Learning Gap in Exact Curricular Components in High School and Impact in Engineering Courses in Higher Education

Fábio D. Chaves, Virnei S. Moreira, Márcia N. Camargo

Abstract— **To assess the quality of education in schools and the impact on university was objective of this study. Seeking to understand the relationship between the formation of the students from elementary and secondary education, up to the challenges in an engineering course. The lack of quality in the training of students have provided high levels of failures in curriculum components such as Physics, Mathematics and Chemistry. To contain the evolution of these negative rates, suggest the adoption of practical classes in laboratories or in appropriate places for learning and a regional pact between the Federal University of Pampa with other bodies to improve education in the region.**

Index Terms—**Teaching quality, impact on engineering courses, retention in physics, mathematics and chemistry, training of students.**

I. INTRODUCTION

National Secondary Education Examination (NSEE) is the great gateway to the Brazilian federal universities, it is increasing the number of universities that have joined or are in the accession process of this examination as a means of access in federal and private institutions. The number of participants has evolved each year, the proof is that in 1998 the first edition of NSEE when it was used only for high school evaluation purposes, we obtained only 157,221 participants. In 2000 when some institutions began to accept the NSEE as a form of full or partial entry was noted higher growth than 50% of what was recorded in 1998. In the year 2014 obtained 9.4 million, of candidates and participants for 2015 around 8.4 million candidates and in the year 2016 with 9.2 million subscribers [1].

Recently the Lemann Foundation published a survey entitled Life Project: the school's role in the lives of young people, yielding an article in the Zero Hora State of Rio Grande do Sul, where he spent on the topic of the difficulties of students who the Brazilian high school. The results presented show that young people leave primary school without basic knowledge of mathematics, Portuguese, with no ability to logic and oral expression and skills for the labor market [2].

Young the Lemann Foundation cited in his research are the same who performed the NSEE. How many federal and private Brazilian universities joined the NSEE and the implementation of the Unified Selection System (USS) that gave it possible for students from all regions throughout

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Brazil can compete for positions of federal universities in any state of the federation [3].

However a major concern of Brazilian universities are the rates of retentions (disapproval) and evasions (abandonments, cancellations, transfers and other causes.). However [4] claim that this problem is not just national and in other countries like Germany, USA, Italy, Chile, France and Sweden are equivalent rates, or higher than those recorded in Brazil. Certainly the element that contributes to the students of output, for example the engineering courses of federal institutions is the retention in curriculum components (CC) involving the areas of mathematics, physics and chemistry.

According to the authors [5] and [6] attribute the stalemate of freshmen is with the basic concepts in physics and mathematics, and is notorious with application of basic tests to assess the skills of the students enrolled in engineering courses at the Federal University of Ouro Preto (UFOP). They put this unique problem of engineering courses, second [7] these initial difficulties are checked in undergraduate physics course at the Federal University of Rio de Janeiro (UFRJ), the same authors also report that only 10 % of entering students can graduate in physics course, that is, of the 120 students who started the course, only 12 can complete it in the correct travel time due to the difficulties faced by students in the first semester of graduation.

This study is of paramount importance for the Federal University of Pampa (UNIPAMPA) and educational institutions, as it will provide a more thorough discussion of the curricular exact components in basic and higher education.

II. METHODOLOGY

It began the literature for this study, scientific articles, master's theses and doctoral finally reports on the subject in order to provide a theoretical basis, thus aiding the construction of the research methodology. Contextualizing the city of Itaqui-RS, there are three schools with high school with approximately 1555 students enrolled. The UNIPAMPA in turn has a drive UNIPAMPA installed in the city and currently has approximately 1,400 students enrolled in the year 2016.

Presented a proposal for each segment (students and high school teachers, academics and teachers higher education) so we designed a specific questionnaire, aimed at mapping the views of respondents on the question of preparation for higher education and finally identify learning problems in secondary and higher education. The research began on June 30 and ended on July 26, 2014.

The questionnaires were applied as follows: in high schools, applied to students of 1st, 2nd and 3rd years, 75 questionnaires were applied per school. Thus, a total of 25 questionnaires in each of the years of high school, the choice of the participants randomly. Thus, a total of 225 students representing approximately 14% of the entire student population of the average city school. Personal data were not required in the questionnaires in order to ensure the anonymity of participants.

The academics UNIPAMPA used the Google Forms, consisting of a tool for development and forms of sharing on the Internet, Therefore, the form (questionnaire-shaped) was sent to all scholars. The results of the questionnaire Were stored in an on-line spreadsheet and posteriorly generated your file for processing. 162 students completed the questionnaire representing Approximately 11% of the unit's student community.

It conducted a preliminary survey of the areas in question with teachers of Itaqui-RS unit, which was set to apply another questionnaire to 12 teachers of the institution of higher education that teach basic curriculum components and considered basic at the university, such as mathematics, physics and basic chemistry, calculus and physics, to identify the main difficulties faced by freshmen in UNIPAMPA. All questionnaires had open and closed questions (semistructured).

Applied a test with high school students in order to evaluate the perception of some simple concepts. This test is empirical, but theoretical basis of simple concepts that have already been presented to high school students in elementary school, present in the 1st test.

$$10 - F = 20 \quad (1)$$

This is a first degree equation with one unknown, which was requested to students the value of F.

2nd test was made in the formula below the weight force, proposed by Isaac Newton.

$$F_p = m \square g \quad (2)$$

The following information was given: M is mass and G acceleration of gravity. Finally he questioned whether the high school students which would represent the letter P in the equations, ie, what would be the result of mass multiplication by the acceleration of gravity.

The departments of high schools provided the data retention in the curricular components of physics, chemistry and mathematics from the year 2008 until the year 2013 for student performance evaluation during their training in high school. In addition to the retention of data was requested dropout data from institutions. For the academic secretary of UNIPAMPA we were requested data retention of curriculum components of mathematics, physics and basic chemistry, calculus and physics. The Educational Development Center (EDC) of Itaqui-RS unit, released a survey carried out by the same circumvention of UNIPAMPA unit in the city. Nude used the following expression the number of academic retained divided by the number of registered.

III. RESULTS AND DISCUSSIONS

The study demonstrated that more than 40% of high school students in the city of Itaqui-RS, has no affinity with the curriculum components of Physics and Mathematics, the same attribute that do not understand the concept discussed in the classroom and the applicability of same. In this way it presents a worrying scenario, if we add the students who do not understand the concept, they do not understand the applicability of the content and those who are not interested in curriculum component will have the following percentage of 65.56% of respondents.

Over 97% of respondents believe that the use would assist their learning laboratories. Another factor that drew attention was that students know that at their institution there are laboratories that could be used that are not practical classes and used the other hand there are reports of teachers that the high school did not have sufficient financial resources to purchase reagents for classes, there are institutional limitations to the classes are held. The experimental part is not a trivial activity in high school Brazilian schools, being a part of fundamental importance to the learning of science in schools and later to the new students in higher education [8].

The high school student was asked if sought videos to answer questions that arose in class, 55% said they were looking for videos on the internet, but, 45% said they do not seek this type of resource, showing that most seeks answer questions with the aid other resources, but a very large part of students still do not, even though available in its technological resources institutions to access them.

In Itaqui-RS unit of the Federal University of Pampa, has 5 undergraduate courses and the following, in Mathematics, Surveying Engineering, Agronomy, Food Science and Technology, Nutrition and Interdisciplinary Science and Technology, both courses present their curriculum components grids in the field of exact.

The students were asked if they had some kind of preparatory course before performing the test NSEE, only 25% of respondents state that sought to make some kind of intensive study as pre-university and / or pre NSEE course, but the vast majority, 75 % said they would not. As stated [9] this transition from college entrance admission to the NSEE, brought significant changes in the behavior of freshmen before they passed these courses and marathon events before enrolling in a university . The migration of students to other states in the country was reduced to the vestibular and a specific area for entry. With this difficulty than before in basic curriculum components they were not as pronounced in the vestibular became more visible with the implementation of the NSEE, which shows a generic test that evaluates all sciences, difficulties these more concentrated in the areas of exact, because study rite was dramatically reduced.

When asked about why problems with certain areas of study, many attributed the difficulties in the curricular components of the exact area due to lack of good training in high school and even when elementary school students were not interested in components curriculum as chemistry, mathematics and physics. With this we can see the same behavior of high school students and scholars. Difficulties in the exact curriculum components have a direct impact on retention, basic already put in high school are fundamental for understanding for example in the curricular component of physics 1 and 2 at the university.

Another point discussed was the changing behavior of academics in relation to high school students, where nearly 80% search for videos on the Internet to answer questions that arise in the classroom. This increase in video consultation on the internet has a possible explanation, due to the complexity and depth of content in higher education is imminent consultation with other complementary forms for study and understanding of the content, not just using the books available in the institution. The internet offers facilities like, access content anywhere with access to it and revise several times the content.

Again another as they had the same behavior was the perception of both segments discussed in this section on lessons in laboratories. Of the 225 surveyed high school students, 97% believed that the classes would help laboratories in learning, for example in the curricular components of physics and chemistry thus making more accessible and comprehensible. By the academics there is also this statement of high school students, with approximate values of 96% of respondents.

The study routine both segments are almost identical, as well as [10], explicit that in 1995, students did not have the habit of studying at home and in modern times is quite present as demonstrates the table below.

Period leading up to the tests	Students		University	
	Nº	%	Nº	%
Study 1 day before	120	**53,33%**	35	**21,60%**
Study 3 days before	59	26,22%	71	43,83%
Study 1 week prior	18	8,00%	47	29,01%
Daily studies content	28	12,44%	9	5,56%

Table I: Relationship between hours of student and academic studies.

When asked about the routine of study, that is, as the daily hours were spent in the study of the content covered in class. The middle school students asked about their hours of study, many questioned why there was no option not usually study during the week, or just before the exams, which would change the data in Table I, as many have pointed out 2 to 3 hours study because it was the minimum established in the search.

Following asked to the high school student if it believed to be prepared for the NSEE, more than 79% respondents demonstrated that it has no confidence in their training. Indicative insecurity by the students on their basic education and higher education challenges. The result of this course the student with his education show reflexes to academics with a very critical view of their training in high school and thus face many barriers during his graduation and finally resulting in a performance below expectations of it. But this result is close to the search [2] where both demonstrate the insecurity of the high school graduate to enter the labor market or university, this is the result of the disconnection of the content covered in class with reality.

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Table II: Study procedure before tests.

Another aggravating fact that both segments is the period of study for exams, above we saw that students and academics do not have the habit of a routine study for exams notice a small change, as Table II.

High school students studying usually a day before the tests, since academics despite a considerable number still studying the day before the race, most seeks to study three days prior to the tests. The university is clear this habit when we analyze the physical monitoring of the numbers. During the days that do not predate the evidence, according to monitor reports, the average number of academics who seek to ask questions is at most 3, but in week test this number increases 7 times, that is the daily study posture is not practiced on campus reality, as they leave to study in the race week. However 65% of high school students say they are ready for higher education, many state that the method of average polytechnics to provide a foretaste of how higher education, which are developed activities such as presentation seminars. But the issue of training in higher education is deeper than just presentations seminars as stress [5], [7] and [9], in higher education to deepen in any area, it is necessary that the student enter comprising that are needed the basics of physics, mathematics, Portuguese and chemical and etc. academic use throughout training, for example, if an engineering degree.

Applied two tests with the equations (1) and (2) for high school students, to evaluate whether they dominate basic concepts of mathematics and physics. Only 18.67% of high school students correctly answered the test. Than those who did not answer correctly, 60% of committed algebraic errors and other errors are related trading signals. Equation (1) was an equation of 1 degree, demonstrating that even students in the 3rd year of high school, some about to enter university could not answer this type of question. The first-degree equations are considered basic equations of mathematics and central to the resolution of expressions both in high school and in higher education, but this concept of expression is already presented to the student since elementary school.

In test 2 the percentage of students who answered correctly increased considerably however, it is noteworthy that the students who responded that "P" of the equation (2) was a force was considered correct, as they were able to make a correlation with the weight force. Students who do not correctly answer the question, note that many reported random responses to assign the letter "P" of the equation as pressure, product, perimeter, potentiation. If we make the sum of those who were unable to respond and those who answered wrongly, we have more than 65% of the state schools of the city of Itaqui-RS who failed to understand the concept of weight force in the context of 225 students is an alarming number.

In UNIPAMPA teachers who teach curricular components of chemistry, physics and mathematics ensures that the rooms are full and this condition influence the learning of students. This is the big problem for these curricular components have a great retention rate, half and half after the number of students in these components only increase with the freshmen and retained. Of the 12 interviewed teachers UNIPAMPA, 83% ensure that the programmatic content of the components is regular / good. The penultimate question in the questionnaire addressed to teachers, requested the assessment on the perception of the academic in their classes, 91.67% say that

the perception of academic is fair / poor and mostly academics were not prepared for higher education when entered.

The result of these results and discussions follow the best result then that is the data of the secretariats, which should deeply discuss the scenario that is designed high school and the future perspective of the university in relation to high school graduates.

Ano de 2013			
	1º year	**2º year**	**3º year**
Approved	59,07%	77,55%	82,35%
Reproved	21,86%	4,08%	1,96%
Transfer	10,23%	8,16%	6,86%
Cancellations	0,00%	0.68%	0,98%
Evasion	8.84%	9,53%	7,85%

Table III: Data from one of the high schools of Itaqui-RS.

The data obtained from the offices of high schools of Itaqui, the letters A, B and C for the 3 institutions were allocated for no performance comparison between them, it is not the object of study. The school secretaries, we obtained the following data presented in Table III, one of the institutions.

In the above table demonstrates that the 1st year of high school retention rate is high compared to other years in high school. The data from another school we note that the retention rates in the curricular components of physics and mathematics are generally high generally in the 1st year of high school as shown in Table IV.

Physics			
Situation	1st year series 2011	2nd year series 2011	3rd year series 2011
Approved	54,75%	71,63%	90,57%
Reproved	**45,25%**	28,37%	9,43%
Situation	1st year series 2012	2nd year series 2012	3rd year series 2012
Approved	48,82%	77,99%	91,43%
Reproved	**51,18%**	22,01%	8,57%
Situation	1st year series 2013	2nd year series 2013	3rd year series 2013
Approved	75,93%	80,00%	100,00%
Reproved	24,07%	20,00%	0,00%

Table IV: Data on approval and disapproval in the curricular component of

The above table would be all right in basic education, but as previously seen students do not trust their training and beyond that there are other factors such as the content covered, lack of routine studies and others that directly impact on higher education and especially in courses engineering. But these low high school retention rates are completely opposed to higher education, as shown in Table V.

Year of 2013 at the University					
Discipline	**Enrollment**	**Approved**	**Reproved**	**Dropouts**	**Retention Index**
Calculus	44	1	34	9	**97,72%**
Statistic	6	3	2	1	**50,00%**
Physics	45	4	32	9	**91,11%**
Chemistry	45	9	21	15	**80,00%**

Table V: Retention rate in the course of Engineering Surveying.

The exact disciplines are those that have the highest retention rates within the campus and the university. As presents Table V. The curriculum components of calculus and physics are those with rates above 90% and both were presented in the first half of entering university for academics due to the various data presented in this article to emphasize that students and academics do not have the habit of studying every day and do not even know how to study contributes to these rates remain high.

On the other side there is a market that needs these future engineers, according to the National Industry Confederation (NIC), one of the great Brazilian industry advance of problems is shortage of engineers in the market and it also mentions that the number of students enrolled in courses degree in engineering areas in recent years have grown, however, evasion data in these courses are also extremely high. NIC attributes the lack of a solid and consistent training in high school as a major obstacle to be most needed form engineers that the industry and the market [11]. One of the key elements to the role of higher education is the strengthening of basic education, it is the space where students experience first contact with science but also, as the NIC mentions in his research published in the Folha de São Paulo, engineering education must undergo a makeover to meet the industries and the technological advancement of the same.

CONCLUSIONS

It can be seen that the behavior of high school students and academic resembles. There is a need for innovation in the classes of both institutions, using the computer labs with free software or owners, providing an auxiliary form of learning of students and academics.

Conducting a partnership between high schools and UNIPAMPA the city of Itaqui-RS and the region for the creation of activities and events for students of both institutions to seek different forms of learning. Another fact observed is that UNIPAMPA teachers emphasize that the majority of students entering the institution do not prepare for the NSEE and the same students are ready for higher education.

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