Learning through cooperation and competition

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Abstract

In this study, we look into the effects of cooperation and competition on learning outcomes in three universities from Finland, Spain, and Turkey. Feedback was collected via online survey from students who participated in the monitored international group competition. Our results support positive impacts of cooperation on learning outcomes but deny any negative impacts of competition. We argue further that learning outcomes are also influenced by cultural differences in perceptions towards cooperation and competition. Overall, we find the international group project competition with analysis of real-life business problems a creative approach to stimulate enhanced learning for raising "intelligent consumers of business statistics".

Keywords

Learning, cooperation, competition

Introduction

Business statistics is a first-year basic course in the curricula of many bachelor degree programs in business administration. The course aims to develop students' skills in making meaningful analysis of large data sets and applying quantitative research methods to solve managerial problems. Due to its high level of involvement with large chunks of data and unfamiliar quantitative terms with mathematical formulas, this course is vulnerable to become a boring, number-crunching exercise for some students. In this situation, the resulting learning outcomes and performance are likely to be poor as students feel demotivated and at times frustrated in front of meaningless data sets. To avoid such instances, professors of business statistics should exhibit creativity to engage their students in order to achieve better learning outcomes and performance. Stimulating learning creatively is not a concern of business statistics professors only. It has always been a very important topic in education literature and a major issue for educators at all levels of primary, secondary, and higher education (see Gibson 2010).

Creativity in the classroom involves the application of knowledge and skills, in new ways, to achieve valued outcomes (Burke 2007, 36). To better understand how to apply creativity in the classroom, we should consider what is learning and how it can be achieved. Learning is divided into two categories: explicit learning and implicit learning (see Jensen 2005). Explicit learning is achieved through activities such as reading textbooks, listening to lectures, seeing pictures and watching videos. Implicit learning, on the other hand, is achieved through life experience, games and other hands-on activities. Such learning is also called experiential learning (Dewey 1938, Kolb 1984). Experiential learning through meaningful activities increases students' engagement through real-world experience, optimized learning transfer, integrated theory

and practice, and a shift of learning responsibility to the students (Corner et al. 2006).

The proposition to involve students in meaningful activities to increase their levels of engagement is also rooted in activity theory (see Vygotsky 1978, Engeström et al. 1999). Students learn concepts best by doing – seeing, smelling, hearing, touching and tasting as well as thinking, either creatively or logically, so that learning is meaningful and practical (Burke 2007, 35). Such classroom activities include game simulations, problem-based learning exercises and case competitions (see Sachau and Naas 2010). Group work is encouraged in these activities in order to meet students' social needs and thus contribute to improvement of their learning outcomes and performance.

In this research a creative learning activity was developed with the aid of literature on learning jointly by the authors of this paper who all teach the course of business statistics in their respective universities in Finland, Spain and Turkey. In this activity students in each country formed groups of three, proposed project ideas to solve real-world managerial problems, collected relevant data, analyzed their data using descriptive statistics, and came up with practical suggestions to solve the problems. All groups reported their work and made 10-minute presentations in the classroom. All presentations were video-recorded, and the best three groups were selected in each university by individual professors using previously-developed common evaluation criteria. Altogether nine video recordings and reports (the best three from each of the three universities) were watched and read by the three professors, and the final best three were selected and their members were awarded with plaques. This activity involved both competition (between groups) and cooperation (within groups).

Earlier research indicates mostly positive, but also negative results, about the effects of cooperation on learning outcomes and performance (see Orlitzky and Benjamin 2003, Griffin et al. 2004, Krause and Stark 2010). The effects of competition on students' learning outcomes and performance are mostly negative (see Wang and Yang 2003, Lam et al. 2004). This research aims to contribute to better understanding the impacts of cooperation and competition on learning outcomes and performance. We also think that it is interesting to analyze whether the effects of cooperation and competition on learning outcomes and performance differ in different cultural contexts. To research these subjects a group project competition was developed, embedded into and implemented during business statistics courses at the home universities of the authors in Finland, Spain and Turkey. Following that a survey was conducted with all students who participated in this group project competition at the three universities, and results were analyzed.

The paper continues with literature review and derivation of hypotheses. This is followed by description of the project and applied methodology. Results are presented after methodology, and then they are discussed and avenues for future research are suggested in the conclusions section. Finally, the paper ends with an executive summary.

Literature review

Although it is known that individual intelligence accounts for almost half of individual learning (Bacanu et al. 2000), there is still large room for professors to facilitate learning processes. In this section we first review of some of the theories of learning. These theories help us in developing our activity. Later we review literature that looks at the impacts of cooperation and competition on learning and build our hypotheses for achieving more enhanced learning for our students through our activity.

Learning

Learning is a process which results in changes in behavior, and people have different learning styles (Kolb 1984). An interpretation of the first part of this sentence is that learners are expected to behave in 'learned ways' following the process of learning. In other words, they are not only passive absorbers of new knowledge but active appliers of acquired competencies. Learning theories differ based on their assumptions of the concept of knowledge and the concept of human being (Schön 1987). Knowledge is perceived as objective or subjective, and the human being is considered to be active or passive in these theories.

According to behaviorist learning theory (see Skinner 1974), the learner is a passive receiver of ready-made knowledge. Learning is about observable components of behaviors based on stimuli and responses. Teaching is conducted using examples followed by imitation of students (repeat after me). Teachers are task-oriented, and appropriate behavior is reinforced through instant feedback and rewards while students are provided with clear instructions and motivated through continuous assessment. In this approach good learning (which is conceived of as permanent understanding) is facilitated by teachers through linking knowledge with application, and focus is on analysis using critical approach.

According to cognitive learning theory (see Gagne et al. 1992), learning is about perception, problem solving, information processing and understanding. It assumes that the human being is a goal-oriented seeker and processor of information. It also assumes that knowledge can be modified or combined through information processing which results in new knowledge. The process of learning in this approach involves getting motivated, getting oriented, finding the appropriate research problem, understanding existing knowledge and creating new knowledge for solving the problem.

Finally, constructivist learning theory emerges from the assumption that knowledge is not independent of the learners' values and beliefs (see Dewey 1938). Cultural influences are important for the learning process since it is based on interaction with the social environment. According to this theory teachers should take into account previous knowledge as well social backgrounds of learners and plan and implement their methods by emphasizing social interaction. Differences in interpretations of learners are acknowledged as means to activate thinking and create discussion opportunities.

One kind of constructivist learning theory is experiential learning theory (see Kolb 1984). According to this theory, learners are again goal-oriented and actively seek, process, and assess information. Learning occurs through the process of action, experience, reflection, and theoretical analysis / conceptualization. This is a continuous loop, and the outcome is continuously increasing learning reflected between actions and conceptual thinking. A familiar learning approach under this theory is learning by doing. Learning by doing is a kind of trial-and-error learning through conducting meaningful activities. The activity is a mediator or facilitator of learning between the learner and the subject to be learned (Vygotsky 1978). This approach to learning is based on the assumptions that the brain rarely gets it right the first time, and making mistakes is key to developing understanding and learning. Error correction is the key act in this type of learning as it is through reflecting upon their errors that individuals learn. Group work is especially helpful in this approach as learners receive immediate feedback from their peers in the group and reflect upon their actions. This approach is considered to be an effective approach to learning reflected by the words of the Chinese philosopher, Confucius: "I hear and I forget. I see and I remember. I do and I understand".

However, no matter which learning theory or approach is applied there are basic principles which facilitate better learning (Jordan et al. 2008). These are motivation, orientation, assimilation/accommodation, experimentation, and assessment. These principles follow a sequence and should be applied by teachers during the learning process.

First, students need to be motivated. There are a number of theories on human motivation (see Russell 2008 for a broader review). Early theories point out needs as key motivation factors for human beings. Maslow (1943) provides a hierarchy of needs and argues that motivation for higher level needs depends on whether lower level needs are satisfied or not. According to the two-factor theory of motivation (see Herzberg 1968), whereas hygiene factors (basic factors to provide a good work environment) prevent dissatisfaction, factors like achievement, recognition, responsibility, and promotion motivate. There can be extrinsic motivators such as rewards or punishments, and there can also be intrinsic motivators such as self-esteem, own initiative, and self-direction. Human beings are classified as lazy and work shy (Theory X) or self-directed and committed (Theory Y) (McGregor 1960). People of Theory X have external locus of control and need extrinsic motivators. They try to

avoid responsibility as much as possible. People of Theory Y, on the other hand, have internal locus of control and possess intrinsic motivators. They are proactive, self-determined, and take responsibility. They take pride in success and feel shame in failure.

Later theories focus on causal attributions and relationships between goals, expectations and perceptions of ability. According to attribution theory (see Weiner 1985), people usually attribute success to own abilities and failure to uncontrollable external circumstances. According to this theory people are motivated to achieve if they have attributed past performances to their own efforts. According to expectancy theory (see Vroom 1964), motivation depends on anticipation of a reward, the importance of this reward, and the expectation of achieving this reward. Expectation of achievement is driven by self-esteem (perception of one's own worth) and self-efficacy (perception one's abilities). Self-efficacy is affected by past performances, vicarious experiences and persuasion by others. High self-esteem and self-efficacy increase one's persistence and increases chances of success. According to the ARCS model of motivational design (see Keller 1987), motivation comes through attending (A) to a task, understanding its relevance (R), being confident (C) on achieving the goals of the task, and getting satisfaction (S) from the task.

Orientation follows motivation. Orientation refers to the description of knowledge which will be learned and linking it to earlier knowledge of students. This is followed by assimilation and accommodation. During assimilation and accommodation students internalize new knowledge in that they interpret it and think about how they can use it. After that students should experiment. During experimentation, students externalize new knowledge in that they experience it by applying it in a context. Finally, during assessment students reflect upon new knowledge in the light of their experiences.

Cooperation and Learning

Sharing and debating ideas inside a group stimulates cooperative learning through reflective processes, and that might be superior to individual learning since nobody can have all the information required to put the pieces of a puzzle together (Cohen 1994). Cooperative learning occurs in a process whereby group members first enter into conflicts, and then they resolve them by co-creating a common understanding (Doise & Mugny 1984). In the group there will naturally be students of high and low intelligence, but all benefit in their learning. Low-intelligence students benefit as their peers help them, and high-intelligence students also benefit as they externalize their knowledge. Teachers, however, must pay attention to two conditions in order to achieve superior learning in groups (see Slavin 1983, Dembo & McAuliffe 1987, Lou et al. 2001). First, active participation of all group members should be encouraged. This is crucial in triggering cooperation and reflective processes. Second, in some groups some members (those of high-intelligence) may act in ways to dominate others in the group. Such acts may result in withdrawal of other learners from cooperation and thus hinder learning. This may especially happen in the course of statistics since some students lack confidence in their mathematical skills (Krause and Starke 2010). Krause and Starke (2010) indeed found out in their experiment that cooperative learning did not necessarily result in superior performance than individual learning in business statistics course.

Studies have looked into different factors that may influence team performance. Diversity of group members was suggested in some research to increase creativity and positively affect team performance (see Amabile 1989), whereas in other research it was also shown to possibly trigger negative affective reactions and withdrawal of some group members and affect team performance negatively (see Ely 1994, Maznewski 1994). Similar mixed results appear on the relationship of sex composition and group performance (see Ely and Thomas 2001, Orlitzky and Benjamin 2003). Small groups are expected to perform better when cooperation aims at reflection and elaboration rather than extensive discussion (Krause and Starke 2010).

Competition and Learning

In management literature competition is perceived as a positive factor that drives creativity and innovations thus competitiveness of a given location (Porter 2008). Porter (2008) differentiates between zero-sum competition

and positive-sum competition. Zero-sum competition occurs when one competitor wins at the expense of others. This destructive effect occurs since competitors imitate each other in their strategies, products and services that they pursue and offer. In positive-sum competition competitors differentiate themselves from each other in their products and services, and as a result, they all win.

Does competition among students motivate increased efforts and lead to improved learning? This question has been raised and studied in education literature, and effects of competition on learning outcomes and performance are perceived to be negative (Wang and Yang 2003). Competition shifts the focus from learning goals to performance goals (Ames & Ames 1984). Amabile (1989) argues that competition restricts choices and as a result can destroy creativity. Lam et al. (2004) found out that in times of competition students chose easy tasks rather than challenging ones, and that resulted in inferior learning. The negative impacts were more on less able students who knew that they would not be able to win (Vallerand et al. 1986). These students tend to lose interest in the task more easily since their attentions are focused on the end result instead of the process of the activity (Lam et al. 2004). Failure raises emotions of anxiety and being upset and affects students' self-esteem. Ames and Ames (1984) argue that these effects are more severe in competitive learning environments. In Finland, competition in the classroom is avoided in early years of education based on both cultural reasons and findings that it may have negative effects on individual performances during adulthood (Sahlberg 2011).

Hypotheses

This research targets to contribute to the literature on learning through analyzing the simultaneous impacts of cooperation and competition on learning outcomes and performance in a diverse cultural context. We think that the cultural aspect is interesting as perceptions towards cooperation and competition may differ from culture to culture and thus impact learning differently.

First based on literature review we believe that cooperation has a positive impact on learning, and this is reflected in Hypothesis 1.

Hypothesis 1: Cooperation among students leads to improved learning outcomes and performance. Secondly, again following literature we argue that competition has a negative impact on learning, and this is reflected in Hypothesis 2.

Hypothesis 2: Competition among students results in poorer learning outcomes and performance.

Finally, we hypothesize that cultural perception of cooperation and competition impact on learning outcomes and performance. These are reflected in Hypotheses 3a and 3b.

Hypothesis 3a: Cultural perception of cooperation has an impact on learning outcomes and performance.

Hypothesis 3b: Cultural perception of competition has an impact on learning outcomes and performance.

Project description and methodology

The purpose of the group project is to help the students become intelligent consumers of statistics, that is to say, help them know how to do a "real-world" statistical analysis including the process of coming up with a relevant research question, obtaining and working with data, conducting descriptive analysis, and making conclusions based on their analysis.

In this project groups were formed of three students. There were total of 17 groups from Finland, 15 groups from Spain, and 17 groups from Turkey. Each group was required to write a project idea (1-2 paragraphs, 150-250 words) for the analysis of 5 to 10 variables. They could propose any relevant project related to Business/Management. Then they had to come up with a project from a certain point of view, with a clear objective and propose solutions as a result of their analysis.

At the end of the project each group had to produce a final project report (1200-2500 words). The report needed to include the project description, the description of the data (variables, measurement units, etc.), the process by which they had obtained their data set, all the computer outputs, interpretation of the results conducted on their data set using descriptive statistics and their conclusions.

Each group also had to present the report in a 10 minute exposition on an appointed date. The presentations were video recorded. Project reports along with presentation videos were assessed first by their respective course instructor. The top three groups were selected from each of the universities to be further evaluated by the international committee of three professors. Each of the professors came up with a ranking for the nine selected groups and a final ranking, aggregating the individual rankings, was obtained. The best three groups were selected and given plaques stating their outstanding performance.

An online survey was conducted with students in three countries after the presentations to study the students' impressions on the project. The survey questionnaire contained sections on demographic data, self-opinion on relations with others, opinion on project team in general, specific opinion about each member of project team, as well as the group project and competition. The questions in the survey were closed questions with a 1 to 5 Likert-type scale (Likert 1932) where 1 meant "completely disagree" and 5 meant "completely agree".

Results

119 students answered the questionnaire: 41 out of 47 from JAMK, all 45 from Sabanci, whereas 33 out of 45 from UCM.

Table 1:   Gender distribution of respondents (%)

	JAMK	Sabanci	UCM	TOTAL
Female	61	51	52	55
Male	39	49	48	45

55% of respondents were female with distribution by university shown in Table 1. Gender percentages are very similar at Sabanci and UCM, but there is a higher female population at JAMK. There are, however, significant differences in age distributions between the universities (see Table 2). UCM students are younger with 75% being 18 or 19 years, while only 6% Sabanci and 24% JAMK students are less than 20 years.

Table 2:   Age (years) distribution of respondents (%)

	JAMK	Sabanci	UCM
<16	0	2	0
17	2	2	0
18	7	0	33
19	15	2	42
20	15	18	9
21	17	31	9
22	12	29	3
23	7	9	0
24	0	4	0
25+	24	2	3

Hypothesis 1 argues that cooperation among students leads to improved learning outcomes and performance. Despite differences of perceptions, a majority of students in each university (especially UCM) took the project seriously and collaborated in good attitude towards accomplishment of the project (see Figure 1).

Figure 1:   Group attitude towards the project

Figure 1. Group attitude towards the project.

The students, especially those at Sabanci and UCM, spared more time in this project compared to similar assignments in other courses (see Figure 2).
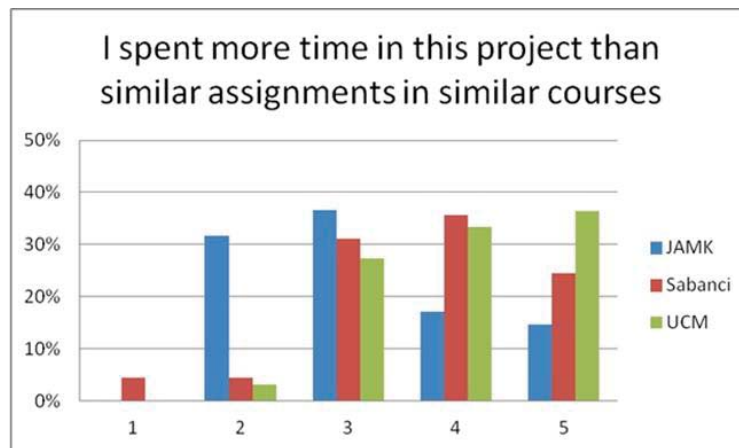
Figure 2:   Time spent for the project

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As a result, a majority of students in each university believe that the project had a significant contribution to their learning (see Figure 3).

Figure 3:   Contribution of the project to learning outcomes and performance
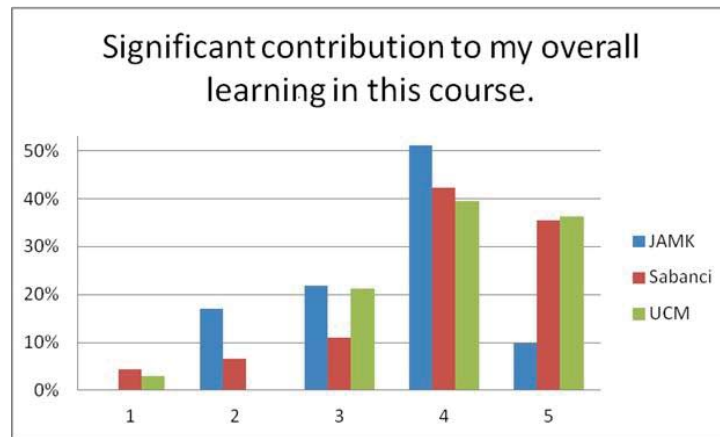

Figure 3. Contribution of the project to learning outcomes and performance.

Combining results from group attitude, time spent for the project, and contribution to learning outcomes, we can conclude that collaboration has a positive impact on learning, and thus *we accept Hypothesis 1*.

Hypothesis 2 argues that competition among students leads to poorer learning outcomes and performance. Except for JAMK students, the students in general said that the group competition increased their motivation (see Figure 4).
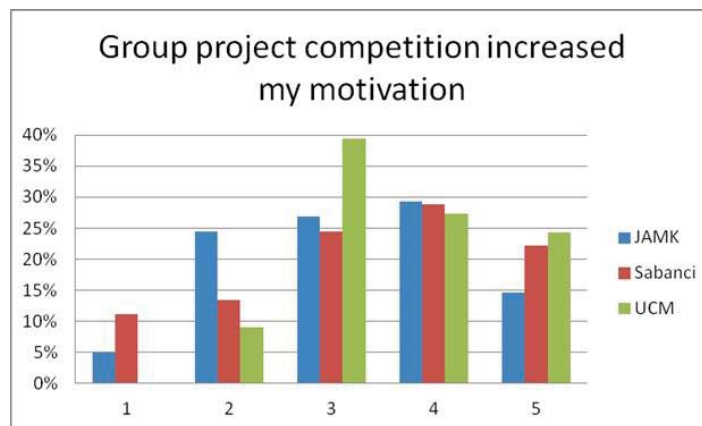
Figure 4:   Increase in level of motivation

Figure 4. Increase in level of motivation.

A majority of students also disagreed that they had negative pressure due to competition (see Figure 5).

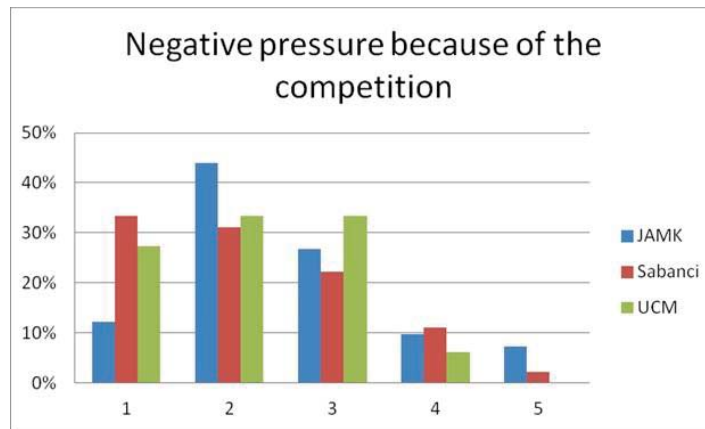**Figure 5:**   Negative pressure from competition

Figure 5. Negative pressure from competition.

In addition, a majority of students in every university like that their project was ranked internationally (see Figure 6).

Figure 6:   Attitude towards international competition
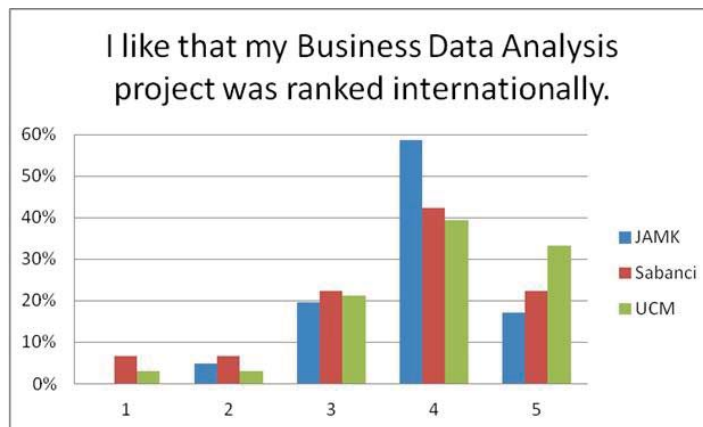
Figure 6. Attitude towards international competition.

Based on results from Figures 4, 5 and 6, *we reject Hypothesis 2.* On the contrary, we can suggest that international group level competition increases student motivation, and this may lead to improved learning outcomes and performance.

Finally, Hypothesis 3a argues that cultural perception of cooperation has an impact on learning outcomes and performance while Hypothesis 3b argues that cultural perception of competition has an impact on learning outcomes and performance. Looking at the graphs we are

not able to conclude with our results on acceptance or rejection of both hypothesis 3a and 3b, therefore statistical inference techniques will be applied.

Results for each Likert-type item may be analyzed separately or, in some cases, item responses may be summed to create a score for a group of items (this is why Likert-type scales are often called summative scales). There are many approaches available for statistical inference such as chi-squared test, Mann–Whitney test, Wilcoxon signed-rank test, or Kruskal–Wallis test (Cohen et al. 2000). As in our case we want to analyze responses to questions on competition and cooperation with university being the independent variable. We decided to analyze responses across the three groups (Jamk, Sabanci and UCM) of respondents using the Kruskal-Wallis test (Kruskal & Wallis 1952) at 0.05 significance-level. Kruskall-Wallis models provide the same type of results as an analysis of variance, but based on the ranks and not the means of the responses.

Results for the KruskaI-Wallis test were obtained using R (v. 2.1.5.) for each of the items individually (see Table 3).

Table 3:   Kruskel-Wallis test results

Item	Kruskal-Wallis rank sum statistic	p-value
Competition		
Having an international competition for this course increased my level of concentration for this course	6,8724	0,03219
I like that my Business Data Analysis project were ranked internationally.	1,5948	0,4505
I like competitions.	4,9637	0,08359
I like competing as group	1,1671	0,5579
My two other group members took this competition seriously	4,568	0,1019
My two other group members thought that winning this competition was important	6,0328	0,04898
Students in my course take this competition seriously	0,3804	0,8268
Students in my course think that winning this competition is important	2,3167	0,314
I wanted to create an excellent project	17,2761	0,000177
I wanted to have our project be among the top groups	15,9405	0,000346
Our group intended to develop our project to be among the top groups	21,3006	2.369e-05
As a group, our intention was to create an excellent project	15,7979	0,000371
I felt negative pressure because of the competition	3,1071	0,2115
Total score competition	11,8422	0,002682
Cooperation		
I enjoy working as a team in a competition	2,509	0,2852
Group project competition increased my motivation	2,1625	0,3392
At the beginning, I believed that as a group we could produce a high quality project	7,8435	0,01981
At the beginning, I felt that our group could produce a project that could win	18,8682	7.995e-05
At the beginning, I believed that as a group we could spend sufficient time and effort on this project	11,5456	0,003111
I work hard in group projects.	9,5237	0,00855
I am successful in group projects.	12,7486	0,001705
Total score cooperation	14,6965	0,000644
Learning outcomes and performance		
I spent more time in this project than similar assignments in similar courses	14,2858	0,00079
The level of my motivation was high in this assignment.	4,1367	0,1264
This project has contributed significantly to my overall learning in this course.	8,4709	0,01447

The p-values turn out to be significant (smaller than 0.05) for items 3, 10, 16, 17, 18, 19 (related to competition) and for items 13, 14, 15, 20, 21, 22, 24 (related to cooperation). What is more, if we apply the Kruskal-Wallis test to the total score of the competition and cooperation items, both p-values are small (see Table 3). Besides, the p-values of items 22 and 24 are also very significant. Hence we reject the null hypothesis of the medians being equal across the groups for all those items. We conclude that the three groups are non-identical populations at 0.05 significance-level. This means that there are significant differences in the perceptions of students from Finland, Spain and Turkey towards competition and cooperation. These differences may have triggered the differences in students' learning outcomes and performance in the three countries. In the light of these results, *we accept both hypothesis 3a and 3b.*

Conclusions

Our results support literature which suggests positive impact of cooperation on learning outcomes. This is especially the case in small groups where all group members actively participate, and no member dominates the group (see Slavin 1983, Dembo & McAuliffe 1987, Lou

et al. 2001). In our project, groups were deliberately limited to three persons to avoid possibilities of freeriding, and students were asked to freely choose their group members. We believe that free choice of group members avoids possible domination by a single member since students know each other already. From our results, it seems that cooperation also stimulates individual motivation and results in spending more time for learning. This finding, however, is subject to cultural differences, as we see significant differences in results from Finland in comparison to Spain and Turkey (see Figure 2). Cultural differences may be one reason why there is also contradicting findings on the impact of cooperation on learning outcomes (see Krause and Starke 2010).

Earlier literature suggested negative impacts of competition on learning outcomes through restricting choices and destroying creativity (see Amabile 1989, Wang and Yang 2003). Students who thought that they did not have a chance to win could be easily vulnerable to lose motivation and give up (Vallerand et al. 1986). Students could also focus on end results rather than the tasks and choose easy tasks instead of challenging ones with the aim of winning, and that would result in inferior learning (Ames & Ames 1984, Lam et al. 2004). Surprisingly, students in our study did not feel negative pressure due to the competition (see Figure 5). Indeed, a majority of them said that group competition increased their level of motivation (see Figure 4). Perhaps, we should note that again there are cultural differences in that results from Finland differ than those from Spain and Turkey. The fact that a larger portion of students from Finland (in comparison to Spain and Turkey) did not feel that the group competition increased their motivation may be due to the fact that competition is avoided in Finnish classrooms (see Sahlberg 2011). One of the reasons why our results differ from earlier literature may be that we did not apply competition at individual level but at group level. Cooperation at group level may have avoided any possible negative effects of competition on individual students. Indeed, as teachers, we paid attention not to create a zero-sum game by offering flexibility in students' choices of topics and providing tutoring throughout the duration of the project. These

may also have contributed to eliminate possible negative impacts of competition.

Our finding that cultural differences in perceptions of competition and cooperation have an impact on learning outcomes and performance leads us to question most of earlier research mentioned in this paper as they are based on samples from a certain culture. Contradictions among earlier research may be due to differences in cultural perceptions of studied sample groups. In our study, we had three different cultural backgrounds: Finland, Spain and Turkey. It is not surprising that results from Spain and Turkey are more similar to each other but different from those from Finland. This is because Spain and Turkey share Mediterranean characteristics, whereas Finland reflects characteristics from northern Europe.

Our findings encourage teachers to develop similar real-life international group competition projects. This may especially be a creative solution in "dull" courses such as business statistics. The project may stimulate student engagement and result in improved learning outcomes. The common project was also a learning experience for us, the teachers, as we learned much from each other through sharing of resources, syllabuses, and ideas. Indeed, it is our intention to develop this common project into a European-level platform for sharing resources, project ideas and outcomes. We believe that more interaction and sharing across the borders may bring more creative ideas, build synergies, and make the experience of learning a meaningful and enjoyable journey for both students and teachers. One possible future idea would be to create multicultural teams where each group has members from different countries. Students would then be utilizing more virtual communication possibilities and be exposed to working in real multicultural learning environments. Another possible future idea would be to develop a virtual business statistics platform to put together ideas, resources, possible research projects, and research outcomes. Such a platform would be the home base to integrate efforts from different countries.

Our research is subject to limitations in generalizability in that it was conducted for the first time with a limited number of students. We

aim to repeat the same research with students of business statistics next year, hopefully including students from other countries as well. In order to overcome this limitation, one possible solution could be to interview selected students from different countries. In-depth interviews could provide richer insights. One further complementary solution could be to conduct surveys with students at different stages of the project. This would provide a dynamic perspective and help better understand how to handle different stages of the process.

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