

A different approach on gaining practical experience by acting as an (open) innovator at Industrial Design Engineering

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Abstract: *At Industrial Design Engineering we aspire to provide contemporary education, both in the content of the program as well as the way in which we teach. We aim to facilitate our students to become responsible entrepreneurs of their own learning experience. At the start of the second year we challenge students to initiate, organise and execute individual, international research abroad for 3 months. Students have to choose a research topic, initiate contact with companies and set-up a project. This ambitious setup at first creates confusion and excitement among the students. However, facilitated by a step-by-step approach, students arrive to inspiring research projects driven by their personal interests. We conducted a case study research to evaluate the educational approach as being successful in stimulating student entrepreneurship. We studied both the preparation course and the student projects. Insights on this approach are retrieved through the collection of multiple data from multiple sources and qualitative analyses. Results indicate that the majority of students are capable of designing an individual research project in an international setting and the balance between freedom and structure resulted in constructive friction*

Keywords: *new teaching, new learning, innovation.*

1. Introduction

The world is rapidly transforming. Economic, ecological, and technological developments transcend existing boundaries and push us to rethink and redesign society. Whether or not to innovate is not the issue. The challenge is in the way we innovate; are we able to rethink, redesign and realise the solutions to transform our society? (Valkenburg, 2011; Brown, 2009)

In order to redesign our world design education has to change (Norman, 2010; Kolko, 2011). At The Hague University of Applied Sciences (THU) at the international programme Industrial Design Engineering (IDE) students from all over the world are educated to become (open) innovators, who can integrate research, design and testing skills in an international context. Students are supported to develop an entrepreneurial attitude, to start up innovation projects that explore new possibilities, reframe contexts and create value for people (Valkenburg and Sluijs, 2012; Valkenburg and Sluijs, 2013).

Young adults today have grown up in a digital world (Prensky, 2001). These are our students, with specific values and needs. As teachers we are aware of this transformation and look for new ways to teach, coach and challenge our students. One innovation in the way we teach is encouraging students to create their own learning experiences throughout the programme. This paper focusses on gaining practical experience where this is explicitly taught. Instead of protecting them from this changing world, as many parents and educators seem to do these days (Furedi, 2012) we challenge them to take risks and discover the world in their own way.



Figure 1. Student projects in the program of IDE. Each module is 10 weeks of education and a school year has 4 modules.

At the beginning of the second year students start to apply the skills and knowledge learned in a practical environment. Half way during the first year the students are challenged to design their own project (see figure 1). The aim is to set-up an international research project directed at finding a meaningful design challenge to be used in a design project executed back in the university. The topic is free, for we want students to identify their personal interests and drivers and transform these to societal relevance. Our approach aims to stimulate entrepreneurial skills and personal responsibility. We facilitate the underlying search process with structure and coaching. The mix of maximum personal freedom for the students and maximum level of structure provided by us should result in challenging research projects (figure 2).

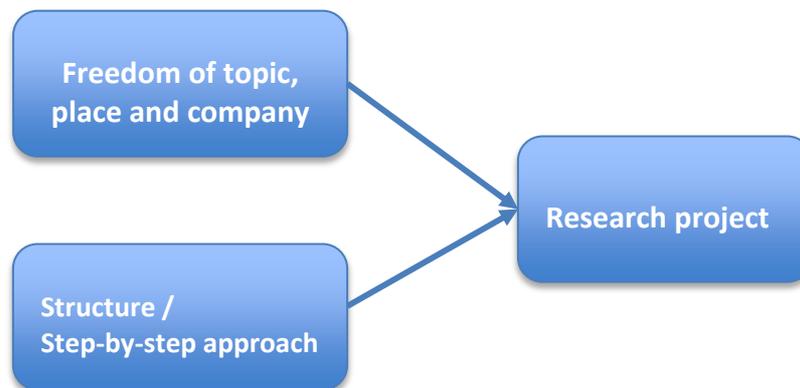


Figure 2. Freedom and structure as input for research project

We were curious how this ambitious educational approach can encourage design students in an early stage of their education to create their own projects. Stimulating students to make their own choices is risky. What are first year students capable of if you challenge them and give them the freedom to follow their own interests? In our opinion it is important to evaluate this new educational approach in order to learn from our experiment.

The main challenge we face in this ambitious educational approach is the balance between the freedom we offer students to find their own passion and help them in these insecure steps with a step-by-step approach. We want their challenge to be as large as possible, yet not scare them off or demotivate them.

This paper is structured as follows. Section 2 provides a description of the theoretical framework used to evaluate the educational approach. Section 3 describes the approach at IDE in more detail. In section 4 the research method is described. The results are presented in section 5. In section 6 conclusions are made on the value of contemporary education and the challenges faced in future education.

2. Theoretical framework

In order to evaluate the balance between freedom of learning and teacher guidance we use the model of Vermunt and Verloop (1999). This model integrates two types of theories to bridge the gap between learning and teaching theories. The model addresses the relation between students' freedom to control their own learning and the control a teacher can exert on the learning process.

First it is important to make a clear distinction between learning activities and teaching strategies. In table 1 learning activities are categorised in cognitive, affective and regulative learning activities. Cognitive activities are related to processing subject matter and changing student's knowledge base. Affective activities are employed to cope with emotions during learning. Regulative activities refer to exerting control over student's own cognitive and affective processing.

Table 1. A categorisation of Learning Activities. Source: Vermunt and Verloop (1999)

Cognitive	Affective	Regulative
Relating/structuring	Motivating/planning	Orienting/planning
Analysing	Concentrating/exerting effort	Monitoring/testing/diagnosing
Concretising/applying	Attributing/judging oneself	Adjusting
Memorising	Appraising	Evaluating/reflecting
Critical processing	Dealing with emotions	
Selecting		

There are different types of teaching strategies. Strong teacher control is a learning situation where the teacher takes over the cognitive, affective and regulative learning activities of the student. Loose teacher control means that the responsibility for all learning activities is handed over to the student. Shared control stands for shared responsibility for learning activities, students are continually activated by the teacher to carry out learning activities.

The learning model by Vermunt and Verloop (1999) shown in table 2 integrates degree of student regulated learning – similar to the freedom we offer our students – with the degree of teacher regulated learning – comparable with the structure we provide. There is a tight balance between student and teacher regulation of learning that can either result in congruent learning, constructive friction resulting in challenging learning or even destructive friction not resulting in any learning.

Table 2. Learning and teaching model. Source: Vermunt and Verloop (1999)

Degree of student regulation of learning	Degree of teacher regulation of learning		
	Strong	Shared	Loose
High	Destructive friction	Destructive friction	Congruence
Intermediate	Destructive friction	Congruence	Constructive friction
Low	Congruence	Constructive friction	Destructive friction

Student activities and teaching strategies can either match and result in congruent learning or they do not match and result in friction. Two types of friction may be discerned: constructive friction where students are challenged to improve their skill in learning and thinking activities, and destructive friction that may cause a decrease in learning or thinking skills.

In our approach on gaining practical experience we used a shared control in the preparation course and a more loose approach in the research project . In order to identify the effect and evaluate the value we conducted a case study research. The main research question is: Does the balance between freedom – student regulated learning - and structure – teacher regulated learning – result in constructive friction?

3. Description of the educational approach

At the beginning of the second year students execute a research project that should result in a design challenge to be used in the design project following after (see figure 1). Our aim is to give students the opportunity to research a topic that lies in their own field of interest. By addressing the students' intrinsic motivation we expect them to live up to the challenge. The project's main criteria are that it has to be abroad and the topic should be related to the theme Social Cities.

Example project: End of Mining, end of Society?

During a three month project, research was carried out on the impact of closing mines on a small community. These effects were investigated during a research trip to the mining influenced Island of Marinduque in the Philippines and in cooperation with the German company DMT GmbH & Co. KG who has a subsidiary in Jakarta, Indonesia.

Through interviews with stakeholders, such as local government and entrepreneurs, and observations of spaces and villages, diverse socio-economic aspects were found. Additional results of previous investigations were used to analyse effects mining can have on the society and.

The main findings show the strong effects of the closing of mines on the economic prosperity. Villages in the neighbourhood of the mines were cut off of basic supplies like water and electricity. These effects can lead to resettling and ghost towns.

(Bandelow, 2012)

The result of the research project will be user insights, based upon societal challenges. These insights are translated in a design challenge which is the starting point for product design. We carefully designed a preparation course (Plan the Project) that prepares first year students in a step-by-step approach to set-up a research project (International Insights Research) to be executed in the second year.

3.1 'Plan the project'

The course Plan the Project is designed to guide students step-by-step to set up their own research. The course contains four assignments. Assignment 1 and 2 lead to a project proposal on which students receive a go or no go from their coach. After students receive a go, they are encouraged to arrange their stay abroad and collaboration with an organisation in assignment 3, workshops and coaching sessions. Assignment 4 focuses on the detailed research plan. In the final project plan the student has everything detailed from research plan to financial overview. Additionally students have to show proof of their arrangements.

3.2. 'International Insights Research'

For International Insights Research students will execute their plans submitted in Plan the Project. Students are only allowed to execute their plans if they have successfully completed Plan the Project. During their stay abroad students are supported by a coach. Students can also attend an online classroom where the students can discuss general issues with peers and the co-ordinating lecturer. These online classrooms are offered twice a week to address different time zones. Every fortnight students have to hand in a reflection assignment related to the different stages of the project.

4. Research method

The educational project is perhaps too new for rigorous evaluation. As the approach is new, it is difficult to determine criteria for success. However, we want to gain insights into the teaching effects and evaluate the ability of students to deal with this amount of freedom and insecurity. We choose a qualitative research approach to leave space for insecurity in definition of the criteria and for surprises in findings. In a case study research (Eisenhardt, 1989) we collected many and diverse data from different resources.

4.1 Data gathering

We gathered data during different stages of Plan the Project and International Insights Research (see table 3).

Table 3. The data gathered in different stages

Phase	Step	Data
Prepare project proposal (Feb – April)	Kick-off	
	Defining itch ¹	Student work
	Exploring	Student work
	Project proposal	Student data (grades, topics, etc.)
Prepare final project plan (April – June)	Approaching companies	Start logbook kept by course coordinator Student work
	Detailing research design	Student work Reflection interview coach
	What if things go wrong?	
	Final project plan	Questionnaire 1 (#16) Interview with education advisor Student data (grades, topics, etc.)
International Insights Research (July – November)	Executing plan	Student work
	Return	Student work Student data (grades, topics, etc.) Questionnaire 2 (#23) Evaluation meeting coaches

Different types of data were retrieved from multiple stakeholders. The course coordinator kept a logbook to evaluate the course on the go. Semi-structured interviews were conducted with a coach and an educational advisor. Student work was examined, such as assignments, reflections and reports. Students were also invited to fill in two questionnaires in order to determine their perception on both courses. In the first questionnaire students were asked to grade specific course steps of Plan the Project and learning activities. They were also asked to explain why they gave the grade. A second questionnaire was used to check their statements made in the first questionnaire, to grade learning activities of International Insights Research and to investigate what learning objectives students think contribute to becoming an (open) innovator.

¹ Itch is 'a hunch' that there is something going on. These undefined feeling can indicate a good starting point for change (Valkenburg and Sluijs, 2012)

4.2 Data analysis

Firstly, statements – both positive and negative – were retrieved from the questionnaires. Then the collected data were clustered into the three categories of learning activities: cognitive, affective and regulative activities. Cross referencing was used to check for the coverage of multiple participants and multiple sources.

The student reflections, the logbook and the interviews were analysed qualitatively. Assignments, proposals and final reports were studied in order to retrieve key issues and insights. Each step of the structure provided by the teacher was analysed resulting in a list of effects illustrated by typical examples.

5 Results

The results section is divided into three parts. The first part analyses students' perspective on learning activities in order to find out how well they regulated their learning. The second part studies the effect of teacher regulation on learning. The last parts examines where congruence and friction in learning occurred.

5.1 Students perception on learning activities

This paragraph shows the results of the collected questionnaires. For each category of learning activity, cognitive, affective and regulative (see table 1) the results are presented and analysed. These results are illustrated with the data of three students as example (see table 4). The students differ in their approach to the project and their perception on the learning activities.

Table 4. *General characteristics of the students*

	Student 1	Student 2	Student 3
Originates from	Indonesia – Dutch father	Nigeria – lives in Netherlands for 10 years	China – grew up in Curacao
Place of research	Indonesia	Nigeria	China – Hong Kong (first visit)
Involvement of relatives	Worked with company of parent	Travelled with parents Co-operated with companies of family members	Worked independently
Details of planning	Switched topic before handing in proposal	Nominal	Started halfway plan the project
Grade PtP	9.2 ²	7.5	8.7
Grade IIR	8	4.5 (retake: 6)	4 (retake: 6)

5.1.1 COGNITIVE PROCESSING ACTIVITIES

These are the activities that directly lead to learning outcomes, for example structuring, analysing and applying. In the first year students followed courses on setting up and conducting research in order to find insights and formulate design challenges. This was mainly done in teams. For this project students needed to apply these skills independently.

² All grades in this article are based on a 10-point scale

In the first questionnaire we asked students which skills they have applied in planning the project. The response to this question was low and these results are not included in this research. In the second questionnaire we changed the question and asked students how the learning objectives contributed to become an (open) innovator (see table 5). Some students, like student 1, answered the question on abstract level resulting in high grades and general arguments. Others, similar to student 1, reflected on their own experience resulting in more diverse grades and reflective arguments.

Table 5. Students' perception on learning goals

Learning objectives	Student 1	Student 2	Student 3
Doing research	6: it would have been better if there was someone to do the research with	5: I had to find my own way with my research	10: knowledge is power
Work independently	8: learnt to be self-reliant	8: -	5: you have to inspire each other
Doing a project abroad	8: experience abroad makes us more open and we can grow as a person	6: it might not have the same impact when I went home	5: too expensive, why do something so far away with a legit purpose
Working with a company	6: you learn to function professionally in a professional environment	7: it helps to set a standard and improve communication	N/A
Finding insights	7: interviews and observation lets you grow as a person	8: it involves everything you know and more	N/A
Formulate design challenge	6: it was a small task but it was good experience for future research	7: it is still not perfected	6: easy to go many ways, easy to sway off

In general students agreed that these learning goals contribute in becoming an (open) innovator. Interesting results are:

- Doing research is a useful skill, however a few prefer to do research in a team or that someone else does the research. They believe that an (open) innovator should be working in a team.
- The majority was enthusiastic about executing the project abroad. Some say it is important to submerge yourself in other cultures referring to it in general or more specific to their own project. However, if they experienced many difficulties, like student 3, they are negative about being abroad and they complain about the expenses made.
- Working with a company was one of the learning goals that was often left blank as did student 3. This does not necessarily mean that this learning activity does not contribute to becoming an (open) innovator. For many students it was difficult to set-up good relationships with a company.

5.1.2 AFFECTIVE LEARNING ACTIVITIES

Affective learning activities are employed by students to deal with emotions that arise during learning, for example motivation and judging oneself. In the student work and questionnaires students made remarks related to such emotions that arose during learning (see table 6).

Table 6. Examples of remarks related to emotions

Negative	Positive
"Beginning was definitely hard." "At the beginning no idea about planning this project and I was anxious about what could I do and how to do it well." "At the beginning very confused." "Assignment 1 & 2 were helpful but quite confusing at the beginning."	"During planning things became clear." "For all done work I feel satisfaction and calmness." "I am really satisfied with the first stage of the research and I am looking forward of executing the research..."

In the beginning most students experienced negative feelings. Along the way more students became more positive with a small dip after the proposal. This was the step where they actually had to arrange their plans by calling organisations for cooperating with them in the project. In the end most students were positive.

Table 7. Choosing own research topic

	Student 1	Student 2	Student 3
Process of choosing own topic	Changed topic halfway first phase. Theme did not help specify it	Knew straight away and stayed in own comfort zone	Straight forward. Went out of own comfort zone
Was it valuable to choose your own topic?	yes because it kept me interested and motivated	yes, I could choose something I was already interested in.	yes definitely because this way you feel more responsible for it. as nobody knows about this/your subject as good as you do

Analysing the affective learning activities gave the following insights:

- Choosing their own topic kept most students motivated. However choosing your own topic is difficult. Some students asked their parents for help. Others switched topic a couple of times. One student preferred an assigned topic.
- In the beginning confusion arose because students did not know what learning or thinking skills to apply and how to interpret the assignment given. However by giving students feedback, they started to understand better what was expected of them. By the time they handed in the project proposal most understood and the confusion was gone.
- Insecurity is an emotion that arises when students do not oversee the task ahead and do not believe that they can control the challenge. They felt insecure when trying to find an itch, setting up the research and making contact with a company for an internship or other form of collaboration.
- Students who worked independently without regular help of a company, experienced more difficulties along the way. The fact they had no one to rely on resulted in feelings of frustration and insecurity.

5.1.3 REGULATIVE LEARNING ACTIVITIES

These learning activities are about the ability of students to plan their learning and monitor, adjust or evaluate along the way.

Table 8. Students' perception on structure

	Student 1	Student 2	Student 3
Start PtP	9: helpful assignments	5: unnatural, did not help in the process	8: clear assignments
Proposal	4: changed topic completely	6: looked more in depth	5: changed formulation of itch
Approaching companies	4: whole responsibility finding a company	4: stayed in comfort zone	2: no, but give advice on approach
Start IIR	Lot of work and meeting new people. Expected to gain a new view of everything	N/A	Going to make an awesome project on my own. Had no idea but I'll enjoy while doing it

In general students were capable to control their own learning. Analysing the regulative learning activities gave the following insights:

- Students were happy with the structure of assignments. Like student 2, some students found it an unnecessary structure as they perceive themselves as good planners.
- Almost all students that filled in the questionnaires were positive on the tutoring in both Plan the Project and International Insights Research. One student stated that the coach was more helpful than the course Plan the Project.
- Some students were capable to independently adjust their learning plan, goals or activities when necessary. They did experience friction because of that. Nonetheless, comparable to student 1 they were motivated to proceed in the new direction.
- A few students asked for help outside our programme, for example from parents and other family members, especially on finding a company to work with.
- Most students felt negative about the fact they received no list of companies to work with or prearranged internship positions. They wanted more support on finding companies and research topics.

5.2 Effect of teacher regulation

The course Plan the Project was designed to provide a learning environment with a shared control on learning between teachers and students. Students were continually activated with various learning activities to adequately prepare them for the research project. In the course International Insights Research students were expected to be more responsible for their own learning. The level of teacher control loosened along the way. In this paragraph the effect of each learning activity is examined.

Table 9. Phase 1: prepare project proposal

Step	Effect	Example
<i>Kick-off:</i> In February 2012 students heard for the first time that they had to design their own international research project.	Many worried feelings amongst the students and parents, because they had no idea how to make such a project happen.	We received an e-mail from a parent in which she expressed their concerns on our aim sending students abroad for practical experience at such an early stage of the programme.
<i>Defining itch:</i> For assignment 1 students had to identify own itch. Students were challenged to find an itch based upon their personal drive and motivation.	Students identified their own itch. However difficult, this led to surprising results.	A student who has lived in the German Ruhr area where her dad worked at a mining cooperation. She experienced herself the impact of mining and the closing of mines on the local society. She was curious if in other places of the world mining would have similar impact.
<i>Exploring context:</i> In assignment 2 students had to conduct background research on the context, the target group and the possible locations of their research by using the “WWWWWH” technique (why, what, who, when, where and how).	Some students showed a clear direction for their research project and even formulated preliminary research questions. Others were more struggling to get the right focus on their work.	One student wanted to go to a place where he could execute his research and hobby surfing at the same time. He looked into Maldives and Australia. Finally a friend showed him a picture of Bali where he saw a littered beach. He finally decided to go Bali and research why there is so much litter.
<i>Project proposal:</i> The proposal is a report combining the information gathered in the assignments 1 & 2. The aim of the report was to convince their coach that their project is feasible and adding value to society.	Almost all students were able to convince us of the feasibility of the project.	Four students had to do a revision of the proposal and received a GO after that. The students that received a No Go either did not hand in a proposal or needed to do a retake of a first year course parallel to the project.

Insights:

- Launching an ambitious project with a loose teacher regulation generates a lot of uncertainty.
- Giving students the opportunity to explore their own itch results in interesting and unexpected projects.
- Two types of student regulation occurred: students who easily knew what they wanted to do and students who struggled to find the right topic and location.

Table 10. Phase 2: prepare final project plan

Step	Effect	Example
<i>Approaching companies:</i> The students have to arrange a context for their research project, by involving a stakeholder on the scene. We offered help in form of an assignment, an acquisition workshop and personal guidance	Students complained that the help was not enough and they needed more help on finding a company. In the end more than half of the students were able to find a company with help from their own network.	One student was rejected many times by different organisations in Germany resulting in doing everything by herself in her home town in Romania. Another student used her personal network to arrange collaboration with a fish farm in Indonesia.
<i>Detailing research design & final project plan:</i> In assignment 4 the students detailed their research activities.	The last assignment was clear to most students and they appreciated the fact that it helped them writing the final project plan.	A group of students proposed a whole different research project a week before the deadline. This group had the idea to start-up their own company and wanted to combine it with their research project. We decided to let the students change their topic if they managed to come up with a good plan. It was one of the best plans handed in and the students were graded a 9.

Insights:

- Finding a company was the hardest part of all. Instructions on acquisition were given, but not sufficient to establish new relations
- Students that were not able to use their personal network struggled the most finding a company.
- Finding a topic is an iterative process that can take a lot of time. However, when they find a topic they like they can work hard and deliver good results in a short time.

Table 11. Phase 3: International Insights Research

Step	Effect	Example
<i>Executing plan:</i> Students executed their research plan guided by a tutor and sometimes a company mentor.	Students were excited about executing their own plan. Almost all experienced difficulties and frustrations at some point of their research. Most of them were capable of dealing with it.	One student experienced blackmailing by a local scooter rental company. He felt unsafe as he had no company mentor to rely on. He decided to cut short his stay and finish his research in the Netherlands.
<i>Return:</i> A special day was organised to welcome students back in school and share stories.	After being apart for a couple of months students were excited to return to school.	A student went to New York with great excitement. After a couple of weeks working independently on his research he was looking forward to be back in school again.

Insights:

- In the third phase the students were mainly in control of their own learning. In case the students encountered difficulties and frustrations most were capable of using advice from coaches and parents to independently solve their problems.
- Students missed working in teams and getting inspiration from others.

5.3 Friction in learning

In order to determine whether congruence, constructive friction or destructive friction took place it is important to analyse how successful students were in Plan the Project and International Insights Research and what caused them to be successful or unsuccessful.

The teaching strategy of used in Plan the Project is a shared approach. The learning was regulated by teachers with assignments, workshops and coaching. The focus of teaching is on guiding the process. The content, the choice of topic and how to plan the research project is regulated by the student. In some cases students were perfectly capable of applying the right activities and needed little guidance indicating a high degree of student regulation. However, 10 students received a no go for their project proposal and stopped with the course (see table 12).

Table 12. Student results in Plan the Project and International Insights Research

	#	Remarks
Participants PtP	50	
No Go PtP	9	7 failed assignments 1 & 2 2 did not meet entry requirements of 18 ECTS
Quit PTP	6	students left IDE
Satisfying grade PtP	35	2 students left IDE

In case of shared teacher regulation, students with a low regulation of their learning are expected to enter the stage of constructive friction and students with intermediate regulation would be in a stage of congruence (see table 13). Tutors have noticed that most students needed guidance to understand how to apply appropriate learning activities. These students probably experienced constructive friction.

Table 13. Regulation in Plan the Project

Degree of student regulation of learning	Degree of teacher regulation of learning		
	Strong	Shared	Loose
High	Destructive friction	Destructive friction	Congruence
Intermediate (few)	Destructive friction	Congruence (high grades)	Constructive friction
Low (majority)	Congruence	Constructive friction (satisfying)	Destructive friction

Seven students were not able to successfully complete the first two assignments. This might indicate that destructive friction did take place. Could this be caused by students employing a high degree regulation? These students indicated they were not able come up with an itch or wanted to wait another year. A possible explanation can

be that teacher control in Plan the Project was more loose than the teachers intended and students with a low degree of regulation experienced destructive friction.

Table 14. Student results in International Insights Research

Participants IIR	33	1 student left IDE
High grade IIR	5	≥ 8.5
Satisfying grade IIR	11	5.5 < x > 8.5
Satisfying retake IIR	5	Not all students were able to write a good research report at the first attempt
Not yet complete	3	Extended deadline
Dropout IIR	2	1 student left IDE
Failed	7	1 student left IDE

In International Insight Research the teaching regulation was more loose. The learning was mainly regulated by coaching talks with teachers. Additionally reflection assignments and online lectures were provided to support the students. However, the main learning activities were planned and monitored by students themselves in a context outside of school. Sixteen students were capable of successfully finishing the course in the first attempt (see table 14). Students who executed their project during the summer holidays, when no coach was available, either dropped out or failed the course.

Table 15. Regulation in International Insights Research

Degree of student regulation of learning	Degree of teacher regulation of learning		
	Strong	Shared	Loose
High (few: 5)	Destructive friction	Destructive friction	Congruence (high grades)
Intermediate (majority: 16)	Destructive friction	Congruence	Constructive friction (satisfying)
Low (few: 9)	Congruence	Constructive friction	Destructive friction (failed/dropped out)

6 Conclusion on contemporary education

At IDE we face the challenge of educating students an entrepreneurial attitude. We dealt with the dilemma of giving first year students freedom to create their own learning experiences and prevent destructive friction from happening. To learn from our experiment we evaluated the courses Plan the Project and International Insights Research. Does the balance between freedom – student regulated learning - and structure – teacher regulated learning – result in constructive friction?

First year students are often treated with strong teacher regulation. Our results show that the majority of students is capable of controlling their own learning. At the start they were uncertain and confused with the assignments we gave them, but towards the end they felt proud and satisfied with their accomplishments.

We applied a shared teaching strategy in Plan the Project to prepare them for the more loosely regulated International Insights Research. We controlled parts of the

learning experience with assignments, workshops and coaching. Nevertheless, we gave students the freedom to choose their own research topic and design their own research project. We can conclude that the teaching strategy we applied matches the learning strategy of most students and prevented destructive friction from happening in most cases.

For a couple of students destructive friction did occur. It might be that our teaching approach was too loose for these students. However, we observed in other courses that these students are having similar problems. Also a stronger regulation will not encourage them to become (open) innovators.

Finally, we can retrieve three recommendations from our findings on how to encourage design engineering students to create their own learning context and content :

- The majority of first year students are capable of creating their own learning activities when they are intrinsically motivated. A step-by-step approach can prevent destructive friction from happening.
- Teachers should help students dealing with emotions such as uncertainty, confusion and frustration, however without taking over the task of creating a learning environment.
- Finding research partners such as companies or research institutions is difficult and out of the comfort zone of students. Therefore teachers should continuously stimulate students to use networking skills and give support when necessary.

Based on these recommendations we will improve our approach. Future research will evaluate how these improvements affect the learning experience of design engineering students.

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References

- Brown, T. (2009). *Change by Design*. HarperCollins, New York.
- Bandelow, K (2012). *End of Mining, end of Society?* Student report
- Eisenhardt, K. (1989) Building theories from case study research. *Academy of Management Review*, 14, 532-550.
- Furedi, F (2012). Keynote speech at the De Haagse Hogeschool Think kennisfestival. (November 8, 2012) The Netherlands, Den Haag.
- Kolko, J. (2011). The Conflicting Rhetoric of Design Education. *Interactions*, 18 (4), 88-91.
- Norman, D. (2010). *Why Design Education Must Change* [cited 15 November, 2012]. Available from <http://www.core77.com/blog>
- Prensky, M. (2001) Digital Natives, Digital Immigrants. In: On the Horizon, MCB University Press, Vol. 9 No. 5, October.

- Valkenburg, A.C. (2011) *The Open Innovator at the Hague University* [cited 9 July, 2012]. Available from <http://www.slideshare.net/riannevalkenburg/the-open-innovator-at-the-hague-university>
- Valkenburg, R. and Sluijs, J., in co-creation with Kleinsmann, M., Den Ouden, E., Rietjens, J.J., Huskens, C., Lazarova, K. and Stoimenova, N. (2012) *The world of the open innovator*, The Hague University of Applied Sciences, ISBN: 978-90-73077-40-9.
- Valkenburg, R. and Sluijs, J. (2013) *Walk The Talk, or: a design driven approach to design design education*. Paper in review process for the International Conference on Engineering Design (ICED13) to be held in Seoul, August 2013.
- Vermunt, J.D. and Verloop, N. (1999) Congruence and friction between learning and teaching. *Learning and Instruction*, 9, 257-280.