THE TRIPLE JUMP LEARNING MODEL: ACCELLERATING DESIGN EDUCATION

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ABSTRACT
In a decade-long search for high impact education, providing continuous feedback in a safe yet challenging learning environment, the Industrial Design Education (IDE) course of Rotterdam University of Applied Science has moved from assessment *of* learning towards assessment *as* learning. A major step in this development has been the introduction of a self-developed learning system called "Triple Jump Learning" (TJL). TJL offers students a framework of four different stepping stones, supported by a set of specific interventions. These stepping stones are meant to induce several formative strategies such as lecturer feedback, peer assessment, benchmarking of results, self-assessment and self-reflection. Thus, students are gradually guided towards higher competence-, knowledge- and skills-levels without the need of an overly detailed assessment framework. As feedback rich learning systems imply risks for high lecturer effort, the interventions within the TJL model have been developed as to reduce teaching and coaching effort, without decreasing learning speed and student motivation.
We have tested the TJL approach with all 75 first grade students in the project class. We have found some strong indications of which interventions may be the most and least effective in terms of learning effect versus staff effort. Collaborative learning, comparing work to peers and fed-forward based final assessments are amongst the most effective interventions. The results have been compared with existing learning theories.

1 MAIN CHARACTERISTICS OF THE IDE COURSE
Since 2003 the Industrial Design Engineering course at Rotterdam University of Applied Sciences hereafter referred to as "IDE course", offers a four-year full time bachelor programme located in Rotterdam, Netherlands. Bachelors in IDE are expected to solve complex design problems in a multidisciplinary environment, leading to innovative, sustainable, producible, marketable and useable product solutions. The IDE curriculum is designed around the main professional design engineering competencies: Analyse, Design, Verify, Manage a project and Learn.

2 FORMATIVE STRATEGIES USED IN THE IDE COURSE
Over the last decade, assessment methods used in the IDE course gradually have moved from mostly summative to mostly formative. These developments were highly influenced by the self-determination theory of Deci & Ryan [4] and John Hattie's findings that emphasise the enormous learning effect of feedback [8]. Gibbs & Simpson [2] have shown us the conditions under which assessments actually support learning and self-efficacy.
As of the academic year 2016-17 we have been experimenting with Assessment as Learning (AaL) as outlined by Dochy [5] and Dochy, Berghmans [3]. AaL intends to fully integrate learning, formative strategies (e.g. feedback, feed forward, peer assessment and self-assessment), in order to gradually and individually guide students towards higher competence levels.
Although the first results of our AaL approach were promising in terms of learning outcomes and student motivation, it appeared that constantly providing feedback to each student while capturing individual progress was highly time consuming for students and staff alike. Another experience in

earlier AaL experiments was that students often tend to dislike the emphasis on feedback and (self) evaluation, which they sometimes experience as a mere distraction from "just developing good ideas and products". Hence we have tried to find ways to blend the feedback and learning process into the product development process as much as possible.

3 THE TRIPLE JUMP LEARNING MODEL

IDE students are being trained to carry out product development projects in an iterative manner. Students go through several design cycles to develop, improve and detail a design solution towards a final design which meets all requirements. Each cycle, usually taking a full week, consists of an analysis phase, a design phase and an evaluation phase. The Triple Jump Learning model [Figure 1], hereafter referred to as TJL, was developed to enhance these cycles, which are both learning cycles for competencies, skills and knowledge and design cycles towards the best possible design solution.

In TJL, students perform three distinctive "jumps" between four "stepping stones" within each design cycle. Each stepping stone should provide students a highly effective "nudge" for their next jump in the form of feedback and goal-setting.
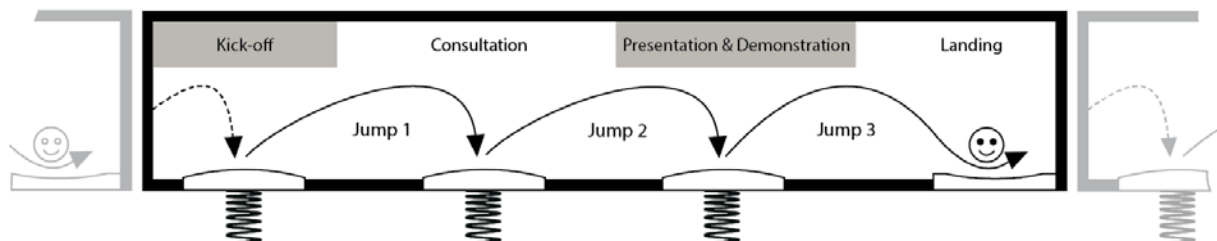

Figure 1. The Triple Jump Learning model

The stepping stones are designed to create a proper variation of interactions, educational settings and environments, thus creating a proper variety of learning experiences:
1. Kick-Off, in which the present design-cycle is being introduced to all students, enabling them to start the first part of the design cycle.
2. Consultation, in which the first part of the design-cycle is being evaluated, fed-backed and fed-forwarded.
3. Presentation & Demonstration, in which students show and present their results to fellow students, enabling them to benchmark their own results to others.
4. Landing, in which students prepare themselves for the next design cycle by documenting and evaluating their results, offering and receiving peer feedback and having their results briefly checked by coaches for meeting main requirements.

4 THE EXPERIMENT

We have tested the TJL approach in the first semester project class of the recent academic year (September 2017 – January 2018), attended by 75 first grade students. The class took six full weeks, spread out over a total of 18 weeks[1]. Each week was organised as a triple jump as mentioned above. Main goal of the project-class was to learn the basics of our iterative design process and gain experience in all of our 5 competencies. The first three weeks were intended as training for the first three competencies one-by-one: analysis, design and verification. The last three weeks, students had to integrate these competencies and gain experience in project management and learning competencies. Students worked in teams for several external clients, who were in this case fourth grade students of the IDE course with their own project as assignment for the first grade students. The project class was finalised by a portfolio-based assessment with a marking based on individual student performance on 14 criteria within the 5 competencies. Half way through the project, students exercised with the assessment (still new to them) in a formative way, providing feed-forward for the second part of the project.

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[1] In our course, project weeks are being alternated with theory, skills and personal development weeks.

5 SPECIFIC INTERVENTIONS SUPPORTING TJL

In total, we have indicated 30 interventions (Figure 2) in the new, TJL-based programme. 12 interventions were directly connected to the four milestones of the TJL approach the other 18 can be categorised as general interventions in organisation, coaching & feedback and assessment.

Triple Jump interventions	General interventions
Kick-off	General organisation
• Monday morning kick-off session • receiving a specified assignment for each week • autonomy in planning your process	• team cooperation • working for an external client • being able to choose from several projects • being obliged to deliver individual results • entire week is available for project • a coach is (almost) always around • changing team mid-project • small lecturer explanations during the process • working in same room with all teams
Consultation (mid-week)	Coaching and feedback
• formal consultation meeting mid-week • formulating action points towards end-of-week • obligation to properly prepare mid-week consultation	• unplanned consultation during week • online design method toolbox available • maintaining a feedback journal • getting feedback / feed forward • weekly self-assessment on competence progress
Presentation (End-of-week expo)	Assessment
• Thursday expo of all results • comparing your work with others	• Using a detailed competence rubric form • mid-project formative assessment • final assessment • receiving a final mark
Landing	
• weekly update of competence portfolio • peer-feedback session • quick check of competence portfolio by lecturer • formulating action points for next week	

Figure 2. 30 TJL interventions

6 STUDENT AND LECTURER SURVEY

In order to evaluate the effect of each intervention, a survey has been carried out with all participating students and coaches. Students were asked to rate the perceived learning effect of each intervention on a four-point scales. 4 lecturers who had coached the students were asked two questions: What is the perceived learning effect for students of each intervention and what is the perceived time consumption? Detailed survey results can be provided upon request. Students also had the opportunity to fill in two open questions on what was standing out for them in the approach, and whether any other aspects had contributed to their learning. Furthermore, the pass/fail ratio and project results have been evaluated and compared to previous student groups. Finally, the overall time use of all concerned coaches was calculated and compared to the allowed time budget.

7 RESULTS & DISCUSSION

In terms of pass rates, the new approach has proven very successful. Of 75 participants, only 3 (4%) did not pass. In the previous academic year, 12 students of 92 (13%) did not pass. Furthermore, the average level of the design results proved significantly higher throughout the entire project class, even to the extent where some first grade students exceeded the level of many second grade students.

The coaching and assessment time needed for the TJL approach is highly comparable with the time consumption of the classical approach. We have found that a lot of time can be saved by the use of an online toolbox that fits the competence criteria, enabling students to self-study. Furthermore, being consistent in the organisation of all interventions (strictly following the TJL approach) throughout the

project has proven to make it much easier for students to prepare meetings and presentations themselves, simplifying the overall organisation effort of all coaches.

In the open questions almost 1/3 of the students mentioned the importance of the knowledge gained in the other classes (mostly design skills and materials/production methods). Although not very surprising, this was an issue we had largely overlooked during the project.

Concerning the effectiveness of the 30 interventions (Appendix 1), there are some interesting findings: Perceptions of learning effects of students and coaches tend to match for most interventions, except for a few. Students tend to value peer feedback sessions, formulating action points and working with the rubric forms significantly lower than coaches do. This is an interesting point to work on, how can we convince students of the importance of setting clear goals, of which we believe that it is a very important too for adjusting learning processes. On the other hand, students tend to value the obligation to deliver individual results and self-assessment significantly higher than coaches. This is especially striking when we look at the results below. Students highly appreciate the learning effect of teamwork, and the ability to compare their results to others. However, when it comes to being assessed on results, they want to be treated individually.

Interventions standing out in both high learning effect and low time consumption:

• comparing own work with others • autonomy in planning your process • entire week is available for project • changing team half-way • being able to choose from several projects • team cooperation • using a detailed competence rubric form	• receiving a detailed assignment each week • quick check of competence portfolio by lecturer • weekly update of competence portfolio • formulating action points for next week • formulating action points towards end-of-week

These results generally match the findings of Gibbs & Simpson [2], which state that student performance is enhanced by setting clear goals, the effectiveness of self-assessment and quick but frequent reviews of work. It also endorses the self-determination theory of Deci & Ryan [3], where it comes to autonomy in planning and the possibility to choose from several projects.

Time consuming, yet high-learning interventions were:

• mid-project formative assessment • final assessment • unplanned consultation during week • getting feedback / feed forward • online design method toolbox	• weekly self-assessment on competence progress • Thursday expo of all results • formal consultation meeting mid-week • being obliged to deliver individual results • working for an external client

These are the interventions that invite for efficiency measures: how to reach most of the learning in less time? However, since Hattie & Timperley [4] have proven the importance of feedback on different levels from different sources, it seems not a good idea to cut feedback. The importance of (guided) self-regulation and the need to provide tools enhancing students in the process is also clearly understated by Nicol & Macfarlane-Dick [1]. The online toolbox, which offers several design methods, instructions, formats and examples, was believed to contribute significantly to the learning process. This toolbox took a lot of effort to develop, but once complete, it will take less time to maintain it, still providing students self-learning opportunities.

The final assessment is perceived to have a high learning effect as well. This is a positive sign, as Gibbs & Simpson [2] state that final assessments only contributes to learning under specific conditions, such as encouraging active learning strategies, helping students feel a sense of accomplishment, etc. Dochy, Berghmans [3] stress that working with assessment as learning generally lowers the pressure on the final assessment, as most of the feedback has already been given during the process and the student has had many opportunities to adapt his process. In the final assessment we experienced mostly open, positive conversations with students about their learning process. In most assessments the emphasis was on looking forward towards the next semester instead of only looking backwards, which added to the positive atmosphere.

Time consuming and low-learning effect interventions are:

• maintaining a feedback journal • peer-feedback session • obligation to properly prepare mid-week consultation	• working in same room with all teams • giving / receiving a final mark

The low score on peer feedback sessions does not seem to match the findings of Gibbs & Simpson [2], who mention peer feedback as a powerful formative strategy. Possibly, weekly peer feedback sessions are too much for students (as Gibbs & Simpson [2]) also suggest. Another explanation might be found in the fact that we have put little effort in instructing students how to perform proper peer assessments. Many researchers, e.g. Liu & Carless [5] have found that peer assessment is a delicate process that has to be trained and coached properly, in order to convince students of its learning effect.

Another interesting finding is the low perception of the feedback journal. This is in line with our observations: students find it difficult to structurally document received feedback and even if they do, little of the feedback is transposed into actions. We believe we might overrate the effect of writing down feedback, of which we thought that it would sharpen thought-processes.

We are not surprised by the relatively low learning effect of receiving marks e.g. Gibbs & Simpson [2] mention the questionable effect of marks on the internalisation of feedback. Students tend to relate the given mark to their person as a whole, rather than questioning exactly what might be improved. The other interventions have to be evaluated critically, although some (e.g. giving marks) will be hard to abolish for legal reasons.

Two time consuming interventions have a low learning effect:

• Monday morning kick-off session	• small lecturer explanations during the process

These interventions might be abolished altogether, or changed radically. The low effect of a centralised, one-way kick-off session could have been predicted by Hattie [5], who found that one-way instruction generally has a very low learning effect.

8   EVALUATION

We have found several indications that the TJL approach and many of the included interventions add to high impact learning with acceptable teaching effort. However more evidence with more student groups has to be collected to be able to draw truly valuable conclusions. Furthermore, the large amount of interventions that may influence each other in unpredictable ways, make drawing conclusions difficult. Let alone the many variables we might have changed without realising, e.g. our pedagogical approach, changes in environment, the coaching team, variation in student groups, etc., etc. However, we have gained deeper and more detailed insight in which interventions may have the most and the least learning effect, related to the effort we put into it.

9   CONCLUSION

The TJL model has proven to enhance project results and pass rates in the evaluated project class. At least in our environment, TJL appears to provide students a challenging and autonomous, yet safe, feedback rich and well-structured learning environment. This without being overly time consuming for educational staff. As TJL incorporates many proven educational principles, it might also be of value for other educational environments in which students learn how to perform complex tasks or projects.

The TJL model needs further development of:
- Provide peer assessment training
- Avoid class-wide instruction & Kick-off sessions
- Help students setting clear, useful goals

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