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Evaluating classroom innovations for motivation and learning: Principles of microeconomics specific course case

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Abstract

The objective of this research is piloting and evaluating the introduction of teaching innovations for better learning in a general microeconomics course for undergraduate students. The assessment is based on the Self Determination Theory and student-centered methodologies (SDT) (Deci and Ryan, 1985; Deci et al., 1991a), which remark the individual motivation as crucial for learning. The piloting of the instrument was implemented with a sample of 323 students grouped into 14 classes, giving evidence that the most relevant course problem is that students do not feel that what they are learning is really useful in their specific professions, despite the fact that they agree with the importance to know about such topics. This piloting allowed us to validate the used instrument which implements two psychometric scales: Knowledge transfer and self-determination scales. The impact evaluation was implemented for a sample of 204 students, distributed in treated and control groups. The assignment of students to treatment is random. Results provide evidence that the intervention significantly improves the self-determined motivation as well as the academic performance of students, although in a modest magnitude.

Keywords: Educational Innovation, Self Determination Theory, Impact Evaluation

JEL: I21 I23 O33

1. Introduction

There is strong evidence regarding teaching that focuses on the students' specific characteristics leads to improvements in the ability to solve problems and understand con-

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cepts. The review of the literature and a considerable number of papers suggest that student-centered approaches, such as those that use collaborative learning, problem-based learning or active learning, enhance learning to a greater degree than the traditional education system (Prince, 2004; Weimer, 2002). According to Michael (2006), active learning is “the process of having students engage in some activity that forces them to reflect upon ideas and how they are using those ideas”. The student-centered approaches include the theory in the self-determination theory (Deci and Ryan, 1985; Deci et al., 1991a). This theory which will be explained subsequently in its general form shows that the benefits of these educational approaches suggests an increase in the students’ interest in learning, the valuation of knowledge and an increase in confidence regarding their own abilities and talents. In fact, some of the aspects to be improved in the traditional courses, that will be very important then in the principles of microeconomics course explained later, have to do with the way in which the students are using knowledge in familiar matters to them, in other words, in how is developing the ability of students to solve real problems based on the knowledge acquired in the classroom. As highlighted by Deci et al. (1991a):

“The main aspects of the optimal learning are the conceptual understanding and flexibility in the use of knowledge. In other words, understanding both the relationships between the facts and the way to find and generate facts are the results in learning that we remark”.

In addition, the authors claim that the motivational conditions that generate an appropriate conceptual understanding are the same that make individual achieve greater personal growth and capacity to adapt. This research aims to evaluate in one year (piloting in 2016-1 and then doing impact evaluation in 2016-2) the motivational conditions in the principles of microeconomics course of EAFIT University in Medellin, Colombia, which has been redesigned in order to look for the accomplishments described in these theories. This course seems to be appropriate for the research project since it is an obligatory course for some majors (different that major in economics) mentioned in following sections and it has a high repetition rate of 12% (approximately 5% above other likewise courses). This problem is explain, according to our hypothesis, due to the students lack of engage even when the topics have a really interesting applications, a fact that economics major students understand well but students from other majors do not.

The first semester includes a characterization of the sample that will permit the identification of faults in the course with respect to the self-determination theory (SDT) and the second concerns the intervention and subsequent impact evaluation on motivational characteristics that lead, according to theory, to better academic performance. The structure of this article follows: section 2 contains the theoretical framework, section 3 presents the piloting along with their partial conclusions, section 4 describes the implemented impact evaluation, its methodology and results to end with the conclusions (5).

2. Theoretical Framework

The Self Determination Theory (Deci and Ryan, 1985; Deci et al., 1991a) question the divergence between the different types of existing motivation: The first of these is the intrinsic motivation which is ideal for the students cognitive development ¹; it is a natural motivation in the human being, who is born with a sense of curiosity to know, to discover and learn new things as the case of the soccer lover child that plays up to the fatigue or the person who reads with emotion a book simply by self-interest. It is noteworthy that the theory is not interested in the causes of this type of motivation, but rather looks at the conditions that stimulate and sustain it.

On the other hand, extrinsic motivation is presented as derived from any type of external incentive either material or psychological. It is the case of the child who attends church simply because of the material or emotional promise raised by their parents without having a real interest for attending and the case of the young man who spends his days studying just to increase the probability of getting a better salary in the future. This motivation has the potential to be self-determined in the individual in such a way that affects positively the prolonged persistence and the well development of a specific objective (Deci and Ryan, 1985). According to Deci et al. (1991a), when a behavior is self-determined, the regulatory process is a choice of the individual ², but when it is a controlled behavior (not self-determined) the regulatory process is a commitment or a challenge raised by someone else. In addition, it is proposed that when the behavior is self-determined the person perceives as internal/own the relationship of causality on the expected benefit from the activity and, on the other side, when it is controlled, perceives this relationship as external to itself so that the activity can be interrupted at any moment in which the external factor is not present anymore.

In their study Deci and Ryan (1985) pose four types of regulatory processes regarding extrinsic motivation: external, introjected, identified and integrated regulatory processes. The intervention and the evaluation model that is implemented over the course on principles of microeconomics focus on extrinsic self-determined motivation with regulatory processes of type identified through the concept of internalization, since this is the type of motivation that makes effective educational innovations in courses like principles of microeconomics. To clarify, internalization is a proactive process through which individuals transform external causes of behavior in internal regulatory processes (Schafer, 1968).

The different types of regulatory processes are explained briefly below, following Ryan and Deci in his text *“Motivation and education: The self-determination perspective”*:

¹“The inherent tendency to seek out novelty and challenges, to extend and exercise one’s capacities, to explore, and to learn” (Ryan and Deci, 2000).

²The regulatory process is the one that guides individual decisions when working to achieve a specific objective either material, academic, psychological, social objective or just to be entertained.

1. External regulation: When the behavior from the beginning is determined by a promise of reward or punishment. It is the case of a student who makes his task simply by the challenge raised by the teacher or for fear of being scolded from their parents. Given that, it is a reason completely external to oneself, it is the less self-determined regulatory process.

2. Introjected regulation: When is incorporated into the personal behavior regulation but is not accepted as their own. This regulatory processes involve psychological pressures as the sense of guilt or the need for ego aggrandizement. It is the case of the student who decide to arrive early to the classroom only for not being the one who interrupts the class and then be the focus of attention when entering in the classroom. Despite not being a result of a compulsory external condition, arises from external social conventions and therefore cannot be considered as self-determined.

3. Identified regulation: When the initial regulation comes from outside but after that the individual performs the activity in their own interest without the need for any external regulation. Following the authors, it is the case of the student who is doing extra work on her math homework because it is aware of all the benefits, in addition to a personal taste for the topics. In essence it is extrinsic because the individuals would not achieve the activity by their own means, but it is highly self-determined because the individual continues the activity by individual interests. As stated earlier, this type of regulatory process is the main to treat in the intervention and posterior evaluation of the course on principles of microeconomics due to its characteristics, and according to the main objective, this regulatory process makes students become aware of the different topics applications to finally take advantage of them not simply by completing successfully the course.

4. Integrated regulation: This is achieved when the individual integrate the identity, values and needs of each individual. It is the case of a student who is identified with the academic field but also with the artistic one. This regulatory process happens when the individual manages to integrate those identities and specific objectives in each of those interested fields. It is a regulatory process that is usually given in psychologically mature ages and that is highly self-determined.

Now, the empirical processes have shown the existence of three factors that invariably stimulate extrinsic self-determined motivation in an individual. These are then the need to be competent ([Harter, 1978](#); [White, 1963](#)) regarding the need to acquire skills to achieve a specific objective; here it has been found that it has real impact on motivation unless it is accompanied by the second element: autonomy ([DeCharms, 1972](#); [Deci, 1975](#)), such as the need to understand internally a causal relationship, independent of the external situation of the individual. That is to say, the individual performs the activity when dimensioning all the personal rewards from it. Finally, the last element is relatedness ([Baumeister and Leary, 1995](#); [Reis and Erber, 1994](#)) since has been proven empirically that the sense of security and work with people always has positive results in one's motivation even after childhood and youth ([Ryan and Grolnick, 1986](#)).

These elements have been developed since the beginning of the self-determination theory becoming fundamental concepts in the analysis of different courses (see Pérez et al. (2011)).

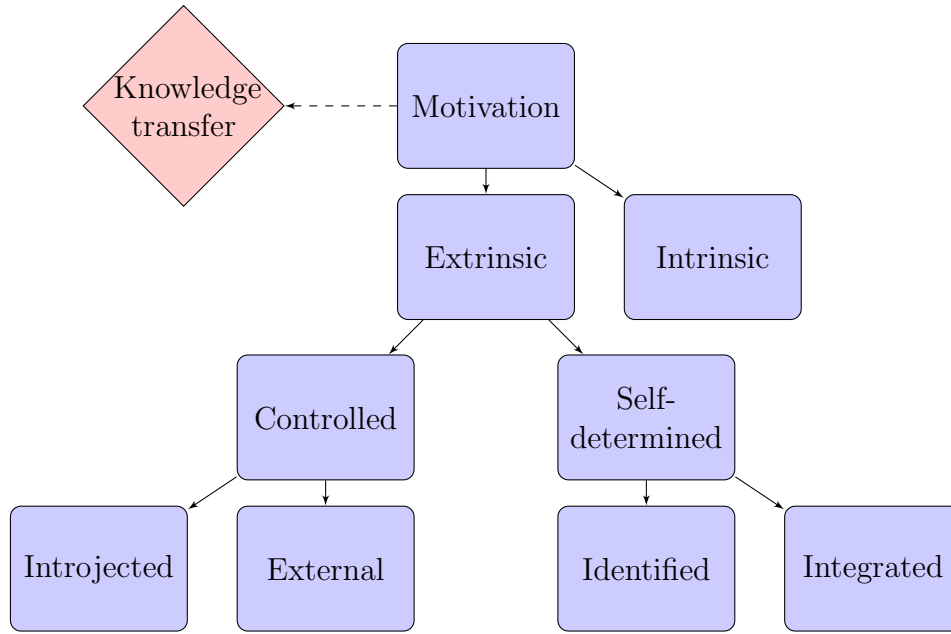


Figure 1: Types of motivation. Authors' elaboration

Integrating these factors, according to the theory, becomes crucial in order to obtain the highest performance regardless the course type. This is why, it is proposed that an innovation in education is only valid if it manages to develop a higher level of self-determined extrinsic motivation in students through these three theoretical elements³. As specified above, this impacts significantly the academic performance of students⁴.

There are two fundamental elements for such a process to be carried out: The methodologies implemented by teachers and the design of the course (its structure) according to the students' interests in terms of the pragmatic use they could develop with the knowledge they acquire. With respect to the first fundamental element, it has been shown that the ways in which teachers encourage students can be divided into two: controllers or constant supportive forms for motivation development (Deci et al., 1981). Some of the most important benefits that have been demonstrated from constant supportive forms are: less desertion (Black and Deci, 2000), a greater preference for challenges, more assistance to the courses and greater academic performance (Reeve

³The validity is defined here as the significant difference in the students' performance between two educational methods.

⁴Measures of students' motivation variations and academic performance will be further explained in following sections.

et al., 2004). In addition, other studies claim that the way to influence a person invariably affects the performance, motivation, emotion, and learning of that person and others (Deci and Ryan, 1985; Deci et al., 1991b; Reeve, 2002; Ryan and La Guardia, 1999). With regard to the second fundamental element, numerous studies have been done that show the importance of course designing on the performance of different types of students not only regarding traditional courses. For example, in the study case developed in Spain that implemented the "Learning Climate Questionnaire" (ABL), the application of new methodologies in education strongly support improvements in results, especially the encouragement of autonomy, although this result according to the article, is explained by the field of implementation (physical education) and depending on the field, a stimulus can have greater preponderance than the other two (Granero-Gallegos et al., 2014).

Finally, to apply this theory is used information and communication technologies (ICT), which offer new possibilities that are revolutionizing the traditional learning environments. It is increasingly common the use of virtual courses that complement face-to-face education with digital content through Blending-Learning or hybrids methodologies (Cabero-Almenara et al., 2013; Chew et al., 2008; Gikandi et al., 2011). The need to use student-centered methodologies and make learning spaces more flexible are strong reasons for promoting Blending-Learning spaces for teaching. In addition, the latest trends provide new opportunities to develop educational experiences based on autonomous and connected learning, Massive Open Online Courses (MOOCs).

3. Piloting: preliminary study and diagnosis

3.1 Evaluation of students on the basis of the SDT in the period 2016-1

3.1.1 Participants

Piloting involved 323 students grouped into 14 groups (162 women = 50.15% and 161 men = 49.85%) of the course on principles of microeconomics in EAFIT University (Medellín, Colombia), a course that the Department of Economy and Finances provides to students from other schools of the University as the School of Administration that graduate professionals in international business, business administration, marketing and public accounting. The age range was between 16 and 31 years with an average of 19 years for both genders and a standard deviation very similar between them (1.63 for men and 1.92 for women).

Of these 323 students 6.8% is studying two majors, the 20% undergraduate has jumped from one major to another and the 12% is repeating the course. These last two results are important to take into account in terms of motivation assuming that the proportion of students who had taken the decision to change their major is supposed to study something more accurate to their likes and abilities.

3.1.2 Instrument

It builds a questionnaire with 30 items divided between three basic structures with the aim of measure perception, motivation and interest of all students with respect to the course on microeconomics. In the majority of the items the student is asked to choose his/her degree of identification in a seven-level Likert scale between "strongly disagree" (1) to "strongly agree" (7). The remaining items include dichotomous questions "Yes" (1) or "No" (2).

Each basic structure has a hypothesis and a question in which are routed the different items. However, in general, all seek to measure the different types of extrinsic and intrinsic motivation raised by [Deci and Ryan \(1985\)](#). The content validation was carried out through the judgment of an expert in both scales construction and analysis of the concepts to evaluate. The items were evaluated, revised and improved up to covering the theoretical target after pre-piloting sections with aim of reaching the possible lower probability of bias.

The title, hypothesis and the corresponding question to be solved are: 1) Pre-course perception. Hypothesis: The magnitude of the impact of any educational innovation is a function of the a-priori motivation that students have. Then, How motivated is the group when taking the course? 2) Perception when exploring the course. Hypothesis: The magnitude of the impact after any educational innovation depends on the level of self-determined motivation that already generates the traditional course. What is the level of self-determined motivation already being generated by the traditional course? And finally, 3) expectation of the course. Hypothesis: the motivation at some level is a function of the projections the individual has for the future. How the students project themselves with the knowledge they acquire in the course? At the end of the instrument it is proposed an additional construct regarding knowledge transfer used by [Quiceno \(2015\)](#), this construct is composed of eight seven-level Likert items. The objective, in addition to directly measure the level of knowledge transfer, will be relating it to the three constructs mentioned above for better analysis.

Finally, for validation of the instrument developed in this work, a factor analysis is implemented following contributions of [Schönrock-Adema et al. \(2009\)](#) and [Beavers et al. \(2013\)](#) with the aim to demonstrate that the items raised are eventually measuring the type of motivation proposed from the beginning by [Deci and Ryan \(1985\)](#). To this end, it has divided the items of the instrument into two groups taking into account the formulation of their scales, this allow us then to correlate the items: the first group contains items with dichotomous scales and the second contains seven-level Likert items (not including the knowledge transfer scale at the end of the experiment that has been already validated). For the first group (see table 1) it is applied the method for principal factors with what is called an oblique rotation. It is permissible the realization with 323 observations and we get two principal factors as we expected: the first presents significant factor loadings (greater than 0.3 according to [Díaz and Morales \(2012\)](#)) for those items that are measuring motivation and interest of students for the course, this

factor validates the hypothesis of the three main groups of items raised and described previously in the instrument. It is important to explain the two negative factor loadings presented in this factor: the fact that the student would replace deliberately the course on principles of microeconomics by another different course clearly presents a highly negative relationship with the level of motivation that the individual has. Likewise, if the student is in two majors at the same time it is more likely that the interest for such specific course as principles of microeconomics is lower than for other students.

Table 1: Factor Analysis for the group of dichotomous items

Variable	Factor 1	Factor 2	Uniqueness
Repeater		0.8168	0.3436
Math course repeater		0.6927	0.4894
Have previous knowledge		-0.4207	0.7966
Replacing the course	-0.7155		0.3338
Training employees	0.6924		0.5294
Studying without final exam	0.6065		0.6477
Economic profit	0.3502		0.8199
Serving as academic tutor	0.5009		0.7285
Topic of interest	0.4118		0.8347
Well informed decisions	0.6364		0.5618

	Variance	Proportion
Factor1	2.44523	0.6157
Factor2	1.69714	0.4273

LR test: independent vs. saturated: $\chi^2(45) = 955.12$ Prob> $\chi^2 = 0.0000$. 323 obs.

Nota: appendix [A.1](#) contains further description of these items

With regard to the second factor, taking into account the nature of the items covered, this measures the **negative effect** and its factor loading with respect to the motivation and interest; this factor valid then the first group of questions in the instrument (socio-cultural questions). Clearly the item regarding if the individual is repeating or not the course has a high factor loading with respect to the decline of student motivation, the same for those who are repeating courses in mathematics (which are constantly applied in microeconomic topics). The item corresponding to whether the student would replace deliberately the course on microeconomics to a different one, that is also significant in the first factor, is validated then to measure both how motivated and demotivated is the student. Finally, have previous knowledge about economics when taking the course is an item that has a significant negative factor loading with respect to this factor ⁵.

Now, for the second group (variables of seven-level Likert scales, see table 2) it is applied the same method of principal factors with oblique rotation (323 observations).

⁵All tables in this paper are authors' elaborations.

The result is a single factor that has a positive and significant factor loading with respect to all the items in the group.

Here is important to remark some details: the first two items regarding the level of interest and importance perception of students for the course according to the comments from friends are statistically significant. This could then explain in part how motivated the student is when taking the course (related to the first main group of questions). Likewise, reading habit (the more significant item) and talking regularly about economics issues with parents are presented as influential to the final academic performance of the students as suggested by the SDT (effect through motivation). Finally, long term importance perception related with whether the students think those microeconomics learnings are going to be or not of importance in their future companies (and in what level this would happen, as a separate item) are also important according the factor analysis. Thus, this group of items are presented as valid for the posterior application.

Table 2: Factor Analysis for the group of polyatomic items

Variable	Factor	Uniqueness
Interesting-references	0.5329	0.7160
Difficulty-references	0.3548	0.8741
Reading habits	0.6220	0.6132
Conversations-economic issues	0.5585	0.6880
Microeconomic-higher utilities	0.5463	0.7016
Microeconomic-level of utilities	0.4697	0.7794

	Variance	Proportion
Factor	1.6277	0.8419

LR test: independent vs. saturated: $\chi^2(45) = 955.12$ Prob> $\chi^2 = 0.0000$. 323 obs.

Nota: appendix [A.2](#) contains futher description of these items

3.1.3 Procedure

With the permission of the coordination area and teachers the implementation of the instrument already designed starts in classes and tutoring time. The students were well informed of the purpose of the research and of their right to participate in the questionnaire: as an incentive to students, the coordination allowed that if 80% or more of the members of the course completed in a conscious way the questionnaire they would be creditors of an academic help in their assessments, in other words, we sought to increase the extrinsic motivation of the student to work excited in the investigation. The instrument was used at the beginning or ending of the class (10 to 20 minutes), tablets were distributed among students in order to achieve an individual and fast

questionnaire, in this way the teacher did not have any contact with the instrument. The answers will remain anonymous and will only be effective for this research.

3.1.4 Results and data analysis

In the first place, pre-course perception results are analyzed. Here it is found that students from these majors (mainly from business administration) have problems in the mathematical component (32% are repeating one of their math courses) and, given that microeconomic topics include calculations to apply the knowledge acquired, students have a perception of high difficulty before taking this course. As a result, it is shown that knowledge transfer is affected when difficulties with mathematics are present (regarding the additional scale at the end of the instrument) in comparison with those students who have passed their math courses without the need to repeat it (see table 3) and, therefore, is a factor that in many cases reduces motivation and the effort to achieve a well academic performance in the course. To a large extent this is what explains the fact that a proportion of 26% of people think to postpone the course within their academic plan. Thus, it is of high relevance a possible redesign of the course in order to improve the academic performance at increasing students' motivation recalling that these types of students tend to be more interested in applying concepts that in the mathematical prove of those concepts and statements.

However, the percentages were high in terms of the factors that most likely would contribute to an accurate perception about the importance of the topics covered in the course; in terms of data, the 57% stated that they have previous knowledge in economics provided by their institutions of middle education, 48% have friends and colleagues that are studying something related to economics, 35% have relatives who are employed in economic jobs and share information with them. Of the latter, have previous knowledge in economics is the aspect that most impact the level of knowledge transfer acquired in the course (with a difference in average of 0.38 statistically significant), as can be seen in table 4. In addition to that, 79% say they usually read and are aware of economics issues and 75% say share and discuss this information with their parents. However, only 40% of the students have been told that the course on principles of microeconomics is interesting (mean comparison of this item and knowledge transfer is presented in table 5) and here is identified a shortcoming in the actual structuring of the course according to the principles of the self-determination theory and a learning climate designed to increase the interest of the students to develop the contents according to their own interests (Ryan and Deci, 2000; Reeve et al., 2004).

Table 3: Statistical relationship between knowledge transfer (KT) in the course on principles of microeconomics and being a math course repeater

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Yes	105	5.1706	0.1136	1.1640	4.9453	5.3958
No	215	5.5321	0.0695	1.0184	5.3952	5.6690
Combined	320	5.4135	0.0604	1.0800	5.2947	5.5322
Diff		-0.3616	0.1272		-0.61178	-0.11134
Diff = mean(yes) - mean(no)					t = -2.8430	
Ho: Diff = 0					df= 318	
Ha: Diff < 0			Ha: Diff ≠ 0		Ha: Diff > 0	
Pr(T < t) = 0.0024			Pr(T > t) = 0.0048		Pr(T > t) = 0.9976	

Table 4: Statistical relationship between knowledge transfer (KT) in the course on principles of microeconomics and the fact of knowing a bit of the economy before the start of the course

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Yes	181	5.5810	0.0674	0.9067	5.448	5.7139
No	139	5.1954	0.1052	1.2407	4.9873	5.4034
Combined	320	5.4135	0.0604	1.0800	5.2947	5.5322
Diff		0.3856	0.1201		0.1493	0.6218
Diff = mean(yes) - mean(no)					t = 3.2117	
Ho: Diff = 0					df= 318	
Ha: Diff < 0			Ha: Diff ≠ 0		Ha: Diff > 0	
Pr(T < t) = 0.9993			Pr(T > t) = 0.0015		Pr(T > t) = 0.0007	

Table 5: Statistical relationship between knowledge transfer (KT) in the course on principles of microeconomics and interest built before the course starting from personal references

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Yes	186	5.7262	0.0683	0.9314	5.5914	5.8609
No	134	4.9795	0.0971	1.1244	4.7873	5.1716
Combined	320	5.4135	0.0604	1.0800	5.2947	5.5322
Diff		0.7467	0.1152		-0.9733	-0.5200
Diff = mean(yes) - mean(no)					t = -6.4824	
Ho: Diff = 0					df= 317	
Ha: Diff < 0			Ha: Dif ≠ 0		Ha: Diff > 0	
Pr(T < t) = 1.00000			Pr(T > t) = 0.0000		Pr(T > t) = 0.0000	

12

Table 6: Statistical relationship between knowledge transfer (KT) in the course on principles of microeconomics and interest to serve as academic tutor in the future

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Yes	98	5.7110	0.1060	1.0492	5.5006	5.9213
No	221	5.2829	0.0721	1.0719	5.1407	5.4249
Combined	319	5.4144	0.0606	1.0816	5.2952	5.5335
Diff		0.4281	0.1293		0.1738	0.6824
Diff = mean(yes) - mean(no)					t = 3.3123	
Ho: Diff = 0					df= 317	
Ha: Diff < 0			Ha: Diff 0		Ha: Diff > 0	
Pr(T < t) = 0.9995			Pr(T > t) = 0.0010		Pr(T > t) = 0.0005	

This last contrasts with one of the most important questions in this section, the 90% think that the contents of the course will have a significant impact on the future performance of their companies or businesses. In summary, it identifies a divergence in the perception of self-interest of each student for the course (linked to the motivation) and the perception of importance for their professional life (having to do it by obligation). Here it is essential to highlight that the perception of interest is significantly relevant to the degree of knowledge transfer that the student will get and, given the failure of the course in this aspect, it is one of the main elements of analysis and posterior intervention.

In the second basic structure (perception when exploring the course) persists the divergence that already exists. An 85% would not replace the course on principles of microeconomics for other different, 88% would be willing to train their employees on the issues that are developed in the course and an 85% said that both the accounting benefits and economic benefits (a difference of fundamental concepts, where only the second of them is dealt with in the course) will be fundamental in their future ventures. However, the course does not generate in the student motivation considered self-determined because when assessing the importance that students give to the grades of the different evaluative acts in contrast to the desire of the student to apply that knowledge in a practical manner, the result is a high score for the first and low for the second, where ideally it should be the other way around. The instrument presented that the 78% of students would use a platform provided by the teacher in order to get better grades. In contrast, when asked the students if they would like to review and apply their acquired knowledge in the course serving as academic tutor, only 30% had an affirmative answer (this group presented, consistently with the whole theory of motivation, a statistically significant higher level of knowledge transfer). However, when an empirical analysis is introduced in the course, 85% of the students claim to be interested in participating ⁶. Again, this identifies a structure not suitable in terms of a climate of learning appropriate for the generation of motivation.

In the third basic structure (future expectation of the course) results are consistent: the 80% stated that they are interest in microeconomic issues that their own companies will face and then make informed decisions based in learnings from the course (learning by sense of obligation) but only 33% said taking the course for the personal interest it generates.

3.1.5 Partial Conclusions

In summary, after applying the instrument and perform an analysis of the data, it is concluded that, in the first place, the perception of difficulty arising from the mathe-

⁶There was an item in the instrument that asked the student if he/she would be interested in analyzing the competitive behavior, from the microeconomics' perspective, between two enterprises like RedBull vs Monsters or any couple of interest.

mathematical component decreases the motivation of students on the course. This fact should be reconsidered because the essential interests of a business manager or an international negotiator is not memorizing the logical algorithm for the solution of a mathematical problem in microeconomics, but rather, to know a concept that allows a well-informed economic analysis for a successful decision-making in an executive position. Secondly, the generation of the type of self-determined motivation called “identified” (Deci et al., 1991c), which is fundamental in a course of this kind, is not to be appropriate because, although the students understand the importance of the contents, does not incorporate it as a personal interest through the course. Thirdly and finally, the course has the potential to develop the type of self-determined motivation mentioned above, proven fact when entering a study case of self-interest for these specific young students (a closer topic to them).

3.2 Evaluation of teachers on the basis of SDT in the period 2016-1

In the same way, it is essential a teaching evaluation to determine the extent to which the faculty allows a learning climate appropriate for the generation of motivation according to the self-determination theory because, according to this, the way in which the teacher generates motivation in the students can be treated from a controller or supporter perspective (Deci et al., 1981). As discussed in previous sections, this is essential given that the way a person influence impacts the motivation, emotion, learning and performance of others (Deci and Ryan, 1985; Deci et al., 1991c; Reeve, 2002; Ryan and La Guardia, 1999). In other words, the teachers are very important because they have the potential to facilitate the benefits of the self-determination theory through finding the way to engage and meet the psychological needs of the students (with respect to competitiveness, relatedness and autonomy) around the course in question (Hardre and Reeve, 2003; Reeve, 2002).

3.2.1 Participants

There are six (6) teachers sampled, most teachers are responsible of two courses so the study implies almost all teachers. Four of them were men (66%) and two women (33%) with an average of 31 years of age (standard deviation of 2.8 years) and an atypical of 80 years. All of them belonging to the School of Economics and Finance of EAFIT University, with a master’s degree in different national universities and on average with four (4) years of experience as teachers.

3.2.2 Instrument

The instrument for this case is composed of 20 items to measure the degree of support and closeness of the teachers with the students. This instrument has the same structure and validation of the previous one: two basic components each with title, hypotheses, a

question to be resolved and a validation of the content carried out through the judgment of an expert in both construction of scales as in analysis of the concepts to evaluate.

The two basic structures are the following: 1) Teacher-student relationship. Hypothesis: in order to incentive self-determined motivation by teacher is essential an appropriate teacher-student relationship. How is the teacher-student relationship? 2) Development of the theoretical elements. Hypothesis: the appropriate development of competitiveness, relatedness and autonomy is essential in the learning process. Does the teacher encourage autonomy, competitiveness and relatedness on his/her students?

3.2.3 Procedure

From the same coordination each teacher was asked to fill out the questionnaire informing them of the purpose of the instrument in the investigation. In the same way, the answers would remain in the anonymity and with the sole purpose of this research.

3.2.4 Results and data analysis

With regard to the first basic structure the relationship between teachers and students does not give a concrete result because in some ways it suggests a close relationship but not in others. For example, the 83% stated that they like to work with students in research projects and tutor programs, but on the other hand, only 50% of teacher say they spend more than two hours to the attention of the students at times outside the classroom. In addition, only 50% stated that they have a participatory group (students making questions and interested in class topics). The data indicate that there is a close relationship with the teacher only for a select group of students probably more pre-motivated to participate in extracurricular activities in company of the teacher.

On the other side, the second basic structure seeks to address the generation of autonomy, competitiveness and relatedness. The data indicate that most of the teachers do not use resources to encourage teamwork in diverse activities since on average each teacher only performs a group activity per semester. In addition, the 66% said they use just casually current societal situations to explain the topics of the course and only 50% say they leave practical applications at the end of the class to be developed by students, indicating a lack in the generation of the sense of competitiveness and relatedness, and this is going to be of relevance when restructuring the course. With regard to the autonomy the result is similar since all teachers use videos only occasional as a tool to bring students to the content, where the diversity of these elements is important where teaching to a group of students with different skills and qualities.

3.2.5 Partial Conclusions

It is important to review the structure that teachers use to make students interested on the topics covered in the course because as stated earlier, the methods being used point to a pre-motivated selected group of students who usually are the ones with better grades and good relationship with teachers. The rest of the group do not make it very probably because the traditional methodologies simply do not match to their characteristics, a fact that does not contribute to the generation of motivation.

3.3 Historical Analysis of the course

As robustness check, it is analyzed the historical educational environment that is given in courses on principles of microeconomics based on students perspectives. The participants are students who have studied the subject in the period 2013-1 through 2015-2 with different professors, schedules and evaluations methods. The instrument used is the evaluation questionnaire to the teaching of EAFIT University, instrument used each semester that seeks to know the perceptions of students in all schools; here is measured student perception about the teacher, among other things.

The procedure is very simple, to carry approximately 80% of the full course the student must fill out the questionnaire associated with each subject. Each Item has a scale of identification and at the end of the questionnaire is allowed a writing to suggest or complain.

The results are positive in regard to the content of the course and their applicability in different areas. However, the lowest scores are related to questions in regard to the methodologies used in the classroom. This is essential because through an alternate instrument to this work it is shown that the results found previously (divergence between perception of importance and genuine interest) have persisted through the years and justify an intervention to correct the problem.

3.4 Intervention piloting

With the objective of achieving an education more centered on students characteristics, identify the appropriate points that must be taken into account in the restructuring of the course (which will take place in 2016-2), and the way this should be carried out, it is implemented the first intervention (piloting) to the course on principles of microeconomics to test a student-centered tool (a platform of type MOOC) that seeks to improve the performance of different types of students.

3.4.1 Participants

Students from six of the 14 groups in question were subjected to treatment, those groups were randomly chosen by the general coordination area. None of the participants were aware of the purpose of the tool for research and, even though they knew the operation of the platform implemented, they had no information about the activities of the intervention through the platform.

3.4.2 Intervention

It is used the Moodle from Proyecto 50, a section of EAFIT University dedicated to the support and follow-up of innovations in education, it is then a Blending-Learning type methodology to support the development of students without interfering with normal activities planned by the teacher. In this Moodle the student will find, in addition to a bank of questions by topic of the course (based on the book guide) where they can review each one of them without academic pressure, the main activity that consists of a preparatory workshop for a future assessment equivalent to 25% of the course final grade. This workshop was developed by former students with the aim of having a questionnaire directed to student concerns. In other words, a workshop created by students for students to achieve a more focused activity on the needs identified by themselves in the course. In addition to that, a document with solutions step-by-step of the workshop will be delivered after a time to students in two different ways, explained in the next section. In the same way the document with solutions was designed by students who had already completed the course and were working as assistants in the project, off course they were well informed about the principles of the self-determination theory.

3.4.3 Procedure

After having completed the workshop carried out by the assistants and accepted by the general coordination of the course, Proyecto 50 is requested to use the Moodle and enable the workshop to the six groups on the same date; the entire operation is performed approximately two weeks before the obligatory evaluation that worth 25% of their final grade. However, it is requested that three of the six groups are allowed access to the document with solutions of the workshop five days subsequent to that date in an hour not determined (for students), this to analyze the input frequency to the platform that day until the time of actual uploading that would be in the evening. For the second group would be required a prior solution of the questionnaire (without the need to contain the correct answers) to have access to the same document with solutions. The diversity of methods is performed with two main objectives: first, as has been said previously, is piloting the tool of type Blending-Learning. The second is to measure motivation and interest of students regarding this type of tools in order to

prepare an appropriate intervention in 2016-2 where impact evaluation will take place. Similarly, it is important to clarify that these activities were not an obligation at all and just had the nature of a preparation for the future exam (equivalent to 25% of the final grade). All this based on the research of [Ryan and Grolnick \(1986\)](#), who conducted experiments to determine the behavior of the students upon a promise of evaluation on the material provided and upon no promise of evaluation (although it was clear that at some point there will be an evaluation), concluding that the second group achieved a better conceptual learning of all subjects.

It is necessary to emphasize that this first intervention has a purpose of diagnosis on the design of the tools that will be used. In other words, this first piloting does not include numerical results regarding any type of impact evaluation.

4. Interventions and results: impact evaluation

4.1 Evaluation of students on the basis of the SDT in the period 2016-2

4.1.1 Participants

For 2016-2 was used the instrument with a sample of 204 students of whom 103 were women and 101 men. The maximum age for women was 29 years, while among men the oldest was 34 years, the minimum age for both genders was 17 years and the average age was held between 19 and 20 years of age.

Table 7 corroborates the homogeneity in sample characteristics for the 2016-1 respect to the 2016-2 regarding socio-cultural data:

Table 7: Socio-cultural data comparatively between 2016-1 and 2016-2

Semester	Mean age	Studying two majors (%)
20161	19.3	6.5
20162	19.7	6.19
Semester	New major (%)	Repeater (%)
20161	20.43	12.38
20162	20	23.33
Semester	Mean of socioeconomic strata	Mean of semester in course
20161	4.8	2
20162	4.8	3

Based on table 7 and the previous validation of the instrument piloted for 2016-1, the case shall proceed to carry out analyzes and estimates in order to contribute with a model that allow others to check and verify the proper implementation of new methodologies that focus on students' characteristics. Both the instrument and the

procedure of implementation were exactly the same as what has been described for 2016-1.

4.1.2 Methodology

After the characterization of the sample, instrument validation and finding evidence of students homogeneity between the two semesters, an impact evaluation and posterior linear estimations have been proposed only for 2016-2 sample as it has the intervention already piloted. The first in order to estimate the impact of this intervention on the students motivation index (this index is created from the group of seven-level Likert scale variables in the instrument, see table 8 for description) and the second to estimate the effect of motivation on the final course grade.

Table 8: Description of the students motivation index

Variable	Obs	Mean	Std. Err.	Min	Max
Motivation	204	4.790378	0.9294714	1.153846	6.846154

Before starting the impact evaluation description is important to mention that the intervention in 2016-2 included new educational tools since the guide book used to be oriented for economist (not for business managers, etc), a fact that could dismiss motivation for more pragmatic students as discussed in previous sessions. Proyecto 50's educational innovations coordinator follow and constantly assist teacher on their new methodologies. It was implemented a game that simulates the students in the market, four collaborative projects, one exclusive session for a study case, two group evaluations with clickers, among others.

Now, there is a *Propensity Score Matching* (Rosenbaum and Rubin, 1983) with the aim of assessing the impact of the intervention on 9 groups (142 students) of the total 14 groups (69 students). These intervened groups not only have developed activities, such as workshops and collaborative activities in class, also using the content available on the MOOC described above, but with new teachers who have agreed to a monitoring and evaluation plan that seeks to develop in students the three paces of self-determined motivation (autonomy, competitiveness and relatedness). To do this, the participation equation on the probit (Khandker et al., 2009) is derived from the socio-cultural data section of our instrument:

$$\begin{aligned}
 Intervention_i = & c + \beta_1 Gender_i + \beta_2 SocioeconomicStrata_i + \beta_3 StudyingTwoMajors_i \\
 & + \beta_4 Repeater_i + \beta_5 MathCourseRepeater_i + \mu_i
 \end{aligned}
 \tag{1}$$

With this participation equation, it is then possible then to perform matching between students who has the same probability of entering in the intervention to subsequently determine the impact on motivation. In this work we perform three types of matching as robustness (Khandker et al., 2009): radius kernel matching, matching and k-nearest matching.

Knowing the impact on motivation, it is possible to estimate the effect of this variable on academic performance. Given that the index created for motivation is not a dummy variable, it is not possible to make another PSM, therefore, only with the region of common support found after the participation equation, an OLS estimation is performed as a simple way to present the results obtained:

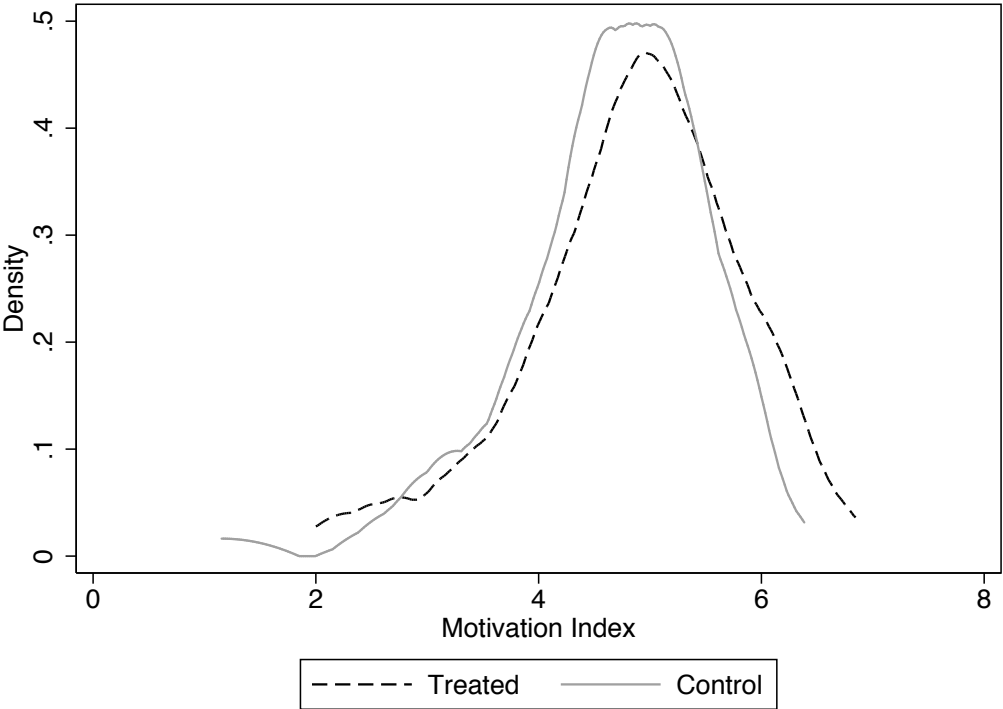


Figure 2: Distribution of treated and control groups

$$\begin{aligned}
FinalGrade_i = & c + \beta_1 Motivation_i + \beta_2 SocioeconomicStrata_i + \beta_3 Gender_i \\
& + \beta_4 Repeater_i + \beta_5 StudyingTwoMajors_i + \beta_6 MathCourseRepeater_i + \psi_i \quad (2)
\end{aligned}$$

4.1.3 Results

As can be seen in figure 2, the distribution of treated students evidence improvements in terms of motivation in comparison with control students. Based on the socio-cultural data provided by the instrument, regions of common support have been found through all methodologies, that means there are similar students appropriate to assess the impact on motivation after intervention and finally estimate the effect on academic performance. That is to say, it complies with the condition of balance as well as a region of common support.

As noted in table 9, the intervention effect is positive for the different estimation methodologies. Despite this, the coefficient is only statistically significant in the radius matching method, this seems to be explained by the promptness of the evaluation (after one semester) and in consequence, if this approach is correct, it suggests to continue the intervention in coming semesters to consolidate and strength the new implemented methodologies to finally have a robust effect on student's motivation.

However, given the problems posed in the introduction, the purpose to do this research is to find a model that considers how adequate it is implementing the redesign of the course and their overall effect on the knowledge transfer.

In order to accomplish that objective, final regressions are performed by OLS with the final grade as dependent variable only for students that were in region of common support as shown in equation 2. These estimates do not include data from k-nearest matching method since the region of common support yielded very few observations, insufficient for a model of this type.

Indeed, motivation has a positive and significant effect on academic performance (according to self-determination theory), result that remain robust throughout different methodologies supporting that an appropriate course redesign improves the knowledge transfer. On the other hand, results suggest that gender differences do not have an impact on academic performance, as well as age, have jumped from another mayor and have repeated the course. However, the negative effect is significant for those who have problems with maths and have repeated those courses, as mentioned in previous sections. Surprisingly, higher socioeconomic strata have a negative and significant effect with academic performance.

Table 9: Results of impact evaluation by three methods and two tests of robustness

Methodology	Region of common support (RCS)	Obs. Treated	Outside RCS	ATT	T-stat.
Kernel matching	130	75	44	0.1877	0.89
Bootstrap	174			0.1877	1.18
k-Nearest neighbors matching	29	19	145	0.2263	0.78
Bootstrap	174			0.2263	0.32
Radius matching	163	107	11	0.2095**	2.05
Bootstrap	174			0.2095*	1.34
Direct matching	174			0.2309	1.32

22

Table 10: OLS results of motivation on academic performance at the end of the course

Regressors	Radius matching		Kernel matching	
	Coef	S.E	Coef	S.E
Gender	0.0717	0.082	-0.0668	0.0989
Socioeconomic strata	-0.1054***	0.030	-0.1104***	0.0392
Repeater	-0.0267	0.095	0.1842	0.1581
Math course repeater	-0.5386***	0.079	-0.5856***	0.1009
Age	-0.0185	0.015	-0.0333	0.0345
New major	-0.1086	0.094	0.0785	0.1141
Motivation	0.1073***	0.036	0.1214***	0.0437
c	4.3113***	0.382	4.4908***	0.7102

Nota: Statistical significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5. Conclusions

This research proposes a measurement instrument on motivation composed of three specific constructs, as well as a model for monitoring and evaluation of the theory raised by Deci and Ryan (1985); Deci et al. (1991a) in a Latin American context. A procedure that is intended to be useful in the evaluation of different courses that meet the same characteristics. However, the specific case of the course on microeconomics lead to the following conclusions:

After applying the instrument and perform an analysis of the data, it is concluded that, in the first place, the perception of difficulty arising from the mathematical component decreases the motivation of students on the course, a fact that should be re-considered because the essential interests of a business manager or an international negotiator is not memorize the logical algorithm for the solution of a mathematical problem in microeconomics, but rather, to know a concept that allows a well-informed economic analysis for a successful decision-making in an executive position.

In the second place, and taking into account the above, the type of self-determined motivation called “identified” (Deci et al., 1991a), which is fundamental in a course of this kind, is not being appropriate generated by the course because although the students understand the importance of the contents do not incorporate it as a personal interest throughout topics covered in the course.

Finally, the developed model has proved, on the basis of the SDT, that higher level of self-determined motivation triggers a significant improvement in knowledge transfer as well as on a student’s academic performance. Generation of self-determined motivation, at least for the Latin American colleges context, can be achieved by means of an appropriate redesign of the course based on new learning methodologies. However, in the specific case of the course on principles of microeconomics, the intervention has generated improvements but not as forceful as would be expected, therefore, a more prolonged and intensive intervention appears to be the way to get a robust and higher effect.

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Appendix

A. Items description

A.1 Dichotomous

Variable	Item
Repeater	Are you repeating the course on principles of microeconomics?
Math course repeater	Are you repeating any of the math courses in your major?
New major	Have you jumped from another major?
Two majors	Are you in two majors at the same time?
Have previous knowledge	Did you learn something regarding economics in high school?
Studying without final exam	Suppose that the teacher allows you, as reward, to skip the final exam. Would you even study just for learning?

Variable	Item
Economic profit	In this course you have learned about economic profits and not about accounting profits (very different). Do you still think that economic profits will help you to rise your enterprise utilities?
Replacing the course	Given the opportunity, would you deliberately replace this course for another of different kind?
Training employees	Suppose you are an important CEO, would you train your employees in microeconomic topics?
Serving as academic tutor	After you successfully finalize the course, would you like to serve as academic tutor?
Topic of interest	Would you like to study, based on microeconomics concepts that you have learned through the course, the competitive behaviour between Redbull and Monster (or two enterprises of your interest)?
Well informed decisions	Suppose that you are the CEO of an enterprise that is competing in a duopoly. Would you take your decisions based on the concepts you have learned in this course?

A.2 Seven-level Likert items

Variable	Item
Interesting-references	Before taking the course. Had you been told that the course on principles of microeconomics was interesting?
Difficulty-references	Before taking the course. Had you been told that the course on principles of microeconomics was easy?
Reading habits	Do you usually read about economic issues?
Conversations-economic issues	Do you usually talk with your parents (or any member of your family) about economic issues?
Microeconomic-higher utilities	Do you believe that the concepts you have learned in this course will help you to increase the level of utilities in your business?
Microeconomic-level of utilities	At what level do you think the concepts you have learned in this course will help you to increase utilities in your business?