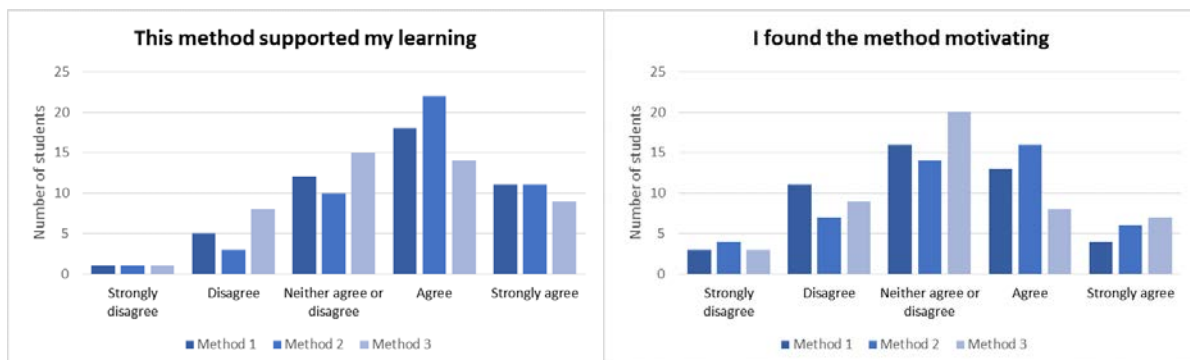

Fig. 1. How the students see the methods explained in section 2.2.1.

There is some controversy in which method(s) the students find most motivating. Open feedback reveals that some students strongly prefer writing learning diaries and some strongly dislike it. Significantly, many of those students who claim that these methods are not motivating nevertheless find that they support their learning. It is also clear that the students prefer peer assessment done individually (method 2) rather than in groups (method 1).

We also asked the students to estimate which of the methods they liked the most and which was the most time consuming. Approximately 10 % of the students felt that the methods were equally nice (or terrible), and 20 % thought that they were all equally time consuming. Method 2 was the most liked one but also most time consuming (Fig. 2). Surprisingly, method 3 was liked the least but it was also the fastest to complete. This, however, is also supported by the open feedback.

The students in general feel that a free-format learning diary gives them more freedom in expressing themselves, and that the structured learning diary based on questions is too restricting. This also reflects the problem of structured or questionnaire-type learning diaries: how to formulate the questions in a way that they support but do not restrict reflection and learning. The fact that students appreciate the support for their learning higher than the easiness or the quickness of the task is good news for the teachers.
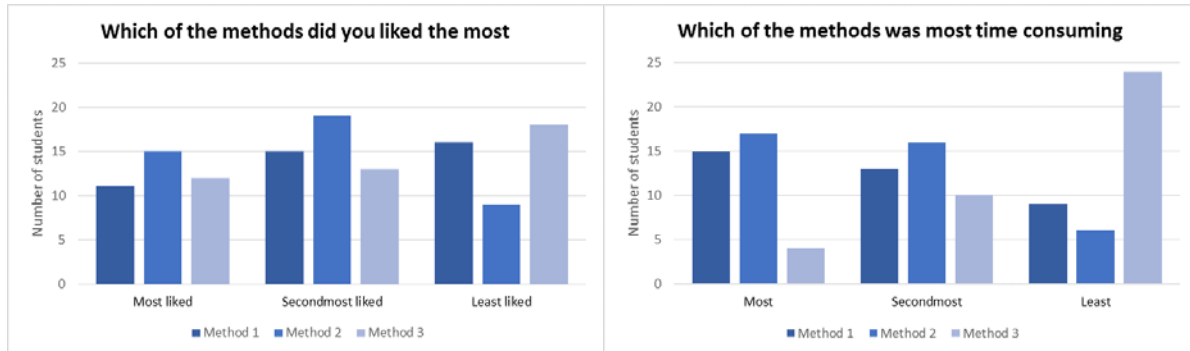

Fig. 2. How the students rank the different methods.

3.2 Students' approach to reflection

On *Mechatronics Exercises*, 82.2% of the respondents had previous experiences in reflection of some form from at least one course. To the question "*Who is responsible for your learning*?", 30 out of 90 students answered "*Myself*". The average was 8.6 on a scale from 1 [*Teacher*] to 10 [*Myself*]. The question was repeated in the final questionnaire but the response was not changed (average 8.7). When asked how well (1 = *Not at all*, 10 = *Very well*) reflection in a form of learning journals, diaries, or similar tools supports students learning, at the beginning of the course the average was 4.7 and at the end 5.4.

Fig. 3. How the students see the applied method.

Students were asked how the questionnaires in this course supported their reflective learning (Fig. 3) in a scale of 1 [*Not at all*] to 10 [*Very well*]. The average was 6.6. To the question "*Did you get any new ideas or insights while answering the questionnaires?*" the answers were divided with 31 for *Yes* and 46 for *No*.

According to the open feedback collected on *Astronomical View of the World*, the students appreciate the positive effect that reflection has on their learning. Somewhat surprisingly most students that gave feedback confirmed that reflective writing has helped them significantly to understand the course topics and deepen their level of learning. Many students also report that self-assessment of the learning diaries has

made them realize the mistakes they have done in studying and learning, and has helped them to focus their learning efforts.

3.3   Reflection support

On *Mechatronics Exercises*, on a scale from 1 [*Novice*]) to 10 [*Expert*], the students estimate their skills in reflective thinking to be on average on the level of 6.8. The need for support seems to be rather low (Fig. 4). When asked "*Which way of reflection would support best your own learning?*" the students favoured digital questionnaires (Fig. 5).
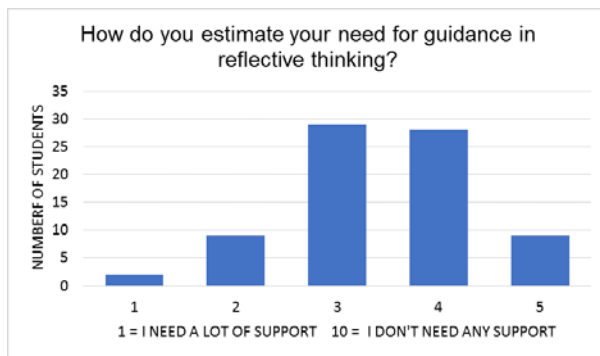

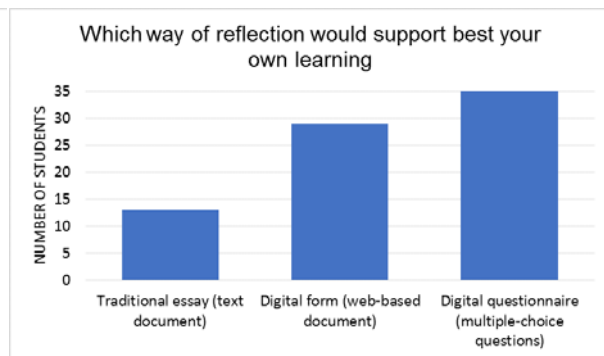*Fig. 4.* Students' need for guidance.   *Fig. 5.* What is the best way to support reflection.

Students are willing to return more reflections during a 12 week course if the assignment is in the form of a questionnaire. Acceptable number of assignments for different executions are, on average, 2.4 for *traditional essay,* 3.7 for *digital form* and 5.6 for digital questionnaires. There seems to be a consensus on usefulness of the support mechanisms between *Written instructions or guidelines*, *Personal guidance and feedback, Guiding questions and prompts* and *Examples of good reflections*. On a scale from 1 [*Not useful at all*] to 5 [*Very useful*] *Personal guidance* scores an average of 3.7 while *Examples* gets an average of 3.3. The other two options rank between them.

On *Astronomical View of the World* we asked the students for their suggestions how the benefits of free-format learning diaries could be achieved without the laborious writing and reading process and without losing reflective thinking. While we did not expect solutions to the tough problem, we got several suggestions worth trying in the future. Group discussions, structured learning diaries with general enough guiding questions allowing for diverse interpretations, and student presentations were brought up as possible alternatives.

4 DISCUSSION

Structured learning diaries or questionnaires can certainly not replace the reflective writing in higher education but they can provide variation in the set of tools to support reflective thinking. The usefulness of questionnaires and questionnaire-type learning diaries is highly dependent on students' own attitude to reflection.

On *Mechatronics Exercises*, in discussions with students it comes out that those who have a more reflective approach to their studies also appear to find the questions thought-provoking. Naturally there are also students who enjoy the possibility to breeze through the questions without thinking. It is difficult to say if the students' liking for questionnaires as a reflection method is due to the goodness of it or the easiness. The easiness explains why students are willing to return more questionnaire-based

reflections during a course than essays. In contrast, on *Astronomical View of the World* the students preferred the more laborious free-format learning diaries over structured learning diaries that are completed faster. According to open feedback, many students appreciated the reflective learning diaries and thought they are an excellent way of assessing their learning. It is possible that the difference comes either from the course content itself (cross-disciplinary vs. engineering) or from the student material (all University schools vs. engineering schools).

Engineering students are often seen reluctant to get into reflection and out of their comfort zone. Questionnaires could provide an easy start for that. In addition, while interest in reflection is increasing among teachers, the students might be saturated with learning journals and essays. Reflection in a form, for example, of a multiple choice questionnaire could offer a welcome alternative to the routines. Some students suggest that there could be open questions among closed ones to give a possibility to justify and deepen their answers.

It does not come as a surprise that students value personal guidance and feedback. Somewhat interesting is that on *Mechatronics Exercises* examples of good reflections was the least useful support mechanism, since the students very often ask for these on the courses. In contrast, on *Astronomical View of the World* many students specifically asked for examples of good reflection, but it may be because the cross-disciplinary course attracts first-year students with very little prior experience in reflective writing. This difference is, however, easy to take into account by making general examples available but not requiring students to use them.

To make both writing and assessing easier, we intend to design an online "digitalized learning diary" that combines the various types of learning diaries and questionnaires. Using the web-based tool, the teacher can choose whether to use only questionnaires, structured learning diaries, free-format learning diaries, or any combination of these, depending on the requirements of the course or a single particular task. This study shows that there is need for such flexibility. The key problem is how to formulate the questions so that they support but do not restrict, and yet encourage the students to think independently.

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