RTTI/OPSA ONLINE

PILOT PROJECT

MECHANICAL ENGINEERING UT/VU

BACHELOR’S PROGRAMME



August 2021

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# MANAGEMENT SUMMARY

In September 2019 a new BSc program, “Mechanical Engineering (ME) UT/VU” began at the Vrije Universiteit in Amsterdam. This programme is a unique collaboration between a technical and a non-technical university, the University of Twente (UT) and the Vrije Universiteit Amsterdam (VU), respectively. This collaboration has enriched teaching and learning by drawing on experienced staff members from both locations and encouraging innovative teaching approaches. The implementation of the RTTI pilot project in September 2019 is one such innovation, implemented in collaboration with the RTTI creators to explore how a program designed for use in secondary schools could be applied to a university setting.

Although we intended to start the project in September 2019, we encountered severe obstacles that made that the project did not have a fair chance of success. The obstacles were a late privacy agreement, for which we started the project for students with a semester delay, and a pandemic for which online teaching and working was introduced which led to an extra high workload for students, teachers and supporting staff in a new programme on two campuses.

Under the aforementioned circumstances, we were approved to extend the project for one year in the hope that the pandemic would be over. But unfortunately, this was not the case. We had to see along the way how we could get the data and what the results, given the data, would show. We have to conclude that we can not answer our question ‘*How can the RTTI online learning system enhance learning in a technical academic programme’.* To come to a strong answer the project should be redone under normal circumstances in a steady-state programme.

# Introduction RTTI/OPSA

RTTI refers to a classification system that defines four different types of learning: reproduction (‘R’), training (‘T1’), transfer (‘T2’) and insight/innovation (‘I’)[5]. When used for creating and assessing learning outcomes and exams, it provides differential information on each student’s performance, which is then accessible via the online platform for both students and teachers. For lecturers, RTTI helps to systematically improve the quality of their tests by providing a holistic assessment of test questions and performance. For students, it provides an integrated online feedback system to guide their learning and improve their study results by highlighting strengths and weaknesses in their performance. RTTI thus serves as a practical, non-hierarchical alternative for Bloom’s taxonomy, which is used in other UT programmes.

The RTTI system includes a counterpart: while RTTI focuses on the types of learning, OPSA refers to behaviours for learning: organization (O), participation (P), self-confidence (S) and autonomy (A). These two frameworks, RTTI and OPSA, are linked to a large number of learning strategies that can help students. These are addressed during the ongoing Academic Skills lectures and tutor meetings covering teamwork, self-reflection and peer feedback. Within the online platform, students can provide feedback to each other based on OPSA criteria, a function that was used consistently in team feedback moments.

# Objectives for the project

The primary question for the RTTI pilot project was: *How can the RTTI online learning system enhance learning in a technical academic program?* The objectives were:

A. To gain insight and knowledge about the ‘learning, thinking and behaviour’ of BSc Mechanical Engineering students.

B. To optimize guidance for students in terms of cognitive learning, specifically focusing on the effects on drop-out rates or other reasons for study delay.

By working with both instruments, teachers and students learn from cognition (RTTI) and behaviour (OPSA) assessments. In the pilot project, we focused especially on OPSA. Focusing on behaviour for learning means that the students gets to know themselves better and learn how to optimize their learning potential through self-reflection and peer review. In addition to this, teachers were supported in learning about how RTTI can be used to evaluate the accuracy with which their assessments measure student learning.

# Methods

To achieve the above-mentioned objectives of the RTTI project we identified deliverables needed to be able to analyse the RTTI experience with students and teachers. We therefore conducted:

* An analysis of the uploaded RTTI online test results
* Questionnaires (and interviews) with teachers and students about their experiences with RTTI/OPSA
* A project report summarizing the main findings and conclusions

**Analysis of study results**

The below-mentioned analysis is done on the number of students (41 out of 61) who entered the second semester of the academic year 2019-2020: Several dop-outs already already left the programme during semester one.

* Drop-outs.
* Comparison of the number of resits for semester one (SEM1) and semester two (SEM2) courses.
* The courses ‘*Continuous Assessment’*. Each semester finishes with a Continuous Assessment test. This small test is a cumulative test of the knowledge and skills offered so far. Therefore this course gives an indication of students Insight and knowledge about their ‘learning, thinking and behaviour’.

**Student questionnaires**

* July 2020: an *RTTI* questionnaire was organized among cohort 2019 students (13 respondents =31%)).
* March 2021: cohort 2019 students filled in a questionnaire about the use and benefit of *RTTI / OPSA* in their study (28 respondents out of 41).

**Teacher interviews and questionnaires**

* 2019-2020: A questionnaire on RTTI is sent to 11 trained teachers involved in the first year. Only 2 teachers responded, therefore the data could not be used.
* March 2021: eleven trained teachers were asked to fill in a questionnaire about their use of RTTI. Ten teachers completed the questionnaire.
* Spring 2021: online interviews were held with four teachers. Six teachers were invited, one of whom never responded and another who did not show up to the scheduled interview.

# Project planning

We started the project in September 2019 with the intention of a one year pilot and the planning was organized for cohort 2019-2020.

# Challenges and impact

From the start of the RTTI project, we faced the following external obstacles which all had an impact on the implementation of RTTI.

* **Privacy agreement**

The training for teachers and the management team started as planned. Due to a delay in arranging the privacy agreement, which took several months, we were not able to upload semester one (SEM1) test results to the online platform until January 2020. This resulted in starting RTTI (results SEM1) with students in semester 2 (SEM2).

* **COVID-19 pandemic**

In March 2020 the Netherlands went into lockdown due to the COVID-19 pandemic. All education and guiding of employees and students had to be done online from home. It was clear that the pilot project would be very difficult to execute properly. We were granted an extra year to conduct the pilot project. The pandemic measures were only lifted in June 2021, at the end of the extended project term, meaning that the pilot project did not get a realistic operational chance. The planned pilot schedule for the academic year 2019-2020 was converted to the next academic year. In the Appendix, you find the detailed planning schedule for both years.

* **The workload for students and teachers**

The lock-down resulted in a very high workload for teachers as all education had to be transferred to an online platform, and students and teachers had to adapt to adjusted schedules and online teaching. This was a huge challenge for everyone and meant that little time or energy was left to implement RTTI, so it had no priority. Students experienced the online teaching, constantly changing course schedules, and the several technologies used in education as stressful and were frequently overwhelmed by the huge number of announcements, emails, etc.

**Supportive plans**

Below we zoom in on the plans for supporting the implementation of RTTI.

1. **Training for teacher and management team**

Teachers and the management team from SEM1 were partly trained by members of Docent-Plus. Teachers from SEM2 were trained by the employed educationist (0,05 fte) in cooperation with a ME teacher who is experienced in working with RTTI at pre-university. In the RTTI online tool, teachers could upload intended learning outcomes, categorize test questions and publish test results so that the students received automatic feedback on their strong and weak points on tests scores via colour schemes.

1. **Training for students**

Students were trained in SEM2, during an Academic Skills lecture, on how to work with and interpret the published test results to make them aware of their strong and weak points on the test scores. Further, they were trained in the OPSA tool, feedback, self-reflection and peer review. There was an understanding that students should independently access the study tips provide by the RTTI-online tool to think over and/or adapt learning strategies as necessary.

1. **Applying OPSA in the ongoing Academic Skills**

OPSA is implemented in the Academic Skills courses. The OPSA tool is implemented especially as a reflection tool so students learn how to reflect and receive and give feedback with regards to their teamwork skills. Because the course Academic skills is part of the semester project, students work in teams, where reflection skills are trained in a group setting and in writing reflection reports. The RTTI online platform is then used to allow students to provide feedback to team members via the OPSA tool. This is then discussed in tutor meetings and used to establish if any changes in teamwork need to take place.

1. **Project participation**

The teachers and the management team are guided and supported in training and the categorization of the test questions by DocentPlus and the educational specialist. The educational specialist also analysed and discussed the test results with the individual teachers to help them improve their tests. Uploading of test results is done by Academic Skills teachers who already were familiar with the tool because of their experience with the tool at pre-university institutions. The total amount of staff effort in hours is indicated at 868 (see figure 2 of the appendix).

# Analysis and results

We did several analyses but the results do not show a direct relation with RTTI/OPSA. Below we discuss the analysis we did.

# drop-outs

We started the programme with 59 enrolled students, 16 (28%) of which dropped out. Of the 16 drop-outs, 15 students left the programme during the first semester. Five of them did not start the programme at all. We can not relate the drop-outs to RTTI/OPSA because we only began using the tool in the second semester and 15 drop-outs already left the programme. However, we can relate the drop-out scores with the pre-university mathematics scores (Math B ≥7), which is a good predictor for study success (see figure 3 in the appendix). In similar technical academic programmes, the number of drop-outs is also around 30%. However, based on the timing of drop-outs no conclusions can be drawn if RTTI/OPSA increased student’s learning.

# study results

We analyzed the study results from the students (41) who enrolled in the second year, so without the drop-outs. The results are based on one exam and a resit per course.

**SEM1**

From SEM1, five courses final results were uploaded in the RTTI online tool in January to be analysed. Teachers from the courses discussed their RTTI online test results with the educationists. The results showed per course per student an overview of test questions with good scores (green) en questions with low scores (yellow or red). Based on the results of the test teachers got an idea about their test results per question. They improved the quality of test question(s) or answer questions from students.

The uploaded test results were not discussed in class because the course had already ended. A positive side effect for teachers was that they adapted their teaching material based on the RTTI outcomes to optimize future tests.

The table below shows how often the students scored red or yellow on R, T1, T2 and I per course (source: RTTI online, development overview/student) and the pass/fail results per course after resit.



Overall: 7 students are inadequate. Six students have (almost) no scores.

What stands out:

* Course 1 can be said to score mainly on R yellow and I yellow. The numbers are low.
* In course 2, students often score yellow on R, T1, T2 and I, with T1 and T2 having the highest scores.
* In course 3, students score red several times on levels T1, T2 and I, but all levels score high on yellow, with especially T1 and T2 standing out (all ≥20).
* In course 4, the students score red for R and especially for I (> 20).
* In course 5, students score yellow for R and especially for I (≥ 20).
* Overall, it can be stated that the number of scores in the red boxes is not too bad, except for course 4.
* The number of yellow and red scores is highest at I.

The SEM1 results on RTTI online were a positive surprise. It was remarkable that in the total overview per student on RTTI online, most students scored green at all levels, that 10 students scored yellow at 1 level and that 5 students scored yellow and/or red at 2 levels. You would expect students to have difficulty with level I, but that turned out not to be the case. The fact that only 5 students failed the first Continuous Assessment test also pointed in that direction (this exam consisted of 12 I questions and 4 T2 questions of 30 questions in total). Apparently, the students had to get used to these kinds of questions and/or the students were well prepared for this assessment.

**SEM2**

In SEM2 students had access to the SEM1 course results in the RTTI online tool as it was discussed in a Skills Lecture. It was not possible to analyze the SEM2 course results on RTTI scores, as these results have not been entered in RTTI online due to teachers workload caused by the pandemic. We analyzed the SEM2 course results from Osiris, the University Student Information System. Despite the pandemic, students did perform well in SEM2. Most students passed the courses (see figure 5 In the appendix) and the pass rates, after resit, were above 90% for all eight courses.

If we compare the number of resits from both semesters we see a large improvement (21% fewer resits for SEM2 courses than for SEM1 courses). In SEM1 cohort 2019, 29% took resits while only 8% took resits for SEM2 courses. The results of SEM2 are better than those of SEM1. There is still one student who has no or only insufficient scores. It is interesting to find out why the results in SEM2 were better. Possible causes for this are:

* the students have become more familiar with the subject matter and the teaching method in SEM2;
* the students have adapted their learning strategies;
* the abolition of the BSA has put less pressure on students;
* a different way of teaching and testing in SEM2 (online);
* the teachers gave the students more feedback and/or guidance during SEM2;
* the subject matter in SEM2 was less difficult than in SEM1;
* due to the Corona measures, students have been given more time to study.

It is therefore difficult to draw any conclusions about the specific impact of RTTI on students’ learning.

# continuous assessment (ca) tests

The course continuous assessment is not a course in the strict sense. It is a recollection of the knowledge and skills offered during semesters. During the semesters the student studied different courses that are related to each other in the field of Mechanical Engineering. Students also practised, applied and integrated these different fields in the project. Via tutorials and self-study students are challenged to work with fundamental theories, their interrelations, and their personal development in the field of Mechanical Engineering which are tested each semester.

For three CA tests, we categorized the test scores per student according to RTTI.  The average grade is calculated, resulting in an RTTI rating:



A comparison of RTTI scores for the three Continuous Assessment (CA) tests shows the following overall results.



The comparison on students individual levels shows that only a few students score fairly consistently on all three CA’s. Most students deteriorate to some degree in their scores in CA2 and CA3. Especially the scores on the T1, T2 and I questions are getting lower. In CA2, this does not yet lead to a lower pass rate, in CA3 in the first test (before the resit) it does, although after the resit the pass rate for CA3 was 89% of the test participants.

Possible causes of the lower scores and the low success rate of CA3 before the resit:

* the influence of online education (less motivation among students?)
* the students no longer needed the EC for BSA (a CA provides 0.5 EC)
* the students have not been able to spend enough time on CA3 because other (re)tests claimed study workload and high level of courses
* the first CA3 test was too difficult (more questions at T2 and I level than in CA1 and CA2),
* maybe students were not properly prepared for the test by teachers (preparation sessions?)
* very low pass rates (before the resit) within two essential courses needed to prepare for CA3

The conclusion, therefore, is that it is difficult to draw any conclusions about the specific impact of RTTI/OPSA on students learning.

# student questionnaires on RTTI and OPSA

To learn more about the ‘learning, thinking and behaviour’ of BSc Mechanical Engineering students we asked students to fill out a questionnaire in which we added sub-questions to gain insight into how the students judge their study strategy and behaviour and if RTTI offers them insight into their study potential.

1. To gain insight and knowledge about the ‘learning, thinking and behaviour’ of BSc Mechanical Engineering students.
	1. *How well do you know yourself?*
	2. *Are you familiar with your study strategies?*
2. To optimize guidance for students in terms of cognitive learning, specifically focusing on the effects on drop-out rates or other reasons for study delay.
	1. *Does the RTTI online tool offer insight into your study potential?*

**Questionnaires**

The students questionnaire only on **RTTI** is taken in June 2020 (during the pandemic, while students had access to SEM1 RTTI results and worked with the online system during SEM2), see also figure 6 in the appendix. Of 41 students 13 responded (31%) to the questionnaire. What stands out?

The results (Likert scale 1-5) show that from the respondents on the questions ‘*How well do you know yourself?’* That the majority is at ease with studying. 100% of the respondents claim to know their strong and weak points and 84% claims to be able to look for alternatives in the study when needed (agree and strongly agree). If they can handle the study well, a minority of 38% agrees while 62% neither agrees nor disagrees. And only 31% of the respondents agree on being able to make a good assessment of the received test grades while 46% neither agrees nor disagrees and 23% disagrees.

On the questions ‘*Are you familiar with your study strategies?’* 62% agrees. It is remarkable that also 62% of the respondents neither agrees nor disagrees that they can switch between study strategies. And remarkable is that 62% do not use the handed out book ‘Get Smarter, Handbook for efficient and effective studying’. On the questions ’*Does the RTTI online tool offer insight into your study potential?*’ respondents are divided. But 46% of the respondents claim to need to improve reflection skills on study strategy.

A second questionnaire is taken during class In March 2021 on both **RTTI and OPSA**. Of the 41 students, 28 responded.Students showed overall that while they were aware of RTTI, it was rarely used. OPSA was rated far more positively, and the comments provided by students supported this (see also figure 7 in the appendix). As mentioned before, OPSA was used to support team feedback and self-evaluations within their Project Groups. We saw that students generally took these evaluations seriously and the 2019 cohort, at the end of their second year, could write accurate, reflective self-evaluations of their skill levels using OPSA.

A small group (15%) of students indicate that RTTI/OPSA has taught them to look at their study skills online and 46% of the students indicate that RTTI online has indeed led to the need for the adaptation of learning strategies while 38% have gained more insight into their strengths and weaknesses.

# teachers questionnaires and interviewS on RTTI and OPSA

**Questionnaire**

Teachers did not work with OPSA except for the Academic Skills teachers. Of the eleven first-year teachers, 10 responded to the RTTI questionnaire in March 2021. 50% of the respondents stated that they ‘adjust their assessments all the time to make sure a good distribution of R, T1, T2 and I is used’. 60% claim to evaluate student assessment scores based on RTTI outcomes to improve their assessments. See also Figure 8 in the appendix.

**Interviews**

The educational expert also talked to the trained teachers about their experiences with RTTI during the academic year 2019-2020. Another six teachers were invited in March 2021 to participate in an individual interview about their experiences with RTTI. All teachers had received the RTTI training in the past two academic years. Four interviews took place. An additional fifth interview was planned but the teacher did not show up or respond to follow-up emails. The sixth teacher did not respond to the original invitation.

There were positive findings, primarily highlighting that RTTI is easy to understand and apply and that it was considered favourably to Bloom’s taxonomy (used by the UT) as there were fewer categories and it was a non-hierarchical system. Teachers were also positive about the potential for students to receive feedback which was both question and skill-specific.

The results show that OPSA has been partly used in Academic Skills as a reflection tool and as a peer feedback tool. The teachers involved in Academic Skills indicate that OPSA is a suitable tool for this, but that other simpler tools can be used for the same purpose which is equally good or perhaps even better.

There were many structural challenges to using RTTI. This included the need to switch between two different systems, as most (just appointed) teachers work at the UT where they are required to use Bloom. There were also dilemmas related to the externally imposed nature of a course set-up, including provided learning objectives that were unclear, feeling limited by not being able to include insight questions, and concerns about the distribution of each area (R, T1, T2, I) across the course and across the overarching progression of learning in the programme (that depends entirely on the place in the curriculum and the nature of the course). Teachers also pointed out that the workload is very high for both them and students, leaving little time for implementing and using a new system. They also felt there was limited time for flexibility so that course adjustments are often reserved for the next cohort. RTTI online assumes that teachers can follow students for a whole year and therefore can also monitor their development well. That is rarely possible in university education. Interventions and personal tutoring on course level are difficult in the university setting in courses of eight weeks. In short, the university context was not easily suited to the use of such a system.

Beyond structural challenges, there were also issues within the implementation of RTTI. This is primarily related to student awareness and the use of the system. There were concerns about how effectively students could analyse their results and make appropriate changes based on that analysis. While teachers saw the benefits, they were also aware that students need support in these steps and that that support was not present at the moment. The website of the RTTI platform was also challenging, and was described as “very rigid” and the importing of results as “tedious” and “a lot of work”. Two teachers were either not aware of the website or only recently discovered it and had many practical questions. There is also doubt whether students are aware of the benefits of using it. Lastly, it was noted that for this to benefit students and teachers in the long run, both parties needed to consistently use the website.

# Conclusions

The project’s delay at the start and the 1,5-year pandemic we faced during the project time made it impossible to execute the project properly. Based on the described analyzes we have to conclude that we cannot answer the research question ‘*How can the RTTI online learning system enhance learning in a technical academic program?* The data we did collect do not show a direct correlation between RTTI/OPSA and students' learning performance.

But what did we learn from the RTTI/OPSA project?

* The Corona pandemic has certainly had a huge impact on the implementation of RTTI/OPSA online, but teachers indicate that the RTTI/OPSA online system offers more disadvantages than advantages and it is also not that appropriate within the academic setting of the BSc ME UT/VU programme in which a teacher only sees the students for a short time during the period of teaching the course (i.e. 8 weeks).
* Implementing a new system is best done under normal circumstances in a steady-state situation, ensuring that a new system gets a high priority with extra time for teachers and students. If the RTTI/OPSA tool could have worked in our academic programme under normal circumstances is still a question.
* The question of whether the number of drop-outs has been reduced at the BSc ME UT/VU due to the use of RTTI/OPSA online cannot be answered because these students did not work with RTTI/OPSA in SEM1. However, it can be established that the drop-out rate of Cohort 2019 of this programme was approximately equal to that of the BSc ME programme provided at the UT.
* In this pilot, under these circumstances, it is not possible to draw any conclusions about the specific impact of RTTI/OPSA on students learning.

# Appendixes

**Planning**

Figure 1 shows the project planning for 2019 and 2020, as discussed in paragraph 5.



*Figure 1: Project planning 2019-2020 and 2020-2021*

Figure 2 show the (estimated) invested staff hours.



*Figure 2: Invested number of staff hours for RTTI/OPSA*

**Drop-outs**

Figures 3 and 4 show some statistics concerning the drop-outs of cohort 2019, as discussed on page 5.



*\*Five students did not start the programme*

*Figure 3: Drop-outs statistics*

**Study results from cohort 2019**

Figures 4 and 5 relate to the study results and passing rates of courses for the students of cohort 2019 as discussed in paragraph 6.2.



*Figure 4: Study results and drop-outs of cohort 2019 in the academic year 2019 and 2020*



*Figure 5: the passing rates and number of taken resits per semester per course*

**Students Questionnaire results**

Figures 6 and 7 show the results of the students' questionnaires as discussed in paragraph 6.4.



*Figure 6: Students Questionnaire results on RTTI*



*Figure 7: Students Questionnaire results on RTTI and OPSA*

**Teachers Questionnaire results on RTTI**

Figure 8 shows the results of the teacher's questionnaire as discussed in paragraph 6.5.





*Figure 8: Teachers Questionnaire results on RTTI March 2021*