LUND UNIVERSITY

Competition in higher education – good or bad?

Kristensen, Fredrik; Troeng, Olof; Safavi, Mohammadhassan; Narayanan, Prakash

2015

Link to publication

Citation for published version (APA):
Kristensen, F., Troeng, O., Safavi, M., & Narayanan, P. (2015). *Competition in higher education – good or bad?* Lund University.

Total number of authors:
4

General rights
Unless other specific re-use rights are stated the following general rights apply:
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.
• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: https://creativecommons.org/licenses/

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Download date: 12. Sep. 2026

LUND UNIVERSITY
Faculty of Engineering, LTH
Genombrottet

Competition in higher education – good or bad?

Fredrik Kristensen, Olof Troeng, Prakash Narayanan, Mohammadhassan Safavi and Martin Karlsson

Abstract**: Competition is an integrated part of most civilizations, from sports to education. Often competition arise whether or not it was intended and higher education is no exception from this. Should teachers acknowledge this and try to introduce competition as a part of the course or should they try to prevent competition, even spontaneously arisen competition? In this paper an overview of effects of competition reported in literature is presented together with deeper analyzes of how grading affect competition among students, project-based competition and competition within a class. As always, no one answer is found, competition can be good or bad, but a general trend seems to be that when competition is combined with cooperation good results have been reported. Furthermore, the competitive part of the course should not be the sole factor for grading but rather seen as a complement to regular teaching.**

Keywords**:** Higher learning; Competition; Cooperation; Project; LTH; Grades;

Introduction

Competition between humans or groups of humans is something we come across daily, sport events reported in the paper, corporations trying to sell more than their competitors, kids racing each other to the door, most published papers or answering the teacher's question first. Whether competition is in the human genetics or something learned has been debated in psychology for a long time; Sigmund Freud argued that humans are born competing for the attention of their parents and Charles Darwin's work about natural selection has also been used as argument that competition is in our genetics, even though he never stated such a thing. However, other studies suggest that competition is something induced by culture and how it's viewed is based how society values competition (Competition, 2015). For example, in Swedish culture it's not encouraged to tell people how good you are compared to others whereas in the USA it's more accepted.

In higher education, competitions are found at a number of different levels and in a number of different scopes, from self-competition to rank-based grading, consciously introduced or spontaneously started, all against all or groups against groups. In many cases competition will arise if the opportunity is there or the environment encourage it, whether or not is was intended. In (David Bergin, et al. 1995) there is an example of a school administration that posted an honour roll based on the grade point average, thereby encouraging grade competition amongst students, i.e. grade is more important than understanding, and this was most likely done without thought on how it will affect students' way of learning. A common idea behind structured competition in learning is to increase student motivation, but often it can come with the price that surface-learning is promoted above deep-learning. In (Shui-fong Lam et al. 2001) an experiment was made where the same class was given in a competitive and a non-competitive version. The competitive class performed better at easy tasks but sacrificed learning for performance and had a worse self-evaluation after failure. However, there were no significant difference between the classes in task enjoyment, achievement attribution and test anxiety. In (David Bergin, et al. 1995) study of competition amongst coloured people, it was found that competition seemed to do more harm than good, but if all completion were removed some students lost their incentive to learn.

Not only organized competition affects student's learning but also the competitive nature of students will affect the outcome. By looking at the personal goals of the students in a math class, (Paul R. Pintrich, 2000) divided the students into four different categories, high/low mastery – high/low performance, and measured motivational beliefs, affect, strategy use, and classroom performance. The outcome was measured over several years and it was found that high performance – low mastery students, i.e. students that focus more on doing better than others and little on actual learning, started out with high self-efficacy but had the lowest self-efficacy in the end. Student with high mastery goals were found to be the ones that fared best, but no drawbacks on motivation and achievement were found if high mastery goals were combined with performance goals.

As a general consensus in literacy cooperation is seen as a better alternative to competition (John Hattie, 2009), since these two are often, but not always (Pia Williamsa, Sonja Sheridana 2010), viewed as the opposite of each other. Some

classes use cooperative competition where groups of students competes against other student groups. One such example with positive outcome is reported in (Juan C. Burguillo, 2010), where outcome is measured in students success rate and marks. In this work student groups made a computer program during lab work and homework that competed against the other groups' programs, the winning group was rewarded a smaller amount of bonus points towards the final exam.
This paper looks closer at the effects of competition in grading, in project work and in the classroom. The most direct connection between grading and competition is the rank-based grading system, where grading is based on the student performance compared to the other students. Rank-based grading was used in Swedish secondary schools until 1995 when it was replaced with grades based on learning goals. In Swedish higher education rank-based grading is not used, but there has been some fear (Lundagård, 2003) that when adapting to the European Credit Transfer System (ECTS, 2015) it will be introduced. The ECTS is based on rank-based grading but Swedish universities that use the system has only adapted to the credit system and the 7-graded grade scale, keeping the goal-based grading criteria. In Chapter 2, competition and grading is investigated along with the tightly couple subject of exam design.
At Lund technical university (LTH) the most common form of structured competition within teaching is project courses that ends with a competition between students groups. For example, in the Project in Electronics and Sustainable Development at LTH students can chose to build a ball collecting robot and compete with it at the end of the course, the competition is purely for fun and the outcome is not reflected in the grades. In Chapter 3, competitions in project work is discussed and experiences from LTH is collected.
Finally in Chapter 4, the classroom effects of competition is discussed. What are the positive-negative effects of introducing an element of competition in the classroom? Can competition be avoided or will there always be competition between students even if the teacher does not use it actively when teaching?

Grading

In general grading or assessment is used to evaluate, communicate, motivate, and get feedback. In competition, grading plays a pivotal role. Grading scale serves as an yardstick for students to measure one's performance which then could be compared to compete with themselves, with fellow students or with schools...etc. Grading is used by the teachers as a tool to assess the level of student's understanding. But based on the grading methods, the student's way of approach to the learning differs. There are negative aspects for grading too, obtaining lower grades (in competition) could lead students to demotivate and result in absenteeism (Moos, 1978), whereas in graduate student education, competition for grades seems to have positive effect and enhance the student's' performance (Clark, 1969).

Grading can be broadly classified into two types Pass-fail and ranking method. While some researchers argue that performance declines in pass-fail system

(Gold, 1971) ([Karlins, 1969), and only limited feedback in pass-fail system is feasible (Heaslip, 2012), other researchers argue that this system benefits students by reducing stress and increasing group cohesion (Rohe, 2006).

Ranking method can be broadly classified as criterion-referenced and norm-referenced. Criterion referenced assessment method is employed for the students to meet the intended learning outcomes, whereas norm-referenced method is relative method, it is based on the fellow students performance. Both methods have their own pros and cons, it depends on the course, number of students, involvement of the students …etc. (Cherry, 2005)
A study conducted at primary school level reveals that the graded low-ability students received lower subsequent grades and had lower odds to finish upper secondary education, compared to ungraded low-ability students (Klapp, 2015). This shows that grades affect the low-ability and high-ability student in different ways.

Performance-approach and performance avoidance

Motivations of students behind the grading are clearly analyzed by (Pulfrey, 2011). There are two main distinctions in performance related goals, performance-approach and performance-avoidance. Performance-approach is when the students like to perform better to attain some goal, whereas performance-avoidance is when student try to perform better to avoid embarrassment. Performance-approach enhances one's aspiration, self-esteem (Elliot & Moller, 2003), whereas the performance-avoidance brings in anxiety, hopelessness, shame (Pekrun, Elliot, & Maier, 2006). Since grading is done by an external source, students lose the control of their grades and hence become powerless. Dependence or powerlessness has been associated with a basic inhibition or avoidance motivational orientation (Keltner, Gruenfeld, & Anderson, 2003).

Teacher Evaluation

Teacher evaluation and grading has some correlation. Grading could affect the teacher evaluation by the students. It is found from previous study [Peterson, 1980] that the teacher evaluation is simply not the reflection of the grades. But both grading and teacher evaluation are strongly correlated (DuCette, 1982) and this could pave way for grade leniency. Grading leniency has some moderate effects in the teacher evaluation (Marsh, 2000). The severity of teacher evaluation by grading leniency is also based on the course types for example if the course is elective or mandatory.

Factors affecting the teachers in grading

A study focusing on English language teaching at Chinese school found out that there is a significant difference between the teachers with and without training in assessment in their considerations for grading (Cheng, 2015). The influence of class size and school size is very minimal when it comes to assessment however grading could be influenced by the subject, taught by the teachers (Duncan, 2007). According to another study (Diana, 2011) all the factors can be divided into two groups called academic and non-academic factors. Academic factors include project, tests, quizzes, home-work…etc. Non-academic factors include student work habits, behavior, responsibility…etc.

The factors deemed most important are the classwork progress, which includes classwork assignments, which are used to demonstrate the progress and development of students.

Grading in higher education – A survey

To study how grading is perceived by graduate students and teachers, a brief survey was performed at Lund University at the Department of Mechanical engineering. Overall 16 student responses and 11 teacher responses were recorded. The survey was done to understand

(i) Which type of grading is favored by students and teachers?

(ii) Are grades used by students for competition (among students) and are grades used by teachers to rank students?

(iii) Do grades play a role in future employability of students?

Pass-fail grading

Pass-fail grading shows the learning of the students, which could be good in many ways, but it doesn't show the performance of the students. It is clear from the responses that the students are inclined towards the pass-fail grading method whereas teachers are inclined towards not using it. This could mean that teachers would like to see the performance of the students,perhaps, to compare the students from different year, or to compare them from previous year or to filter underperforming …etc. Although from Figure 2, it is seen both teachers and students like to have rank based grading. This contradicts student's previous response, this could mean students care less about the type of grading and care about passing the course.

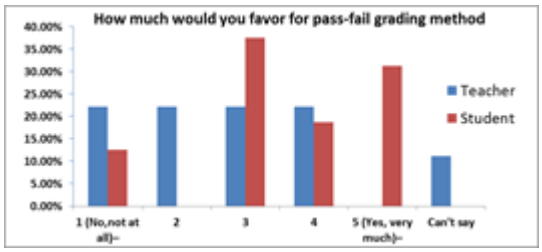

Figure 1. Pass-fail grading method. Student vs teacher.

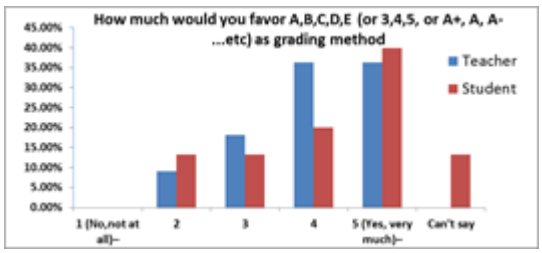

Figure 2. Rank based grading. Student vs teacher.

Ranking and competition with grades in classroom

From figure 3, it is clear that both teachers and students dislike ranking pupils in the classroom. But they don't reject the idea of using the grades to compete with each other. Most of the teachers couldn't say if they would do that. But student's response shows that they compete moderately with the grades. From the responses in Figure 5, both students and teachers feel that the grades are moderately important for future employer.

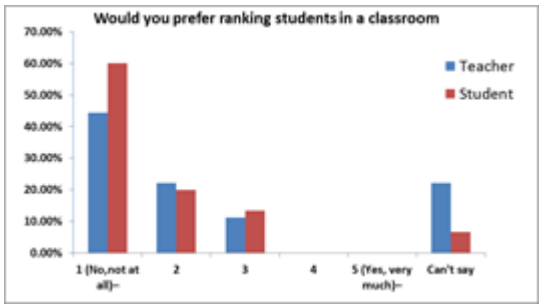

Figure 3. Ranking in class. Student vs teacher.

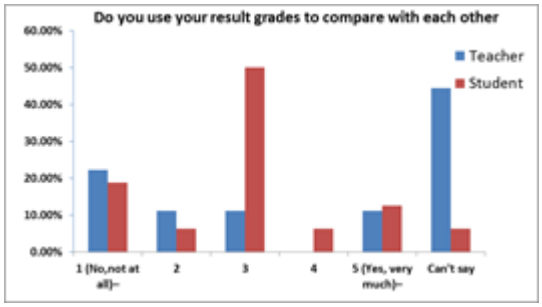

Figure 4. Grades for comparison. Student vs teacher.

Figure 5. Usefulness of grades. Student vs teacher.

Survey Summary

- Teachers and students both support Rank based grading.
- Both were against ranking students in classroom
- Both find the grades to be moderately useful for future employer

Project-based competition

In the classroom we can impart the application of knowledge and skills in new ways to achieve desired learning outcomes and more important, the creativity! (Burke, 2007, p. 36). There are two kinds of learning, explicit and implicit. Explicit learning can be achieved through activities such as reading textbooks, listening to lectures, seeing course materials. Implicit learning can be achieved through experience, games and other hands-on activities which increase students' engagement (Dewey, 1938; Kolb, 1984). Students learn concepts best by doing – seeing, smelling, hearing, touching and tasting as well as thinking, either creatively or logically (Burke, 2007, p. 35).
Students need motivation to get engaged. There is a theory called expectancy theory (Vroom, 1964), which argues that motivation depends on prediction of reward, the importance of the reward and the expectation of achieving the

reward. This expectation may depend on perceptions of one's own worth and abilities, and high perceptions of both increase one's persistence and chances of success.
Project-based competitions are considered as key experiences by students and these experiences have a long lasting impact (Yair, 2008). In a questionnaire, a large group of adults were asked to describe educational key experiences, many remembered about their involvement in group-competitions that were followed by public events where artefacts were presented (Yair, 2006).
Should project work be group-based or on an individual level? Research indicates that group-based project competitions where a certain number of students cooperate as a group to compete against other groups can produce higher learning performances than competition among individuals (Fu, Wu, & Ho, 2009). Moreover, such competition in high school can be implemented in higher education as well. Here we concentrate on engineering and physic disciplines which can easily be project based. For example, in the physic program some competitions have been done among universities, nationally as well as internationally. Another example is the Association for Computing Machinery (ACM) that hold a programming project competition among computer science and mathematics students across universities. Other project-based student competitions are described more in detail below.

Formula Student

One of the most famous student competitions is formula student which is a student engineering competition (www.formulastudent.com). Here, teams from around the world try to design, build, test, and race a small-scale formula style racing car. Each big university or higher education institute sponsors a group of students to make a formula car. The cars are judged by industry specialists on different criteria like engineering design, cost, safety, brake, noise, fuel economy and etc. The winner is a team with highest number of points from judging process.
Formula Student definitely is a group-based project competition and mainly involve mechanical and electrical engineering students. Students have the opportunity to implement their knowledge in a practical engineering project. Such kind of students' project is a fantastic experience for students especially because of the group interaction and the possibility to test their skills. They get involved with many challenges and tests-errors and even if they are defeated in the game such experiences are worth it. It seems that formula game can be very exciting apart from its scientific point of view. And excitement definitely has a positive effect on the learning process (Railsback ,2002). Other professional group-based competitions are formula one and EcoCar. Formula one are for university formula students after their graduation and EcoCar are targeting green engineering.

Robocup

Robocup is a yearly international project-based competition game proposed in 1997 (www.robocuphumanoid.org). University students from all over the world put their efforts on a group-based robot project in order to compete with other team's robots. The word "Robocup" mostly refer to "Robot Soccer World Cup" but these days is not necessarily limited to soccer robots. There are also RobocupRescue, RoboCup@Home and RoboCupJunior. In order to

select best team as a national team of each country, such competitions also held on a national scale between different universities. These games are held in different styles, sizes and leagues.
The technical aspect of robots cover a wide range of research disciplines like mathematic, electronic, computer, control, mechanic and etc. It means in each group, students with different majors attracted to come together and they learn how to work in an interdisciplinary project like most real world engineering projects. It seems they learn how to implement their knowledge in a near to real project and how to interact with others. Such project can take several years and each member learns how to be involved with successes and mistakes. Most of the winners in these leagues were the defeated ones in previous leagues. It means the students learn that a project cannot be prefect and can be upgraded to be a better one.

Other sorts of projects

Generally project-based games can be implemented in all sorts of disciplines. For example for architecture and civil engineering students there are some project-based games like spaghetti-bridge, a Balsa wood bridge design which let students learn how to implement static equilibrium and robustness in their handmade structures. For computer science or mathematic students there are contests on making software, simulations or web-pages. Moreover, even for art related students there are various kinds of competitions on their handmade artefacts or visual arts gallery projects. Definitely there are more examples on project-based contests and we assume engaged readers could find more in their related disciplines.

Rule of technology

Competitions support project-based learning by inviting students to think like engineers. Each competition presents a unique engineering challenge that may require months, or even years, of intense focus and hard work. Using industry-standard tools in developing the projects is unavoidable, because students need to learn how to use tools in their projects to be competitive. For engineering students using design tools is necessary and can be a worthy skill to have in the resume. In real industry the employers tend to hire educated people according to their experiment on using some special tools. In engineering disciplines one of the best way to learn how to use a tool is to use it in an educational or real project. Here all sorts of hardware or software and simulation tools can be considered which is developing based on advanced technology.

Experiences from LTH courses

The text (Eklundh, 2013) in one of the major Swedish newspapers is typical for how competition based activities in courses in elementary-level education are seen by many in the Swedish education system, it is stated (without references or arguments) that “Research has shown that competitions and rankings in school reduces the interest among the students”. Also in the article “Everyone loses on competing” in the magazine Skolvärlden (Wahlgren et al., 2003) it is argued that competition in school gives rise to increased insecurity among the students. The sentiment that competition is a bad thing is in

resonance with the “Law of Jante” that to some extent is still spread throughout the Swedish society.

Without discussing the validity of the above point of view for lower-level education, it seems to be detrimental and irrelevant for higher-level engineering education, whose main objective is to prepare the students for the harsh realities of industry were the market forces will make companies that are unprofitable, irrelevant or just not good enough, perish. However most companies will not benefit from having overly competitive employees, success for a company rather comes from that its employees have the right skills as well as the motivation and ability to work together towards the same goal. That said, the effects of the competition in the market is something that every engineer that gets a job in industry will get exposed to, whether more or less directly. Exposing engineering students to, preferably team-based, competitive activities during their undergraduate education, would be one way to increase their readiness for a job in industry.

Competitive activities within courses also make students who like competition spend more time working with the course material and and it will also make them more motivated to master the subject. On the other hand, the students that do not like competition or students that feel that they have no chance to do well, will become discouraged. Given that the teachers properly manage these negative effects through encouragement and support, it seems like higher-level engineering programs would benefit from including competitive activities in their courses. However competitive activities within the courses at LTH are rare, some of the few examples that the authors have been able to find are shortly discussed below. The purpose is to show in what contexts competitive activities are used in courses at LTH and for those cases where it was possible, provide a perspective from people involved.

Artificial Intelligence (EDA132)

The course in Artificial Intelligence (EDA132) given by the Department of Computer Science contains a comprehensive programming assignment on search methods where teams made up of about 3 people are to design a computer program for playing a recreational board game. As part of the assignments the programs of the different teams will face off during a tournament. The result of the tournament do not influence the grade of the students per se, but the quality of the programs have an impact on the final grade in the course.

In the CEQ evaluations for the course there were no specific comments pertaining to this competition, neither good nor bad. However experiences from students taking part in the course are that many really did go that extra mile in order to obtain a competitive program for the tournament. Since many of the ways to improve the performance of the programs are key components in efficient search algorithms, the assignment was well aligned with the learning outcomes.

Project in Electronics and Sustainable Development (ESSF05)

In this course given by the Department of Electrical and Information Technology the students have the possibility to choose a project where they will compete with other teams in robot competition. The robots compete pairwise on two adjacent but separate playing fields filled with balls of varying sizes. The objective is to throw as many balls as possible to the field of the opponent and have as few balls as possible remaining after a set amount of time has passed.

One of the faculty members involved in the project felt that the spirit of competition motivated the students to work harder and try to make a really excellent design rather than a design that is not more than working. He had also got positive feedback from the students that the competitive component made the assignment feel more "real" and the prospect of being benchmarked against the other students groups.

CADCAMCAE (MMT160)

A course on computer assisted design, CADCAMCAE (MMT160), given by the Department of Production and Materials Engineering, one of the hand-ins, where a 3D model for a tape dispenser should be created has the format of a competition where the submitted designs are ranked and a winner is selected.

Competition within class

There are several forms of competition between students that take form within class. For instance, the examiner might compare them to each other to determine their grading. This is an example of where the results of the competition, which does in fact not even have to be explicitly announced, is used for decision making. Competition is also widely used as a mean to encourage students to perform well, for example by announcing that they will be compared to each other during grading. There might also be less formal forms, such as dividing the class into groups that will compete against each other in the end of the course, as a fun event rather than very serious. Furthermore, there might be informal, but still serious, competition among students, where just the prestige is at stake. This does not have to be pronounced, and it does not even have to be mutual, but might still have a large impact on the students that feel that they participate.

In (Lundagård, 2013) there is an interesting discussion about relative grading, and the risk of unfairness that this implies. In short, there is a risk that your grades get affected not only by your own results, but also by your classmates'. In this case, that effect was unwanted, and the purpose with relative grades was not to introduce competition, but to make the Swedish grading system compatible with European grading standards. However, competition will probably be the immediate effect, potentially with a worse working climate as a result.

This concern is promoted by the conclusions drawn in (Shui-fong Lam et al. 2001), where 52 students in the 7th grade were divided into one competitive

environment, and one normal environment for reference. Albeit the exposure to competition was short in time (2 hours), the authors claim to see results in evaluations much later. Further, the experience was that the students in the competitive environment had higher stress levels, learned less and got lower self-esteem, on average. This is, of course, not a sought-after situation.

On the other end of the spectrum we have friendly competitions, designed to motivate the students and by this increase their performance, as described in (Juan C. Burguillo, 2010). Here, game theory was used to design the competitive environment. The students were divided into groups that competed against each other, but just for fun. That is, the results of the competition was by no means used to determine their grades or anything of vast importance. This environment seemed to have a very positive effect on the participants' learning. Collaboration within the groups was also emphasized as an important aspect, meaning that individual competition would probably not have the positive learning effect. This raises the question whether it is actually the competition itself that contributes positively, or if it might be the collaboration only that affected the students. This is not clearly discussed in (Juan C. Burguillo, 2010).

Discussion

Competition can be used as a mean to encourage students in a positive way. However, this requires some very important aspects to be taken into account. Firstly, it should not imply negative stress on the participants. In order to achieve this, the results of the competition should not be the most importance factor for the students. They should, for instance, not be used for grading. Secondly, it should include cooperation. A good way to achieve this is to divide the students within teams, so that cooperation will take place within these. An interesting aspect of this, is that it might be argued that competition will take place regardless of whether the course leader has arranged it or not. If not structured in the right way, this might be of one of the destructive kinds described previously in this article. It might also end up with a competition that does not have to do with the course material, such as a competition of who parties the most, who is strongest, best looking, or something similar that takes focus from the academia. In order to avoid this, the course leader can then purposely introduce competition related to the course material.

Grading students is a necessity or a sanity check to control the learning outcomes of a course. But the type of grading used could instill a positive or negative behavior among students and grading also affects the low-ability and high-ability students in different ways. There are numerous factors in deciding if it will affect positively or negatively, and to accommodate all the factors to derive an answer is close to impossible. But looking at a few vital parameters we could arrive at the direction we shall work towards. Firstly, from studies it is clear that rank based (grading with intervals) grading promotes performance-avoidance more than the performance-approach, which puts unnecessary pressure on students. Secondly, grading also affects the students' teacher-evaluation with different magnitude depending on the subject, size, and sex of the teacher…etc. Nevertheless teacher-evaluation is affected by the

students grading and this could lead to grade leniency. Third important parameter is how reliable is the grading performed by the teachers. Grading affects students in various ways and if the grading is not done reliably, for example the grading done by a teacher with training in assessment is different from a teacher who has not; this is an external source of error which could affect the student's approach to learning itself. With the brief survey performed, it's shown that the majority of the students would moderately use the grades to compare with each other.

With these few parameters it is hard to arrive at something concrete, however it shows that rank based grading is a negative influence. One suggestion is to use pass-fail method in the courses. Many teachers were inclined against this; the reason could be that this method doesn't give enough feed-back about the performance measures like teaching methods, comparison of students among classes…etc. If this is the main concern then the teacher can grade the students but not reveal the grades to them, it could be still a pass-fail course at the end. Student doesn't have to be demotivated or pressurized or in fact doesn't affect at all by grades and teachers could still have what they want. There could be risks involved with this as well, for example a teacher could prefer one student over other based on the grades he/she offered. But this is a question the authors haven't investigated and is open for future studies.

Project-based learning can be very useful for students to learn how to implement their practical and theoretical knowledge, how to interact with others and work as a team, how to choose best strategy or solution, how to use different available tools and master them, how to face challenges and solve problems, how to test and evaluate their results, how to compete with other teams, and many things with project-management, time-scheduling and leadership skills. These are all experiences and skills they will need in their future careers.
Competitive activities within the courses at LTH are rare, arguable too rare considering that LTH should prepare the students for the competition in industry.
As discussed in the articles in the introduction there is a significant risk that those students that from the outset perceive that they have no chance to perform well in the competition loses motivation and spend less time on the task than they would have done otherwise, this might be unavoidable and as always it is hard to adapt the education to fit every student of every background. These weaker students has however just as good opportunities to learn from the activity as anyone else, but it could be helpful with some extra encouragement from the teacher.
It is also a problem if the competition becomes too serious, that could lead to more hostility in the class, less collaboration and a worse learning environment. For example, in a class where the pass-fail criteria is only based on the students' position in the competition, it's easy to imagine that students would be less likely to help each other. By the way, this is very close to how norm-referenced rank-based grading works.

As a summary we do not think teachers should be afraid, as they seems to be at LTH, to introduce competitive activities in their courses as long as they can keep it playful and still maintain cooperation and discussion among the students. Care has to be taken to construct the competition so that it is

necessary to have absorbed the learning outcomes to a high extent in order to be successful.

References

Lundagård, 2003 http://lundagard.se/2003/02/05/4918/
ECTS - European Credit Transfer System, 2015, http://ec.europa.eu/education/ects/ects_en.htm

Paul R. Pintrich (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psycology.*

Juan C. Burguillo (2010). Using game theory and Competition-based learning to stimulate student motivation and performance. *Computers & Education*, Volume 55, Issue 2, September 2010, Pages 566–575

Zhi-Hong Chen (2014). Exploring students' behaviors in a competition-driven educational game. *Computers in Human Behavior*, Volume 35, June 2014, Pages 68–74.

Pia Williamsa and Sonja Sheridana (2010). Conditions for collaborative learning and constructive competition in school. *Educational Research*, Volume 52, Issue 4, 2010

David Bergin, et al. (1995). Academic competition among African American and Mexican American students: A Qualitative study. *Annual Meeting of the American Educational Research Association*.

Shui-fong Lam et al. (2001). The effects of classroom competition on achievement motivation. Annual Meeting of the American Educational Research Association.

Henry Wang and Bill Yang (2003). Why competition may discourage students from learning? A behavioural economic analysis. Educational Economics Vol. 11.

Stephanie Shimotsu-Dariol et al. (2012). Students' Academic competitiveness and their involvement in the learning process. *Communication Research Reports* Vol. 29 No.4.

John Hattie (2009). Visible Learning – A synthesis of over 800 meta-analyses relating to achievement. *Routledge*
Burke, C. (2007). Inspiring spaces: Creating creative classrooms. Curriculum Briefing

Dewey, J. (1938). Experience and education. New York, NY: Collier Books
Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall.

Vroom, V. H. (1964). Work and motivation. New York, NY: McGraw Hill.

Yair, G. (2006). From key experiences to turning points: A study of educational impacts [In Hebrew]. BneiBrak, Israel: Sifriat Poalim.

Yair, G. (2008). Key educational experiences and self-discovery in higher education. Teaching and Teacher Education, 24(1), 92–103.

Fu, F. L., Wu, Y. L., & Ho, H. C. (2009). An investigation of coopetitive pedagogic design for knowledge creation in web-based learning. Computers & Education, 53(3), 550-562.

Johanna Eklundh (2013), ”Lärarna får en att vilja tävla – fast mer mot sig själv”, 16 Jan, http://www.svd.se/lararna-far-en-att-vilja-tavla--fast-mer-mot-sig-sjalv

Anna Wahlgren Andrew J. Elliot, Arlen C. Moller (2010), “Alla förlorar på att tävla”, Skolvärlden 9 NOVEMBER, Performance-approach goals: good or bad forms of regulation?, International Journal of Educational Research, Volume 39, Issues 4–5, 2003, Pages 339-356, ISSN 0883-0355, http://dx.doi.org/10.1016/j.ijer.2004.06.003.

Cheng, L., & Sun, Y. (2015). Teachers' Grading Decision Making: Multiple Influencing Factors and Methods. Language Assessment Quarterly, 12(2), 213-233.

D. Cecil Clark. Competition for Grades and Graduate-Student Performance. The Journal of Educational Research Vol. 62, Iss. 8, 1969.

Daniel E. Rohe, Patricia A. Barrier, Matthew M. Clark, David A. Cook, Kristin S. Vickers, Paul A. Decker. The Benefits of Pass-Fail Grading on Stress, Mood, and Group Cohesion in Medical Students. Proceedings. Volume, November 2006, Pages 1443–1448.

Diana Yesbeck (2011). Grading Practices: Teachers' Considerations of Academic and Non-Academic Factors. Theses and Dissertations. Virginia Commonwealth University, 2011.

DuCette, Joseph; Kenney, Jane. Do grading standards affect student evaluations of teaching? Some new evidence on an old question. Journal of Educational Psychology, Vol 74(3), Jun 1982, 308-314. http://dx.doi.org/10.1037/0022-0663.74.3.308.

Duncan, C.R., & Noonan, B. Factors Affecting Teachers’ Grading and Assessment Practices. The Alberta Journal of Educational Research, Vol. 53, No. 1, Spring 2007, 1-21.

Hochweber, Jan; Hosenfeld, Ingmar; Klieme, Eckhard. Classroom composition, classroom management, and the relationship between student attributes and grades. Journal of Educational Psychology, Vol 106(1), Feb 2014, 289- 300. http://dx.doi.org/10.1037/a0033829

Howard, George S.; Maxwell, Scott E. Correlation between student satisfaction and grades: A case of mistaken causation?. Journal of Educational Psychology, Vol 72(6), Dec 1980, 810-820.http://dx.doi.org/10.1037/0022-0663.72.6.810.

Keltner, Dacher; Gruenfeld, Deborah H.; Anderson, Cameron. Power, approach, and inhibition. Psychological Review, Vol 110(2), Apr 2003, 265-284.http://dx.doi.org/10.1037/0033-295X.110.2.265.

Klapp, A. (2015). Does grading affect educational attainment? A longitudinal study. Assessment In Education: Principles, Policy & Practice, 22(3), 302-323. doi:10.1080/0969594X.2014.988121.

Marsh, Herbert W.; Roche, Lawrence A. Effects of grading leniency and low workload on students' evaluations of teaching: Popular myth, bias, validity, or innocent bystanders?. Journal of Educational Psychology, Vol 92(1), Mar 2000, 202-228. http://dx.doi.org/10.1037/0022-0663.92.1.202.

Marvin Karlins , Martin Kaplan , William Stuart. Academic Attitudes and Performance as a Function of Differential Grading Systems. Vol. 37, Iss. 3, 1969.

Moos, Rudolf H.; Moos, Bernice S. Classroom social climate and student absences and grades. Journal of Educational Psychology, Vol 70(2), Apr 1978, 263-269.http://dx.doi.org/10.1037/0022-0663.70.2.263.

Pekrun, Reinhard; Elliot, Andrew J.; Maier, Markus A. Achievement goals and discrete achievement emotions: A theoretical model and prospective test. Journal of Educational Psychology, Vol 98(3), Aug 2006, 583-597.

Peterson, Christopher; Cooper, Sloan. Teacher evaluation by graded and ungraded students. Journal of Educational Psychology, Vol 72(5), Oct 1980, 682-685.http://dx.doi.org/10.1037/0022-0663.72.5.682.

Pulfrey, Caroline; Buchs, Céline; Butera, Fabrizio. Why grades engender performance-avoidance goals: The mediating role of autonomous motivation. Journal of Educational Psychology, Vol 103(3), Aug 2011, 683-700. http://dx.doi.org/10.1037/a0023911.

Railsback Jennifer, PROJECT-BASED INSTRUCTION: Creating Excitement for Learning ,North west regional educational laboratory, 2002

Richard M. Gold , Anne Reilly , Robert Silberman , Robert Lehr. Academic Achievement Declines under Pass-Fail Grading. The Journal of Experimental Education Vol. 39, Iss. 3, 1971.

Todd L. Cherry and Larry V. Ellis. Does Rank-Order Grading Improve Student Performance?. International Review of Economics Education, volume 4, issue 1 (2005), pp. 9-19 DOI: 10.1016/S1477-3880(15)30140-7.

Vanessa Heaslip, Janet M.E. Scammell, Failing underperforming students: The role of grading in practice assessment, Nurse Education in Practice, Volume 12, Issue 2, March 2012, Pages 95-100, ISSN 1471-5953.

Appendix

Survey questionnaire for Mechanical engineering students at Lund University.

	1 (No,not at all)	2	3	4	5 (Yes, very much)	Can't say
How much would you favor for pass-fail grading method	○	○	○	○	○	○
How much would you favor A,B,C,D,E (or 3,4,5, or A+, A, A-...etc) as grading method	○	○	○	○	○	○
Would you prefer ranking students in a classroom	○	○	○	○	○	○
Do you use your result grades to compare with each other	○	○	○	○	○	○
Do you think your grades are useful for your future employer	○	○	○	○	○	○

Typical grading scales followed in Sweden (Lund University)
Pass-fail
Pass with Distinction-Pass-Fail
Pass with Distinction-Pass with Credit-Pass-Fail
Five-Four-Three-Fail
A-B-C-D-E-Fail