Mapping Factors that Impact on Motivation of Undergraduate Students in Software Engineering: A case study

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Abstract. *This paper presents a case study with the evaluation of factors that impact on the motivation of 112 undergraduate students in a Software Engineering program. Considering that motivation and engagement are key aspects of students' success, the goal of this paper is the identification of the factors that contribute to students' motivation and engagement. We applied a questionnaire which evaluates 48 motivational factors divided into 6 groups: personal and demographic data, general perception of motivation, perception about the university, student behavior, perception about program and perception about class/teacher. As results, after applying statistic tests, we found 15 factors with significant variance in the type of students' motivation, only 3 factors with variance in the approval rate, and 5 factors with variance in the overall grade average. We conclude that, for the sample used, the perception of student behavior is associated with his/her performance. The type of motivation is associated mainly with the perception about the program, classes, and faculty. The intention of dropout is mainly associated with the perception of the classes and faculty.*

1. Introduction

The high dropout and failure rates in undergraduate computing programs continues to be a challenge. A factor associated with the success and retention of students is their motivation. According to Entwistle (2003), motivation is one of the characteristics that influence how students learn and, according to Bruinsma (2004), motivation is important in academic performance. One reason for the withdrawal of students is the low motivation for studies, which in turn may influence the learning results (KORI, PEDASTE, *et al.*, 2016).

According to Ryan and Deci (2000), "to be motivated means to be moved to do something. A person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated toward an end is considered motivated". The most basic distinction is between intrinsic motivation, which refers to doing something because it is inherently interesting or enjoyable, and extrinsic motivation, which

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refers to doing something because it leads to a separable outcome. On the other hand, there is amotivation, which is the state of lacking an intention to act. When amotivated, a person's behavior lacks intentionality and a sense of personal causation (RYAN e DECI, 2000).

Entwisttle (2003) summarizes some of the main conclusions of research on motivation and learning in higher education: i) describes the amount of effort put in an activity and its goal; ii) has some consistency but can also change; iii) affect but is also affected by performance; and iv) its current form and level is a reaction to circumstances but is also dependent on the past personal history, and habits of thought and studying of that person.

There are several reasons that can be considered as factors for motivation and consequently generate this high rate of failure, including specific factors in the field, among which the difficulty of students with computer programming (NIITSOO, PAALES, *et al.*, 2014) (BERGIN and REILLY, 2005) and the lack of familiarity of students with the subject (CARTER, 2006). Another factor addressed by some studies is that many novice students relate STEM (Science, Technology, Engineering, and Math) courses as being interdisciplinary and innovative. However, this view is often not confirmed by the first experiences in the university, bringing disappointment and doubts (PETERS and PEARS, 2013).

In this context, are these the only factors that impact the success of students? According to Sinclair et al. (2015), more qualitative data are required and other measures – such as student expectation – are necessary for the broad understanding of the experience of the computer science student.

This paper aims to evaluate the impact of motivational factors on the performance and motivation of Software Engineering students, to understand what keeps students motivated and engaged with the course, possibly increasing the performance and approval rate. In order to achieve this goal, the following seven research questions have been developed: RQ1 – Are personal data (gender, age) and way of entering in the program related to motivation and performance? RQ2 – Are motivation factors related to the students' satisfaction and intent to continue studies? RQ3 - Is the perception about university related to the motivation and performance of the students? RQ4 – Is the perception of the student's behavior in the studies (engagement) related to the motivation and performance? RQ5 - Is the perception about the program related to the motivation and performance of the students? RQ6 - Is the perception about classes and faculty related to the motivation and performance of the students? and RQ7 – Are students' performance and performance perceptions related to motivation?

2. Related Works

Until 2018, no revisions were found on the topic of motivation or engagement of students in computing. Systematic reviews were found about motivation in software engineering but focused on professionals outside the academy (BEECHAM, BADDOO, *et al.*, 2007) (FRANÇA, GOUVEIA, *et al.*, 2011). Others similar works can be categorized into three main groups: i) motivation of students for their program or some computer-related courses (JENKINS and DAVY, 2002) (SHELL e SOH, 2015) (SINCLAIR, BUTLER, *et al.*, 2015) (MARTIN, 2015); ii) motivation of students from other programs for courses related to programming (YACOB and SAMAN, 2012) (NOOR, HARUN and ARIS, 2014) (KURKOVSKY, 2006); and iii) motivational analysis for different approaches/styles of teaching-learning in computing (DEBDI, PAREDES-VELASCO e VELÁZQUEZ-ITURBIDE, 2014) (NAVARRO and VAN DER HOEK, 2009) (SERRANO-CÁMARA, PAREDES-VELASCO, *et al.*, 2013).

Additionally, there are many studies concerning the motivation of computing students. Most of them propose or report the use of new educational approaches and tools. However, when the issues and factors that influence motivation and engagement are investigated, few studies converge or use categories that may be followed by other researchers, hindering the

dissemination and replication of those studies. The differential of this work is the measurement of several factors reported in other works in the literature, focusing on factors that affect the motivation of students in the program, as a whole, not specifically in a course or activity.

3. Research Method

The proposed study is based on a survey to 112 students of the bachelor program on software engineering at University of Santa Catarina State (UDESC). This program offers only evening classes. The development and implementation of this survey were based on the process described by Kasunic (2005). The questionnaires were applied in the period from November 27th to December 1st, 2017, from first-year students to graduates, reaching 112 replies. This shows that 54.1% of the students regularly enrolled in the program answered the questionnaire.

We worked out a questionnaire[1] with 48 items divided into six groups: personal and demographic data, general perception of motivation, perception about the university, student behavior/engagement, perception about the program, and perception about class and teacher (Table 1). Each item has options following a Likert scale of 4 points (SA – strongly agree, A - agree, D - disagree, SD – strongly disagree).

Table 1: Group and factors of questionnaire

Group	Factor	
1. Personal and demographic data	1A – Gender 1B – Quota [2] 1C – Entrance exam position [3]	1D – Age 1E – Way of entering
2. General perception of motivation	2A – General level of satisfaction about the program 2B – Reasons to continue studies 2C – Level of intention to continue studies	2D – Reasons to dropout 2E – Self-efficacy
3. Perception about University	3A – Adequate student support 3B – Adequate learning resources 3C – Adequate LMS (learning management system)	3D – Level of satisfaction of faculty 3E – Graduation and qualification of faculty
4. Student behavior	4A – Feeling of being prepared for the study 4B – Interaction with students outside of the academic environment 4C – Sense of belonging to the University 4D – Interaction with different students 4E – Participation in discussions with students and teachers 4F – Group work with other students	4G – Attendance 4H – Commitment to activities and deadlines 4I – Studying in the correct way and proper time managing for activities 4J – Trying to do more than requested 4k – Doing the best to stand out in the class
5. Perception about program	5A – Installations of industrial importance and updated 5B – Alignment with the job market 5C – Appropriate type of program and courses (focus of course in computing, schedules, etc.) 5D – Appropriate curriculum (syllabus) and program of courses (contents)	5E – Ease of insertion in the labor market and prospects for the future 5F – Balance between areas of knowledge allowing a systemic vision 5G – Proper teaching quality
6. Perception about course and professor	6A – Active learning 6B – Fun 6C – Challenges 6D – Peer learning 6E – Diversity of pedagogical approaches 6F – Team spirit 6G – Practice outside the classroom 6H – Utility and future application of the contents	6I – Participation of the student in decision making 6J – Reward to the effort 6K – Information provided 6L – Adequate difficulty level 6M - Clarity in the goals of the course 6N – Students with difficulty are not exposed 6O - Gender distribution of faculty

The focus of questionnaire is educational issues, it does not include familiar, professional, and other personal factors. Our goal is to know what the university, faculty, and coordinator can do in the educational context to improve the student motivation and retention.

Groups 3, 4, and 5 of the questionnaire were based on a compilation of factors extracted from the literature. Group 2 is a light motivation scale adapted from Vallerand

[1] The questionnaire is available online on https://goo.gl/TRUrEh

[2] In Brazilian public universities, there are some reserved vacancies to specific social and ethnic groups, called “quota”.

[3] The university fills the program vacancies accordingly to the candidates' admittance grade

(1992), and Jenkins and Davy (2002), to identify motivation to studies containing 11 items[1] divided into: intrinsic factors, extrinsic factors, and amotivation. We also created a classification to decide the type of motivation, according to the following rules: i) only items related to amotivation = TOTALLY DEMOTIVATED (TD); ii) items related to amotivation and others = PARTIALLY DEMOTIVATED (PD); iii) most of the items related to intrinsic motivation = INTRINSICALLY MOTIVATED (IM); iv) most of the items related to extrinsic motivation = EXTRINSICALLY MOTIVATED (EM); and v) the same number of items related to intrinsic and extrinsic motivation = INTRISICALLY/EXTRINSICALLY MOTIVATED (IEM).

To measure and evaluate the performance of students, we define two variables: i) general grade average: arithmetic mean of the final grades of each course completed, including the failed ones; ii) approval rate: percentage of courses successfully completed in relation to the total of courses attended. For statistical analysis, we used: comparison of means of independent samples (student's t-test), comparison of means for different levels of one factor (ANOVA – one way), qualitative data correlation (Spearman's coefficient) and quantitative data correlation (Pearson's coefficient and Pearson's chi-square test). The reliability of the questionnaire is measured by Cronbach's alpha coefficient, which measures the internal consistency.

4. Results

The Cronbach's alpha coefficient of the questionnaire used was 0.862 and can be considered reliable. As the identification and filling of personal data were not mandatory, some students chose not to identify themselves or not to inform all personal data. Due to this, the analysis of the student's performance considers only 82 of the 112 students.

Of the respondents, 64% work full-time during the day, 11% work partial-time as a scholarship student, 74% are male, 10% female and 16% have not informed. Most respondents entered via the university exam (Vestibular) (78.6%) and national high school exam (ENEM) (13.4%). The average age of respondents is 21.55 years old, although more than half (50.9%) is 20 years old or less. Just over half (50.9%) entered in the first call and 26.8% are quota students, primarily by public school quota (25.9%).

Table 2: Results by demographic data

	Gender	Entry	Age	Exam position	Quota
General satisfaction	0.703 [a]	0.324 [a]	0.697 [b]	0.892 [a]	0.052 [a]
Motivation to continue	0.396 [a]	0.341 [a]	0.514 [b]	0.617 [a]	0.408 [a]
Average grade	0.811 [b]	0.814 [b]	0.118 [c]	**0.002** [b]	0.842 [b]
Approval rate	0.538 [b]	0.960 [b]	0.128 [c]	**0.002** [b]	0.158 [b]
Type of motivation	0.556 [a]	0.624 [a]	0.088 [b]	0.1445 [a]	0.360 [a]

[a] Pearson's chi-square test / [b] ANOVA one way / [c] Spearman's coefficient

Table 3: Results by entrance exam position

Exam position [a]	General Average			Approval rate		
	Avg.	*SD*	*Qty*	*Avg.*	*SD*	*Qty*
1	7.855	0.939	47	0.952	0.080	47
2	6.711	1.685	18	0.854	0.179	18
Other	6.660	1.670	10	0.850	0.118	10
NA	6.786	1.220	7	0.817	0.152	7

[a] ANOVA one way

In order to answer the first research question (RQ1), we analyzed the correlation between the demographic data (gender, age), student entrance data (way of entering, quota and entrance exam position), motivation, and motivation factors (Table 2). We verified that only the entrance exam position was related to the average grade and approval rate, and no variable had significant variance according to the type of motivation. We identified that first-call students have better performances, as shown in Table 3.

We analyzed the correlation between the overall grade average, success rate index and the type of students' motivation. We did not find significant correlation of motivation with

grade average (p = 0.94) and approval rate (p = 0.58). The only strong correlation found was between the success rate and the overall average (Spearman's coefficient, r = 0.884).

Considering the motivation to continue studies, 55% of students never thought of dropout, 40.5% already thought or still think of dropping out, but intend to continue and 4.5% seriously think about giving up. We identified a variance in the type of motivation, according to the intention to dropout (p = 0.041). Students intrinsically motivated have a lower level of intention to dropout, following by extrinsically motivated and demotivated (Table 4).

Table 4: Motivation related to the intention to dropout

	IM	EM	IEM	PD	TD	Pearson	Fisher
No	35	14	4	8	0	**0.0481**	**0.0417**
Yes	25	10	1	9	6		

[a] IM – intrinsic motivated, EM – extrinsic motivated, IEM – intrinsic/extrinsic motivated, PD – partially demotivated, TD – totally demotivated

About possible reasons to dropout the program, 48.2% of students have no reason, because they do not think about dropout, 17% indicated the difficulty in reconciling studies and work, 15.2% informed that the distaste for programming can be a reason for quitting, 9.8% the lack of affinity with the course, 4.5% the difficulty in mathematics, in addition to 13.4% that reported other reasons.

Students who have no reason to dropout are more intrinsically motivated and less demotivated. The main reasons why students continue in the program are the search for knowledge (64.3%), taste for the field (64.3%), and achieving good positioning in the job market (46.4%). These results show that the main motivation to continue the studies is intrinsic, related to the attraction by the field, but extrinsic motivation related to the job market is also another important factor.

We identified 7 factors that impact on the intention of dropout: i) sense of belonging to the university (p = 0.0029); ii) balance between areas of knowledge allowing systemic vision (p = 0.0453); iii) fun (enjoyable activities) (p = 0.0191); iv) academic challenges (activities that promote reflection, creation of strategies, etc.) (p = 0.0454); v) peer learning (exchange of knowledge with colleagues) (p = 0.0213); vi) promotion of team spirit (class union, group activities, collaboration) (p = 0.04268); and vii) usefulness and future application of the content learned (p = 0.0029). Students that evaluated negatively these factors have a higher level of intention to dropout.

4.2. University-related factors

Regarding the university environment, and the RQ3 question, we evaluated the variance of the grade average, approval rate and students' type of motivation, according to the perception of the factors related to the university environment.

Table 5. Results of perception about the university

	General average		Approval rate		Type of motivation	
Question	***F value***	***Pr(>F)***	***F value***	***Pr(>F)***	***X Square***	***Pr(>F)***
3A – Adequate student support	0.255	0.775	1.458	0.237	7.517	0.351
3B – Adequate learning resources	0.122	0.947	0.243	0.866	40.238	**0.001**
3C – Adequate LMS (learning management system)	2.121	0.086	2.803	**0.031**	16.947	0.656
3D – Level of satisfaction of faculty	0.335	0.716	0.352	0.704	9.8767	0.873
3E – Graduation and qualification of faculty	2.023	0.118	2.314	0.082	32.722	**0.036**

We found three significant variances, as shown in Table 5: i) approval rate according to perception of LMS support (3C); ii) type of motivation according to the perception of adequate learning resources (3B); and iii) type of motivation according to the perception of qualification of faculty (3E). The students who have negatively evaluated their learning/infrastructure resources are more often demotivated, but students who have positively

evaluated the qualification of faculty have a lower intrinsic motivation and a higher rate of demotivation. The students who have evaluated the virtual environment very positively, have lower approval rate. We suppose that unmotivated students blame the bad infrastructure of the university for their failure and motivated students are more criticist about the teacher and the learning process.

4.3. Factors related to student behavior

Students were questioned about their academic performance. About 60% of students indicate good performance and expect to complete the program without problems. As expected, students with a better perception of performance have a higher grade average ($p = 0.00224$). The approval rate factor had the similar behavior, but the statistic confidence was lower ($p = 0.0596$). We found no significant variance of motivation type according to the perception of performance ($p = 0.454$).

We found significant variance in the overall grade average for 5 factors, as shown in Table 6: i) feel prepared for the studies (4A); ii) often work in a group with other students (4F); iii) attendance in class (4G); iv) commit the activities and deadlines (4H); and v) do the best to stand out in class (4K).

Table 6. Results of factors related to student engagement

	Grade average		Approval Rate		Type of motivation	
Item	*F value*	*Pr(>F)*	*F value*	*Pr(>F)*	*X square*	*p-value*
4A – Feeling of being prepared for the study	3.231	**0.045**	2.709	0.073	7.8008	0.801
4B – Interaction with students outside of the academic environment	1.729	0.168	0.863	0.464	33.092	**0.007**
4C – Sense of belonging to the University	0.459	0.765	1.093	0.366	52.458	**0.000**
4D – Interaction with different students	0.767	0.516	0.714	0.546	12.961	0.879
4E – Participation in discussions with students and teachers	0.52	0.721	0.624	0.647	11.356	0.936
4F – Group work with other students	3.017	**0.035**	3.531	**0.019**	17.474	0.356
4G – Attendance	2.299	0.066	1.272	0.288	17.555	0.617
4H – Commitment to activities and deadlines	5.212	**0.003**	1.578	0.201	9.066	0.697
4I – Studying in the correct way and proper time managing	1.771	0.143	1.433	0.231	14.998	0.777
4J – Trying to do more than requested	1.785	0.157	1.269	0.291	11.071	0.805
4k – Doing the best to stand out in the class	3.047	**0.034**	1.272	0.290	10.325	0.849

Students who agree with item "work often in group with other students" (4F) have better grades. In addition, only 2 factors were related to the variance of motivation type: i) interact with students outside the academic environment (4B); ii) sense of belonging to the university (4C). For example, we identified that partially or totally demotivated students evaluated more negatively the "sense of belonging to the university" factor.

4.4. Program-related factors

We observed a low number of students who strongly agree with the program-related factors, showing that even in positively evaluated aspects (AGREE), students believe they need improvement.

Table 7 Program-related factors

	General grade average		Success rate		Type of motivation	
Item	*F value*	*Pr(>F)*	*F value*	*Pr(>F)*	*X-square*	*p-value*
5A – Installations of industrial importance and updated	0.620	0.649	1.356	0.257	36.748	**0.002**
5B – Alignment with the job market	0.196	0.899	0.393	0.758	31.052	**0.001**
5C – Appropriate type of program and courses (focus of course in computing, schedules, etc.)	0.252	0.908	0.257	0.905	47.710	**0.000**
5D – Appropriate curriculum (syllabus) and program of courses (contents)	0.603	0.615	1.452	0.234	45.448	**0.000**
5E – Ease of insertion in the labor market and prospects for the future	1.148	0.341	1.823	0.133	26.167	**0.052**
5F – Balance between areas of knowledge allowing a systemic vision	0.694	0.598	0.849	0.499	65.991	**0.000**
5G – Proper teaching quality	0.389	0.816	1.513	0.207	20.323	0.206

Regarding the RQ5 question, we verified that there was significant variance in the type of motivation for all items except for the item related to the quality of teaching offered, and we found no significant variance for the general grade average and success rate (Table 7).

4.5. Factors related to classes and faculty

Regarding the factors related to faculty, didactics, teaching strategies, evaluation, among others, intrinsically and extrinsically motivated students have evaluated more positively than demotivated students, in all program-related factors. Analyzing the RQ6 question, we observed that, in general, the factors related to the courses and faculty are related to the type of motivation, as shown in Table 8.

Table 8. Factors related to classes and teachers

	Grade average		Approval rate		Type of motivation	
Item	*F value*	*Pr(>F)*	*F value*	*Pr(>F)*	*X square*	*p-value*
6A – Active learning	1.402	0.248	0.807	0.493	13.215	0.3536
6B – Fun	1.377	0.256	3.568	**0.018**	37.157	**0.0002**
6C – Academic Challenges	0.566	0.639	1.263	0.293	55.951	**0.0000**
6D – Peer learning	0.71	0.549	2.455	0.069	23.59	**0.0231**
6E – Diversity of pedagogical approaches	0.202	0.936	0.452	0.771	13.618	0.6271
6F – Team spirit	0.104	0.981	0.347	0.845	12.337	0.7205
6G – Practice outside the classroom	0.477	0.753	0.787	0.537	20.438	0.2012
6H – Utility and future application of the contents	0.203	0.936	0.113	0.978	68.010	**0.0000**
6I – Participation of the student in decision taking	0.348	0.844	0.66	0.622	18.812	0.2785
6J – Reward to effort	0.707	0.590	0.676	0.611	27.580	**0.0355**
6K – Information provided	0.243	0.866	0.475	0.701	15.842	0.1986
6L – Adequate difficulty level	0.372	0.828	0.149	0.963	18.286	0.3074
6M – Clear and defined goals of the course	0.645	0.632	0.916	0.459	31.904	**0.0103**
6N – Students with difficulty are not exposed	0.515	0.673	0.675	0.57	7.0252	0.9728
6O - Gender distribution of faculty	0.162	0.957	0.362	0.835	19.454	0.2458

We found no significant relation between the factors and the grade average. We found significant variance in the type of motivation for the following factors: i) fun (enjoyable activities) – 6B; ii) academic challenges (activities that promote reflection, creation of strategies, etc.) – 6C; iii) peer learning (exchange of knowledge with colleagues) – 6D; iv) usefulness and future application of the content learned – 6H; v) fair reward for students who are most dedicated – 6J; vi) clear goals allowing to realize whether the student is achieving satisfactory performance throughout the course/program – 6M.

In general, students classified as demotivated or partially demotivated have evaluated more negatively (disagree or totally disagree) the items related to classes and faculty, while students intrinsically motivated evaluated them more positively. Considering the approval rate, the only factor that had significant variance was “Fun”. Students who strongly agreed or strongly disagreed with the factor "fun" had lower approval rate.

5. Discussion and Conclusion

Regarding RQ1, we confirmed significant variance in the student's performance (average grade and approval rate) according to the entrance exam position. However, we found no significance in the other relations. This shows that the performance in the entrance exams is related to the student's performance at the university. Then, we suggest an effort to increase the number of enrollment of those candidates who passed in the first places..

Regarding RQ2, we realized that the intention to continue is mainly related to aspects of the teaching-learning process in the classroom and which therefore can be managed by the teachers. It is important to note that these are not necessarily the factors causing evasion, for example. But there is a different perception about these factors for students who have intent to evade and those who do not. We identified that students are more motivated if they perceive better the future utility and application of the subject and think that the courses goals are clear. Also, the use of some strategies to teach, such as fun activities, challenges, peer learning, and

rewards can improve the students' motivation and their success. To do that, we recommend using more active, dynamic, and experiential activities, gamification, and serious games, among others.

In relation to RQ3, we found significant variances in students' performance. In three university-related factors and the type of motivation according to the perception of the qualification of the faculty. Interestingly, intrinsically motivated students are more critical about teacher qualification. The infrastructure is a current problem in the studied university, but it has been evaluated in an equivalent way regardless of the level of motivation or performance of the students.

In relation to RQ4, we realized that the greatest number of performance-related factors is related to the behavior and engagement of the students. This may indicate that the lack of engagement impacts performance or that there is a perceived guilt of students with poor performance. However, the motivation of the students does not change because of this perception, and it can indicate that they continue with interest and other aspects could help them succeed.

With respect to RQ5, we verified that there was significant variance in the type of motivation for most items related to the program and found no significant variance for general grade average and success rate. Regarding the RQ6, we observe that, in general, the classes and faculty factors have relation with motivation but have no significant relation with grade average and success rate of the students. These results from RQ5 and RQ6 may indicate that students, regardless of performance, are motivated by interaction with the teacher and classmates in the classroom, didactics, and other aspects related to the teacher and classes, in addition to the characteristics of the program. In addition, these results may indicate that perceptions of teaching-learning aspects are similar among lower and higher performance students, or that these factors do not influence students' performance. In the context of this experiment, we think that the first option fits better. This may indicate a lack of student maturity to critically evaluate these aspects and the lack of diversity of teaching strategies used by the faculty, not allowing them to experiment with new approaches and hindering the evaluation by the students.

With respect to RQ7, as expected, students with better performance perceptions have higher overall grade average ($p = 0.00224$). The approval rate had the same behavior, but with lower significance statistic ($p = 0.0596$). With respect to the type of motivation ($p = 0.454$), we found no significant variance.

Although there are several factors that are related to the type of motivation, it is interesting to note that the type of motivation was not related to the grade average and the success rate of students. Partially and totally unmotivated students have higher approval rates. This may indicate that although there are factors that may impact on the reasons that lead the student to graduate (type of motivation), the type of motivation is not necessarily associated with the performance of students, unlike many studies in the literature (SOENENS and VANSTEENKISTE, 2005) (RYAN and DECI, 2000).

In the context studied, these results suggest that performance is not a decisive factor for the student to be motivated. We believe that performance is a consequence of motivation and not vice versa. In summary, we found 15 factors with significant variance in the type of motivation of the student (has adequate learning resources, sense of belonging to the university, qualification of faculty, alignment with the job market, access to facilities of industrial importance and relatively up-to-date, and suitable program and disciplines type, interaction with students outside the academic environment, adequate curricular matrix and courses contents, and existence of mechanisms to facilitate their insertion into the labor market and prospects for the future). We found only 3 factors with variance in the approval rate

(entrance exam position, fun, and LMS support) and 5 factors with variance in the overall grade average (entrance exam position, feel prepared for study, do the possible to stand out in the class, and commitment of activities and deadlines).We conclude that, for the sample used, the perception of student behavior (engagement) is associated with performance. The type of motivation is associated mainly with the perception about the program, and the perception about the classes and faculty. The intention of dropout is mainly associated with the perception of the classes and faculty.

These results show that the type of motivation does not impact on performance, but it can impact on the students' retention. The results also show that the factors related to the course and the process of teaching (didactic, teachers) are the most relevant to students. Through these results, we assume that the students' retention has a greater relationship with factors perceived throughout the program than with previous factors.

Based on the results obtained, we understand that in order to increase students' motivation, the classes should have more fun, have more practical aspects that promote more interaction and group work among students, and find a way to reward the students that are more dedicated. This can be accomplished through the diversification of teaching approaches, especially using gamification, experiential activities, problem-based learning, serious games, and other approaches to active learning.

In this sense, we understand that the concern with the didactic aspects, through the continued training of the teachers in pedagogical issues or the incentive to the development of innovative and active teaching strategies are very important to increase the retention of students in computing programs. Especially in countries where basic education is deficient, and students do not have as much discipline and autonomy to study, teaching strategies can make a difference for students to be motivated and be engaging in their activities and thereby increase retention and success in the computing courses and programs.

There are some threats to the validity of this research: i) the limited number of participants; ii) the limited context that includes only one program in one university; iii) other factors not considered in the study that may have impacted on the results; iv) the student self-assessment allows bias in responses according to the student's current state of mind. Therefore, it is important to conduct more and new studies to better evaluate the impact of these factors on students to confirm or not the results found in this study.

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