

Analyzing the influence of the secondary to university core courses alignment. Case study: engineering programmes

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Abstract

The student success in the first year, is influenced, among the other things, even by academic factors: college readiness, core curriculum in high school, cognitive, etc. The alignment analysis of the some core courses between university and high school, is the main objective of this article.

The qualitative method and student questionnaires, are used to carry out this analysis. The results obtained indicate the influence of curriculum alignment on classroom teaching and student success for three core courses: Mathematics, Physics and Chemistry, on the first year. Using the regress analyze, some linear relationships are found, either for two classroom teaching and student success indicators as well. Based on these results, we emphasize the necessity for a greater student support during the transition from high school to university, in order to foster student success. This study was conducted in engineering study field, but it can be used in the other fields as well.

Keywords: analyses, influence, alignment, subjects, student, engineering

Introduction

Higher Education Institutions (HEIs) apply academic standards of student admission in the first year of the study programs, which are integral parts of the admission policies. These standards also contain the academic criteria for admission of candidates competing for admission to university study programs. Although they are of different forms, they must be in accordance with the mission of the HEI and support the student in the transition from secondary to University. Academic background expressed through these criteria, with which the student is admitted by the HEIs, affects his success in the first year of study. Therefore, the analysis of the impact of this academic background on student success remains a permanent object of research not only from university, but and from curricula makers of secondary education.

In some developed systems, admission policies have led to the use of standardized tests to measure the candidate's status in order to determine the degree of academic readiness for admission to the University [L1].

In other cases, such as admission to engineering programs in Albania, the process of selecting candidates is based on the academic results of the high school. In fact, the average grade is also a predictive indicator of student progress in the first year of university [L2].

In the literature there are many articles and studies that analyze different aspects of the transition process of students from secondary to post-secondary education with a focus on: transition, curriculum alignment, the gap between secondary and post secondary education, college readiness and student success [L3,4,5,6]. Mach [L7] argues that the term transition is more appropriate than the term change. Meanwhile the other authors [L8,9] have discussed on how the state of college readiness, effectiveness of program and efforts can help students during this transition, including underrepresented student groups. An interesting study addresses student transition issues by applying an approach that identified 5 skills: independent learning, research, time management, English and critical thinking, that are central to quick adaptation to university learning [L10]. It is also interesting the finding of this study concerning the inadequacy of private education in bridging the gap between secondary and post secondary education. The existence of this identifiable period of transition has already been proven, as well as the bridge between secondary and postsecondary education. The analysis of the transition process from the student's point of view serves to better understand this process [L11]. Aspects of the influence of HEI on certain course, with the aim of strengthening equality in admissions and student success, is given [L12].

The admission to postsecondary education represents an important stage for the student's further success, which depends on many factors like cognitive, non-cognitive [L13,14]. Their analysis serves as a basis for admission policies, as well as for financial student aid. In [L15], the differences in the first year student success, are analyzed for three domains, focusing mainly on students' academic achievement, which is most important for students themselves.

Different models are used to study the problematics of curricula alignment and student transition from secondary to post-secondary education. Among them, a statistical model is used to determine the relationship between university readiness and academic achievement [L16]. It is proven that student success depends on the university environment and the student [L17], but when it comes to the first year of study, variables should include also the academic alignment between secondary and post-secondary education. The state of academic readiness to the university admission, facilitates the transition process and on the other hand supports the further student progress in the first year and beyond. This process also requires a strong Secondary-to-Postsecondary Curriculum Alignment. A guide containing gap and curriculum alignment analysis [L18] can serve for better understanding the relationship between them.

In this article, the curriculum alignment is considered the process that aims to ensure coherence and consistency between learning outcomes of high school and teaching activities in University. The curriculum alignment is required not only within a system either secondary or university, but also between K12 of secondary education and the first year of study program. A rigorous alignment allows university teachers to rely heavily on the prior knowledge acquired in secondary education by reducing unnecessary repetitions and encouraging student progress [L19]. Among the various barriers, it is evident that there is a lack of cooperation between professors and teachers who cover the same courses, for their content.

The Albanian education system includes pre-university and university subsystems that carry out their activities based on two different laws. Thus, creating a gap between these two subsystems, influencing student progress, is present and influential in mutual collaboration.

Based on in – depth studies, it has been shown that academic collaboration between two subsystems is very necessary and useful to enable student success in university programs. However, given a long transition, this academic collaboration is sporadic and weak in Albania.

In principle there are different ways to enhance academic collaboration between two subsystems, that in some cases these are formalised. Although the use of a specific system-change framework is not achieved, it has shown that, the use of certain elements still helps this alignment of subsystems [L20].

The issue of being in a line between high school and University is an integral part of many strategies at the system or institution level. At the system level there are various strategies used in this direction like [L19,21]:

- Organizing preparatory courses
- Establishing a collaborative partnership between K12-HEIs teachers.
- Course sequencing.
- Dual credit course
- Curriculum aligning standards.
- Data system

Despite the fact that postsecondary access is open-door type, or it depends on the academic achievement of the candidate, HEIs have to demonstrate their responsibility undertaking the actions to help students of first year for their proper placement within college curriculum [L22]. The study shows how important is the level of knowledge of the respective course taken in secondary education in student success. In this context, although it has had the positive impact on the student success, the choice of a larger number of scientific subjects [L.23], again the academic background of the admitted students is different.

Acknowledging this important role of scientific courses, it needs to be distinguished that among them, the mathematics course plays a special role in student success [L24,25,26,27, 28], including the engineering fields.

Despite the fact that in the higher education system in Albania, compulsory supplementary courses for scientific courses that support the college readiness, are not applied, again for some areas they are developed individually (ex. for medicine, architecture). So even for engineering programs, the students admission in the first year is based only on their achievements from secondary education.

The linear sequencing of respective courses is a prerequisite for student success at university, as evidenced by the course sequencing in various curricular experiences[L29]. This prerequisite is applied to the entire curriculum that the student performs in HEIs and should be taken into account by each of them. The linear course sequencing [L30] should also be used to ensure a logical transition from secondary to postsecondary education.

Unlike [L.31] which examines relevance of secondary curriculum design in relation to the knowledge required by engineering programs, this article aims to analyze the influence of core courses into respective first year university ones teaching and student success as well.

Based on the qualitative and quantitative analyzes, the article aims to evaluate influence of the core course alignment into teaching and student success.

Methodology

Students who have completed the first semester on Engineering Bachelor degree were invited to participate and to complete a language corrected, validated and anonymous questionnaire. The survey was attended by 516 students of the first academic year 2018-2019, who belong to

19 engineering study programs. As part of a three-year study (2017-2020), the survey process has adhered to ethics and requirements for statistical analysis as well. Only one study program was excluded due to the small number of participating students. At the HEI level, the rate of interviewed student from vocational high school averaged 2%, while from the gymnasium it was 98%. The number of unanswered questionnaires is respectively (0.8,4.8,5)%.

From the group of 5 subjects included in the questionnaire, for the article purpose, three of them are analyzed: Mathematics, Physics and Chemistry because these subjects have continuity from high school to all the engineering studies programs considered and on the other hand they are included in the admission criteria in all engineering programs. In secondary education every student who aims to be admitted in engineering program, may complete advanced after respective core course which is compulsory. Indicators for assessing the student success are the average grade and the student pass rate, which are obtained from the relevant offices after processing the exam results of first semester.

Procedure

The process of students survey was conducted randomly at the break of lecture hours, ensuring that the number of students participating in survey, was not less than 20% of the total number of the students of the first year in each engineering program .

Based on the relevant answers to the questionnaire, the distribution of students according to the type of high school they came from, was initially analyzed. In this way, the academic background of the students enrolled in the first year, is known. After that, the weight of the influence of various factors on the student's success in the first year is determined.

The answers to these two questions, described above, were followed by passing on the answers to the other two questions, which are related to the student's difficulty and repetitions in the course. In the context of this article, the term "repetition" is used to repeat knowledge, which is not planned in the program of the respective university course. In this sense the term "Repetition" is used as an act of overlapping between two correspondent core courses.

Marking with "x" the variable that expresses the ratio of the number of students who have completed the elective course in high school with the total number of students of the respective

core course:
$$x = \frac{\text{nr of stud. adv. course}}{\text{nr of stud. core course}}$$

it has been initially required to find two functions that express the influence of academic alignment in teaching in each of the three subjects of the upper cited. For this purpose, the questionnaire contains two questions for the student, the answers to which are related to the level of difficulty in the subject and the repetition encountered in it. In this way it becomes possible to search and find the dependence of students rate in function of the variable x, for each of the course. Such dependencies will serve the relevant pedagogues to take measures to improve teaching.

Having as the final goal, the evaluation of the student success in the first year of university, in the next section, using linear regression, we determine the relationship that expresses the influence of student rate with advanced course on student success and teaching as well.

Distribution of the number of students by core courses

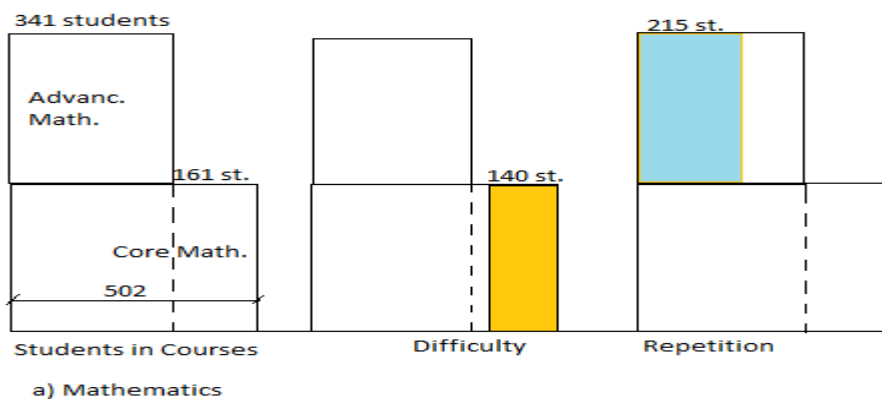
In order to better understand the situation at the students' entry in the first year, a graphic presentation is given in Figure 1, respectively for Mathematics (a), Physics (b), Chemistry (c). In each figure, the number of students, respectively for the basic course and the advanced one, is presented in appropriate scale. The second column presents the situation for the answers to the question regarding the difficulty of the respective course, while in the third those related to the repetitions in them. The numbers, in columns 2 and 3, are presented as the edges of the rectangles painted in brown and sky blue, respectively.

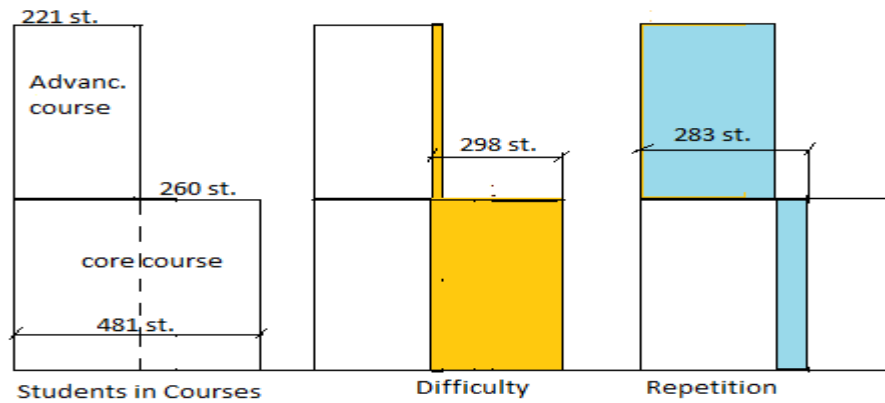
For the above reasons, the total number of students valid for this analysis and their distribution depending on their curriculum, is given in the following table.

Table 1 The admitted students' distribution by core curriculum in high school

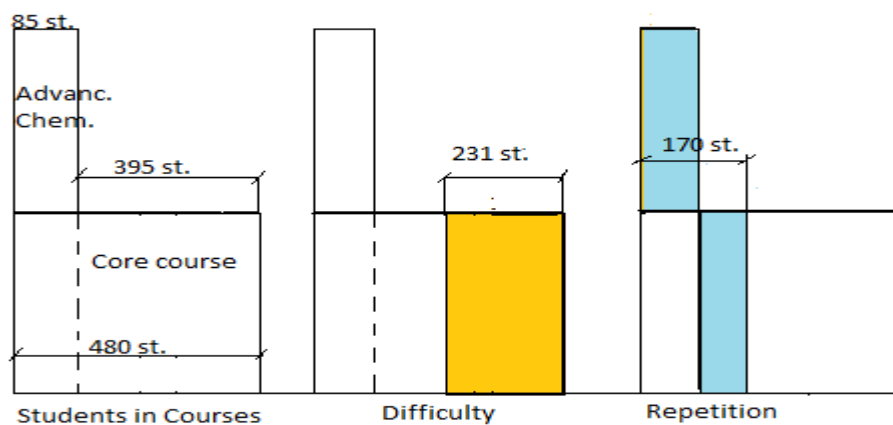
Nr	Subject	Number of students			
		No answer	Advanced course (1)	Without Advanced course (2)	Core course (1+2)
1	Mathematics	4	341	161	502
2	Physics	25	221	260	481
3	Chemistry	26	95	385	480

The data obtained from the student questionnaire for the two questions posed are given in Figure 1, for all three courses taken into consideration.





b) Physics



c) Chemistry

Figure 1. Graphic interpretation of the influence of course alignment into three course teaching

Results

To verify the factors that have influenced the student success, the results obtained from the questionnaire are used, for the question: which are the most important factors that have impacted the student success in the first year. These results are presented in Figure 2.

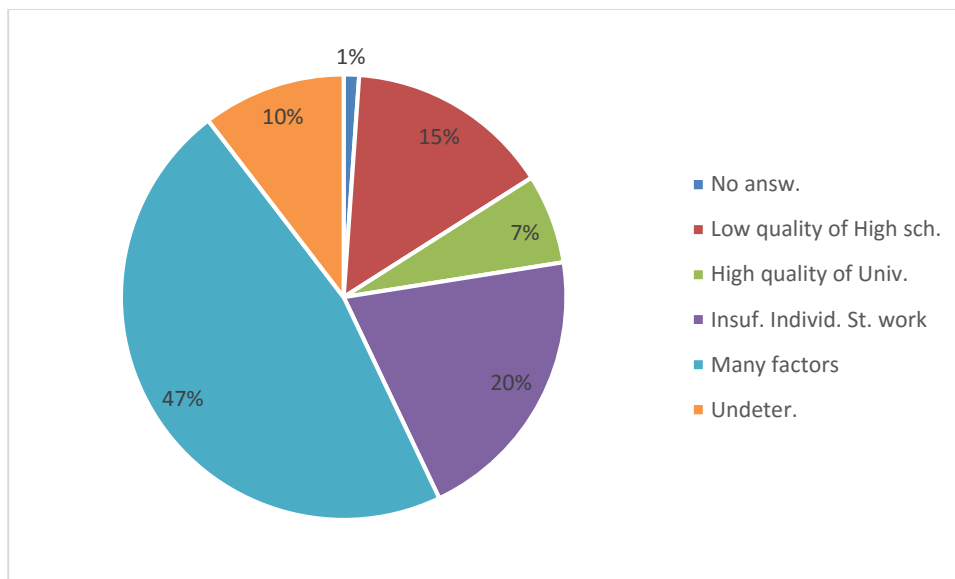


Fig.2 The most important factors which have impacted student success in first year.

The results obtained from the questionnaires for both questions, were processed in Excel and the relevant relationships were found.

Referring to the question of the difficulty rate encountered in a course, Figure 3 presents the dependence on the variable x of the “Yes” students’ answers rate. This rate is calculated by dividing the number of students who have encountered difficulties with number of student with advanced course.

Figure 4 presents the dependence on the variable x of the “Yes” students’ answers rate. This rate is calculated by dividing the number of students who have encountered repetition during the course with the number of students with advanced course.

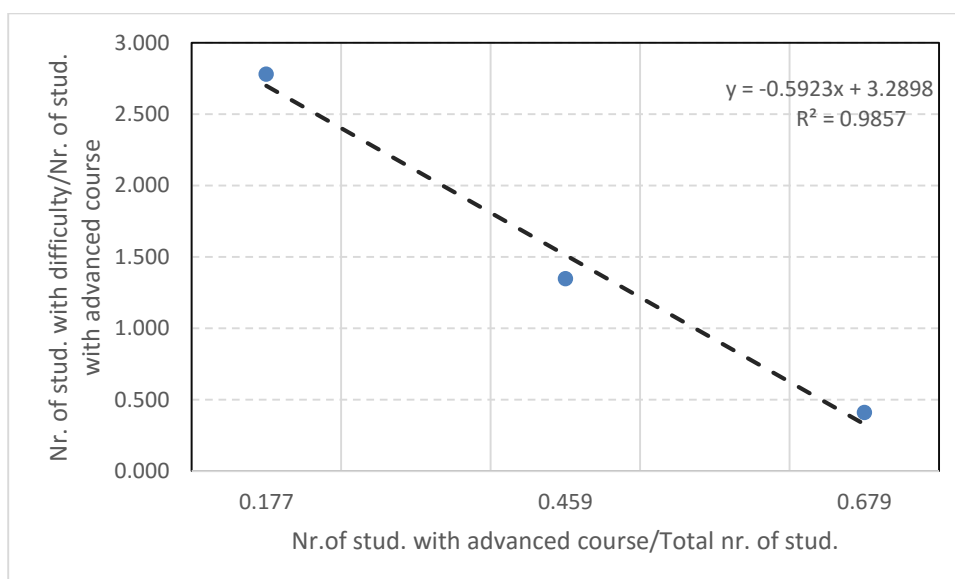


Fig.3 Influence of advanced course rate into student difficulty rate

To examine the influence of the variable x into student success, the students' results of the first year, were obtained, regarding the two indicators of this assessment and for each of the three selected courses.

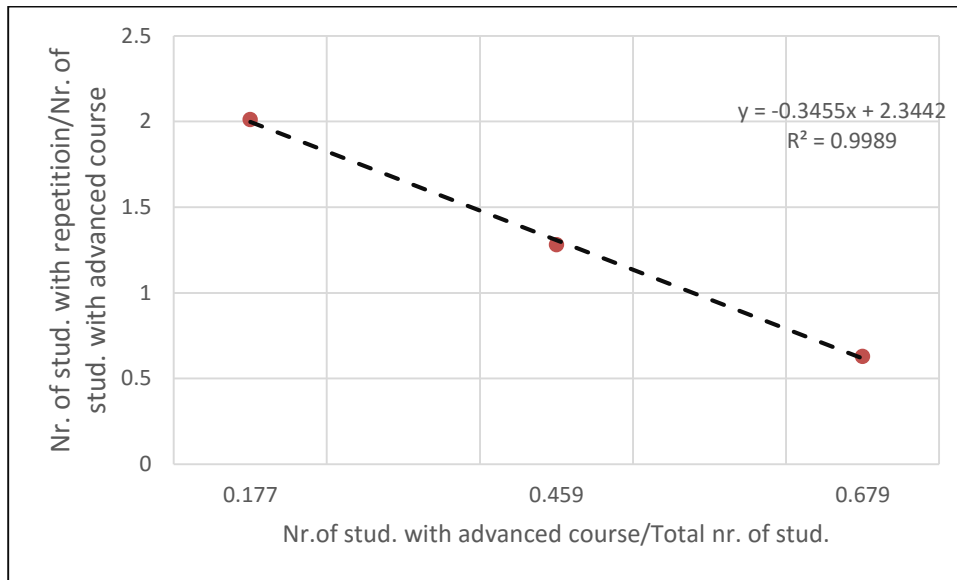


Fig.4 Influence of advanced course rate into course content repetition rate

Figure 5 shows the dependence of the student pass rate, in function of the variable x, while Figure 6 represents the change of the average grade of the university core course, with the corresponding in secondary education.

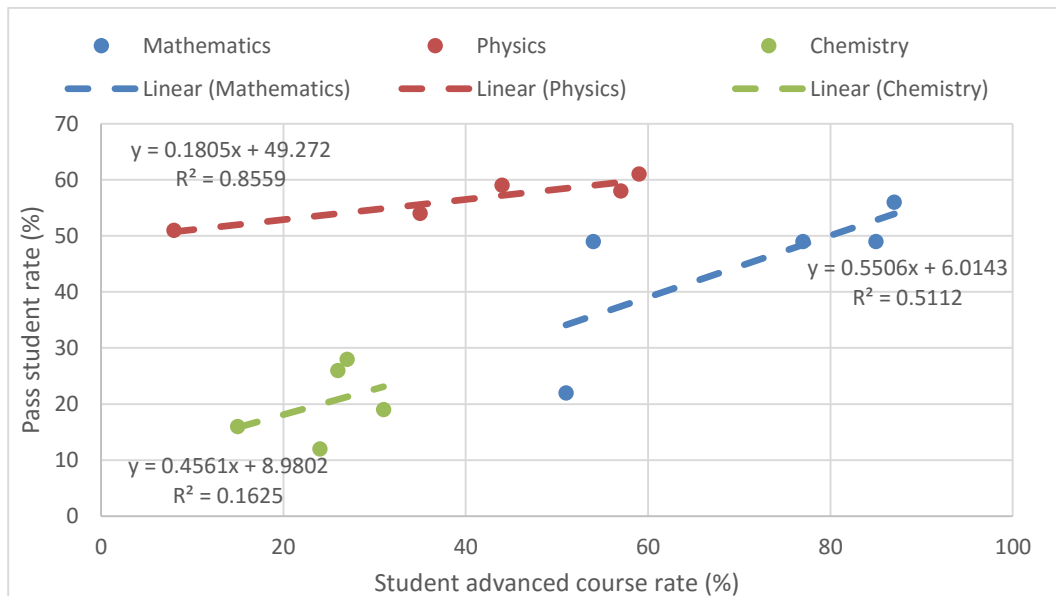


Fig.5 The trends of students pass rate

Increasing of the curriculum alignment rate would positively affect student success. Referring to the student pass rate, the equations of which of these three course, are presented in Figure 5, it is found that the potential growth of the student pass rate for each course and different study programs, calculated by trend equations, is given in Table 2.

Table2. Interval of changes for potential student pass rate in different course

Nr	Advanced core course	The potential of student pass rate (%)		
		Absolute (ref. x=100%)	The change	
			Max	Min
1	Mathematics	61.07	27	7.206
2	Physics	67.272	6.27	16.27
3	Chemistry	36.63	20.81	13.51

There is also the range of change of student pass rate, for three core courses and different study programs.

Comparing the average grade between high school and university, there seems to be a significant decline. Referring to the results of the academic years, this decrease results respectively **1.67**, **2.02** and **2.18** points for Mathematics, Physics, Chemistry respectively.

On the other hand, by analyzing the relationship between the change of the average grade and the advanced course student rate, there is a strong linear relationship, as shown in Figure 5.

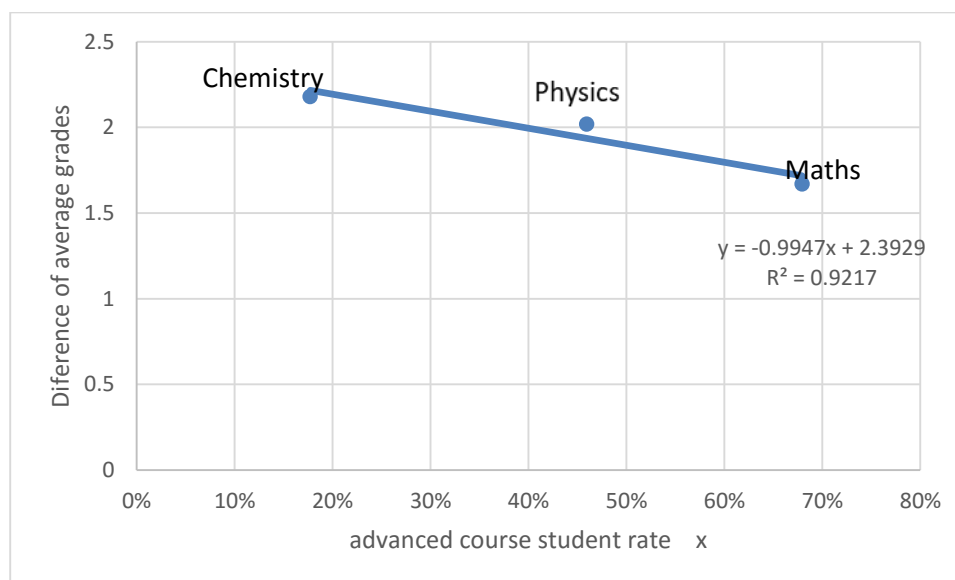


Fig.5 Results of average student grades into three courses between high school and engineering programs

Discussion

The results obtained show the influence of curriculum alignment between high school and university, expressed through advanced (elective) core courses rate, either in the student success and in the classroom teaching.

Keeping in mind the purpose of this article, we are evaluating quantitatively the weight of the three core courses which influence on the student success. Through the answers to the relevant question, the impact of high school quality is estimated "low" at average 15% (12-18%) according to the study program. This means that efficiency in high school programs can be improved to this extent.

Referring to the insufficient work, the students answers "Yes" are averaged in 20%, thus expressing their readiness for a higher success.

Meanwhile 47% of students answered "Yes" to the influence of many factors, referring primarily to curriculum alignment and the environment; the influence of the economic factor has already been exhausted.

Regarding to the high quality level of the University, students responded positively to the rate of 7%, which means that the level of core courses developed at the university didn't deepen the gap that exists between secondary and postsecondary education.

Knowing this situation has allowed to pass into the next step, which means the quantitative assessment of the curriculum alignment influence on teaching and student success.

This influence was initially considered in classroom teaching. The lecturer of the first year university course, having students with different academic background, is "forced" to increase the rate of repetition on various issues. In essence, this is a reduction in the level of quality of the content of the course. Due to this misalignment, the lecturer of each core course is under the simultaneous pressure of two students groups, while he has to deal with all the scheduled issues of the respective course syllabus.

So, the lower the rate of students who have a curriculum alignment between high school and university, the greater the difficulty and repetition rate. These linear relationship serve for the quantitative assessment of the curriculum alignment influence on the student's difficulty and the repetition rate, found in each of the three core courses considered. Looking at the angular coefficients of the graphical representations of these two equations, it can be ascertained where this greatest influence is. Thus, by comparing the angular coefficients respectively **0.592** and **0.354**, it results that the greatest influence is on the student difficulty rate.

The mentioned factor, along with others, has influenced student success also.

Therefore, the trend of student pass rate change has been analyzed in function of x . For all three core courses examined above, an increasing trend is found. Although the highest values of x are in mathematics, again the potential for increasing student success has the expectation of being achieved in this course.

The low values of x and the student pass rate in Chemistry, are the reason that the expectations of the growth of the student pass rate remains high, ranking after mathematics'. The trend for Physics results in a stronger relationship, due to the content of this course.

Referring to the indicator of the average grade, the comparison between high school course and respective's in university, shows a difference of **1.67÷2.18**, in the engineering programs considered. Analyzing this difference, it is found that its distribution in study programs is random.

The analysis of the results given in Figure 5 and in Table 2, shows the potential of improving the student pass rate for each of the courses taken into consideration. The calculations are made for the study program within the change range of the student advanced course rate. In this way HEIs have the opportunity to quantitatively assess the influence on the student pass rate caused by improving the curriculum alignment between high school and university.

The same analysis is done for the other indicator of student success evaluation, which is average grade. A linear relationship with the angular coefficient **-0.9947** was also found for this indicator. This analysis shows that improving curriculum alignment will reduce the change in student grade between secondary and postsecondary education for three core courses.

The next step to be undertaken, would be a comparative analysis of the student's progress in terms of learning outcomes between high school and university.

Conclusions

1. HEIs, being interested in the success of first year students, should improve their admission strategies, as well as pay more attention to core curriculum alignment, expressed in academic admission criteria. HEIs take into account the influence of curriculum alignment on student success both in the first year and throughout his or her academic career.
2. The core curriculum alignment have also influence in teaching methods in respective university courses. This influence is different in terms of difficulty and repetition level in engineering core courses.
3. There are linear trends between the difficulty and repetition rate depend on the student advanced core course rate. The angle coefficients are -0.592 and -0.355, respectively.
4. Although the influence on student success is different, the upward trend is found in each of the core courses. This means that increasing the students rate who have core curriculum alignment between high school and engineering programs, will lead to increase the student success assessed by the pass rate.
5. The greatest influence on student pass rate is found in Mathematics, versus Physics and Chemistry. The angular coefficients that express linear trends are 0.5506, 0.1805, 0.4561 respectively for Mathematics, Physics and Chemistry.

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