Factors associated with dropping out of the program for Bachelor's and Licentiate's Degrees in Mathematics Teaching at the Universidad Nacional de Costa Rica (UNA): Evidence from the 2016 Student Cohort

Factores relacionados con la deserción estudiantil en la cohorte 2016, de la carrera de Bachillerato y Licenciatura en la Enseñanza de la Matemática de la Universidad Nacional de Costa Rica (UNA)

Fatores relacionados à deserção estudantil na coorte 2016, da carreira de Bacharelado e Licenciatura no Ensino da Matemática da Universidade Nacional da Costa Rica (UNA)

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Abstract

This study addresses the problem of dropouts among students in the program for Bachelor's and Licentiate's Degrees in Mathematics Teaching of the Universidad Nacional de Costa Rica. It is intended to describe the 2016 cohort of students in the program, and identify factors associated with academic dropout through semi-structured telephone interviews conducted with dropouts. Among the variables considered for the descriptive analysis are the grades students obtained in their high school of origin, their admission exam scores, standardized scores, an index of social development, social class, sex, type of school financing, scholarship status, place of residence, and the number of credits for which a student enrolled and how many of them he or she earned. The investigation found that there are differences between dropouts and non-dropouts in terms of admission exam scores and the number of credits that students enrolled for and earned. In addition, dropping out is more frequent among women, students without a scholarship, and students from urban areas. Eleven dropouts were interviewed, and three of these cases were analyzed in detail; final results showed that vocational and economic factors, teaching methods, and unmet expectations of students about the program are the main factors associated with dropping out.

Keywords: dropout; mathematics teaching; academic performance

Resumen

El estudio abarca la problemática de la deserción universitaria en los estudiantes de la carrera de Bachillerato y Licenciatura en la Enseñanza de la Matemática de la Universidad Nacional de Costa Rica. Se pretende describir a la cohorte 2016 y determinar algunos factores asociados con la deserción, mediante la aplicación de entrevistas telefónicas semiestructuradas a los desertores. Se consideraron, para el análisis descriptivo, variables como la nota del colegio de procedencia, la nota del examen de admisión, la nota tipificada, el índice de desarrollo social, el estrato, el sexo, el tipo de financiamiento del colegio, la condición de beca, la zona de residencia, los créditos matriculados y aprobados. Como resultado de la investigación, se encontró que existen diferencias entre desertores y no desertores en las variables nota de admisión, créditos matriculados y aprobados. Además, la deserción afecta más a las mujeres, estudiantes no becados y de zonas urbanas. Se entrevistaron 11 desertores y se ilustraron tres de esos casos, en los cuales se logró determinar que los aspectos vocacionales, los económicos, los métodos de enseñanza y las expectativas no satisfechas hacia la carrera son los principales factores asociados con el abandono escolar.

Palabras claves: deserción; educación matemática; rendimiento académico

Resumo

O estudo abrange a problemática da deserção universitária nos estudantes da carreira de Bacharelato e Licenciatura no Ensino da Matemática da Universidade Nacional da Costa Rica. Pretende-se descrever a coorte 2016 e determinar alguns fatores associados à deserção, por meio de entrevistas telefônicas semiestruturadas com os desertores. Foram consideradas, para a análise descritiva, variáveis como a nota do colégio de procedência, a nota da prova de admissão, a nota tipificada, o índice de desenvolvimento social, o estrato, o sexo, o tipo de financiamento do colégio, a condição de bolsista, a zona de residência, os créditos matriculados e aprovados. Como resultado da pesquisa, descobriu-se que existem diferenças entre desertores e não desertores nas variáveis nota de admissão, créditos matriculados e aprovados. Além disso, a deserção afeta mais as mulheres, estudantes não bolsistas e de zonas urbanas. Foram entrevistados 11 desertores, sendo que três deles ilustraram esses casos, nos quais se conseguiu determinar que os aspectos de vocação, econômicos, os métodos de ensino e as expectativas não satisfeitas com relação à carreira são os principais fatores associados ao abandono escolar.

Palavras-chaves: deserção; educação matemática; rendimento acadêmico

The program for Bachelor's and Licentiate's Degrees in Mathematics Teaching at the Universidad Nacional (UNA), in its efforts to provide the country with competent professionals in the field of Mathematics, has undergone evaluation by the National Higher Education Accreditation System (SINAES) since 2005. Recognizing the constant improvements made to the program, training of faculty, infrastructure, and other factors related to the quality of education offered, the program has been and continues to be accredited by SINAES. This shows a continuous interest in maintaining academic and administrative standards to provide students with high-quality education.

As a part of this search for constant improvement, there is a strong interest in understanding the phenomenon of students dropping out of the program, and a recognition of the need to study this phenomenon in more detail, seeking to identify the factors

that may influence students' decisions to drop out or stay in the program. Identifying these factors would make it possible to take measures, either during the course of study or in the student selection process, to keep more students in the program and increase their possibilities of graduating.

The objectives of this study are, initially, to describe the 2016 cohort of students who started the program Bachelor's and Licentiate's Degrees in Mathematics Teaching program in terms of their socio-demographic and academic characteristics. Subsequently, other factors that may be related to students from the 2016 cohort dropping out of the program during their first semester of studies were identified through interviews with these dropouts.

Conceptual framework
Defining dropping out

The definition of the term "dropout" is complex, due to the number of factors which can affect it, and because a definition depends on the approach used. For instance, from an institutional perspective, dropping out is basically defined as leaving a particular educational center before completing the course of studies (Tinto, 1989). In the case of the university system, dropping out occurs when a student stops enrolling in courses in any institution of higher education (González & Espinoza, 2008).

For Himmel (2002), dropping out consists of the premature abandonment of a program of studies before obtaining a diploma or degree, followed by a period of time long enough to rule out the possibility of a student returning to continue studying. Perassi (2009) refers to dropping out in the sense of not completing the program of studies defined by the educational system.

Other definitions include that of Rodríguez & Hernández (2008), which consider student dropout to be dissolution of the relationship established through academic enrollment, for any reason, due to actions by either the student or the university. On the other hand, Mori (2012) defines dropping out in terms of a final or temporary suspension of studies, voluntary or involuntary, which has different modalities such as abandonment of a course of studies, leaving an institution, and leaving the higher education system.

If time is considered as the main variable, two types of dropping out can occur: partial or total. In cases of partial dropouts, those who stop enrolling in courses of a program of study for varying reasons later return to the institution. In cases of total dropout, students completely abandon their studies and do not enroll again (Paramo & Maya, 2012).

Tinto (1989) states that dropping out of universities is a highly complex phenomenon, which cannot be encompassed entirely in a single definition. Therefore, researchers should carefully choose the meaning of the term that best fits their interests and goals.

Consequently, for the present study and given the current conditions of the UNA, a dropout of the Bachelor's and Licentiate's Degrees in Mathematics Teaching program is defined as a student who, having entered the program of studies in the first semester of 2016, did not enroll in any course in the area of mathematics (with a MAB code) during the second semester of 2016.

This definition pertains to early dropouts, since this study focuses on determining the magnitude of this phenomenon during the first year of studies in the program. In addition, the information for this study was collected during the second semester of 2016,

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and students that dropped out in subsequent periods were not taken into account.

Factors associated with dropping out

Given the complexity of the phenomenon, a decision to drop out is influenced by many variables. According to González & Espinoza (2008), among the characteristics found in dropouts are: poor performance in courses or deficiency in studies changing programs of study because they could not gain admission to the program that they wanted; uncertainty about the institution; working while studying, including the conditions under which they work; high academic loads; lack of financial assistance from the institution; wrong beliefs about their careers; the teaching methodologies used, and dissatisfaction with the career.

In the case of beliefs about the career chosen, university professors' experiences indicate that if these beliefs are not in agreement with reality and the students' initial expectations, students can be disappointed with their vocational choice and abandon their studies. On the other hand, certain factors influencing dropping out are more related to the students' economic context, such as obtaining a scholarship or financial support from other institutions or relatives. If this support is not obtained, the student may have to work while studying, which can also affect the decision to drop out.

In his interaction model, Tinto (1993) states that permanence of a student in a program or institution is based both on academic and social interaction, making it important to identify and analyze students' family and socioeconomic characteristics, as well as those related to previous and individual knowledge, to determine their level of commitment to completing their higher education.

Other authors such as Paramo & Maya (2012) mention that among the factors considered in their study that can influence dropping out are low academic performance, disciplinary problems, the fact that parents are not interested in the education of their children, legal problems, low socioeconomic level, health-related problems, low classroom attendance, age-related conflicts, bad interpersonal relationships, violent family environments, lack of motivation about the program of studies or university, and resistance to education.

Likewise, authors such as Gardner, Dussán & Montoya (2016) and González & Espinoza (2008) classify important factors as follows: **personal factors**, such as lack of motivation on the part of the student, students' career expectations, motivation and family support; **academic factors**, related to previous knowledge, lack of student discipline, poor academic performance and the methodologies implemented in classes; **economic factors**, which are associated with the availability of material resources and financial problems with staying in school; and **institutional factors**, associated with the quality of education, schedules, and infrastructure offered by an educational institution.

In addition, dropping out and its possible causes have been studied at different levels of the educational system, from primary school to tertiary education. Some of the most important factors mentioned in investigations about dropping out of universities are summarized below.

Studies on dropping out of higher education

One of the first studies on dropping out is the one carried out by Spady (1970), who analyzed the phenomenon of dropping

out based on Durkheim's model of suicide (1951), in which he presents an analogy indicating that dropping out is the result of a lack of integration of students into the university system.

In a related study, Tinto (1975) claims that the decision to drop out seems to have its origin in a lack of personal integration with the intellectual and social environment of the institution the student is attending, and later mentions the important role of social and academic interaction in determining student permanence in higher education (Tinto 1997).

On the other hand, Donoso & Schiefelbein (2007) analyze dropout from a more economic perspective, in which students value the social and economic benefits generated by university studies, and, if these are perceived to be lower than those derived from alternative activities (for example, a salary when a person gets a job), the students decide to drop out of school.

In addition to the above, some investigations emphasize the moment at which dropping out takes place. Authors such as Giovagnoli (2001), Yengle (2015), Huesca & Castaño (2007), among others, agree that the dropout rate is higher during the first semesters of university education. It is therefore precisely in this period when it is necessary to take measures to reduce dropout rates.

In the case of the Costa Rican public higher educational system, authors such as Abarca & Sánchez (2005) have explored the issue of dropouts using a combined approach at the Universidad de Costa Rica (UCR), analyzing cohorts from 1993 to 1995. Among their findings are that there is a high dropout rate of students from night schools, and that dropouts may be pursuing programs of study which they do not like.

Likewise, Castillo (2008), in his study on dropout rates at the Universidad Estatal a Distancia, mentions that factors such as gender (with dropout rates being lower among women) and having a partner have an effect on dropping out. His study also indicates that dropout rates increase depending on the number of courses which a student enrolls in and on his or her age.

At the Universidad Nacional, two studies on the problem of dropping out of the Bachelor's and Licentiate's Degrees in Mathematics Teaching program stand out. The first is by Chaves (2003), which studies dropping out and permanence in the program of study in cohorts from 1995 to 1998. The study found that 60.4% of the population dropped out, and that men entered and dropped out proportionately more often than their female counterparts.

Pascua-Cantero (2016) analyzed cohorts at the Universidad Nacional from 2007 to 2009 during the first two years of studies, using a combined approach. She found that the dropout rate of new students in the analyzed cohorts was 34.23%. In addition, analysis of semi-structured interviews conducted with dropouts found that among the factors that had an influence on social integration of students and their subsequent decision to drop out of university studies were: lack of preparation for mathematics courses, classroom environment, lack of flexibility in schedules, difficulties in understanding the subject in some courses, lack of educational integration, students' economic conditions, and misleading expectations about the program of study.

In short, as explained by Carvajal & Trejos (2016), who carried out a detailed review of 120 studies of dropping out, the phenomenon has common factors in many countries. Solutions to this problem must include defining the characteristics of dropouts, roles of teachers, and institutional

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retention strategies, as well as the creation of information systems. There is therefore a clear need to rethink the role of educational systems in the maintenance of social, economic and cultural structures.

Methodology

1. The 2016 cohort was analyzed, composed of 64 persons who entered the UNA and enrolled at least one course in the program for Bachelor's degrees and Licentiate's Degrees in Mathematics Teaching (with a MAB code) during the first semester. From this population, students with a "dropout" status were identified using the following criteria:

2. For the purposes of this study, a student is considered a dropout, if he or she enrolled in courses of the program for the Bachelor's and Licentiate's Degrees in Mathematics Teaching during the first semester of 2016, and did not enroll courses in the area of mathematics (with a MAB code) during the second semester of 2016.

3. The reason for using this criterion is that courses with a MAB code are delivered by professors appointed by the School of Mathematics, and have a high mathematical content. It is assumed that if a student does not enroll in these courses, he or she may drop out of the program during the year of admission. Courses in the pedagogical component of the program and so-called service courses such as English, General Studies or optional courses are not considered, since a student may decide to drop out of the program, but continue enrolling in these courses, since they could be useful in other programs of study.

Instruments and data collection techniques

The study is divided into two parts. The first is a descriptive statistical analysis of the main sociodemographic and academic variables of students who entered the program of study in 2016, and the second part presents the results of a series of semi-structured telephone interviews conducted with students identified as dropouts, to find out the reasons for their decisions. The information for this analysis was provided by the UNA Registry Department, and by the School of Mathematics, and includes variables such as a personal identification number, student's social development index (SDI), gender, stratum, scholarship status, grade average in the diversified cycle of secondary education (the last years of high school), admission type, type of school of origin (public, private or semi-private), weighted grade average for the first semester of 2016, the numbers of credits enrolled for and earned in the first semester of 2016, and area of student's origin (rural or urban).

There are three variables in the database provided by the Registry Department that need to be discussed in more detail: social development index (SDI), stratum, and standardized scores. The SDI is an indicator developed by the Ministry of National Planning and Public Policy of Costa Rica (MIDE-PLAN) at the level of districts or cantons, and its construction takes into account economic, electoral participation, health, and education factors (MIDEPLAN, 2013).

A district is a geographical area composed of neighborhoods, and the SDI, at this level, attempts to characterize the living conditions of its inhabitants, based on the aforementioned dimensions. The SDI scale ranges between 0 and 100, classifying the districts in

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zones of relative development; those with the greatest development obtain scores between 72.5 and 100. There are three other development levels: medium (between 58.0 and 72.4), low (between 43.9 and 57.9) and very low (between 0 and 43.8) (MIDEPLAN, 2013). The SDI could be determined at the level of the district where the student lives or attends school; for this investigation, the SDI for the district where the students lived was used.

On the other hand, the stratum and standardized scores are variables that arise directly from the UNA's admission process. A student who applies to the UNA competes for spaces available in the different programs of study based on an overall score which is a combination of the score obtained in the Academic Aptitude Test (AAT), better known as the admission exam, and whose weight is 60% of the overall score, while the remaining 40% is based on the student's average grade in the diversified cycle of secondary education (high school).

The AAT score goes through a stratification process, in which applicants are divided into three strata, according to the characteristics of their school of origin. Stratum 1 consists of students from private, semi-public, scientific, humanities, and foreign schools; stratum 2 is made up of students who graduated from the majority of public schools; while stratum 3 is made up of students with diplomas from other sources, including night schools, high school equivalency programs, distance learning and online programs, and Integrated Adult Education Centers (whose acronym in Spanish is CINDEAS) (UNA, 2009).

Through a technical standardization process, each student is then assigned a score, depending on the stratum to which he or she belongs (the "stratified score"), after which a standardized score is calculated.

The standardized score is obtained using the average and standard deviation of admission scores for all students enrolled to take the admission exam, in addition to the standardization by stratum (UNA, 2009). The standardized score increases the likelihood that the best students from lower strata can compete for available spaces offered by UNA, taking into account differences in educational opportunities that students have had during their secondary education.

For the interview process, attempts were made to locate all those students who dropped out during the first semester of 2016, through telephone calls. However, only 11 of the 20 dropouts were interviewed. During the telephone conversations, they were asked about the main reasons that motivated them to drop out of the program of study, as well as about other aspects related to their experience in the university during the time they attended classes.

In the case of the nine dropouts who were not interviewed, two of them were contacted, but work reasons prevented the interview from being conducted. Although three non-consecutive attempts were made to contact the other seven students, it was not possible to reach them because their phone numbers were no longer current, suspended or canceled. E-mails were also sent to these students, but no response was received from any of them.

The interviews conducted were semi-structured and the questionnaire developed by the UNA Registry Department as a measurement tool to obtain information about factors associated with dropping of the university was adapted for the purposes of the present study: some reaction questions that were considered important in the context of the Bachelor's and Licentiate's Degrees in Mathematics Teaching program were also included.

As a selection criterion for a subsequent in-depth analysis and description of several individual cases, a variety of associated factors was considered, including some mentioned by the 11 persons interviewed. Other characteristics such as scholarship status, sex, area of residence, stratum and school of origin were also taken into account. The three cases that were analyzed in detail were selected based on the evaluation of all these factors.

Results

Results of the interviews are summarized in three sections: a descriptive analysis of sociodemographic and academic variables of students in the 2016 cohort, classified as dropouts and non-dropouts; a section that describes in-depth interviews with three dropouts, and a final section in which the selected cases are analyzed together.

Description of the 2016 cohort

Table 1 shows the main characteristics of the 2016 cohort, using a classification that distinguishes between students that did and did not drop out. Dropouts represent 31.25% of the cohort.

Table 1 provides information about the student's entry profile to the Bachelor's and Licentiate's Degrees in Mathematics Teaching program for 2016. As can be seen, the cohort is mainly made up of students with the following characteristics: male, with a scholarship, coming from public schools (stratum 2), from urban areas and with a medium level of social development. The largest proportion of students that dropped out is characterized by, being women, without a scholarship, with a higher social development index, and residing in urban areas.

It is important to note that, although men's entry to the program is almost double that of women in percentage terms, dropping out is more frequent for females. A similar situation occurs in the case of scholarship status, since most of the students who entered the program of study have a scholarship, but the dropout rate of those without a scholarship is more than 18 percentage points higher than that of students who have some type of exemption from payment. It is also important to mention that only three of the 21 students from rural areas dropped out, which may be due to the fact that most of them lived in student residencies and had a scholarship.

In the case of academic variables, the largest differences between dropouts and non-dropouts were observed in the number of credits for courses students enrolled for, the number of credits they received, and the admission exam score, as can be seen in Table 2. Dropouts enroll for and receive less credits and obtain lower scores in the AAT, although no important differences were observed between dropouts and non-dropouts in their standardized scores, which ultimately determines whether students enter the program of study.

The values of other variables do not show substantial differences between groups; in particular, the similarity in the score of the high-school and SDI scores is obvious, although they might be considered differentiating characteristics between dropouts and non-dropouts.

Description of the cases

Below are three case studies based on the interviews conducted during the second semester of 2016 with students of the cohort who dropped out.

Table 1

UNA. Distribution of sociodemographic characteristics according to the enrollment status of the 2016 cohort of the program for Mathematics Teaching

	Dropped out		Did not drop out		Total	
	Absolute	Percent	Absolute	Percent	Absolute	Percent
Sex						
Female	8	36.36 %	14	63.64 %	22	100 %
Male	12	28.57 %	30	71.43 %	42	100 %
Stratum						
One	2	40.00 %	3	60.00 %	5	100 %
Two	16	29.63 %	38	70.37 %	54	100 %
Three	2	40.00 %	3	60.00 %	5	100 %
Scholarship status						
Without scholarship	8	44.44 %	10	55.56%	18	100 %
With scholarship	12	26.09 %	34	73.91 %	46	100 %
High school financing						
Private	2	50.00 %	2	50.00 %	4	100 %
Public	18	31.03 %	40	68.96 %	58	100 %
Subsidized	0	0.00 %	2	100.00 %	2	100 %
Area of origin						
Rural	3	14.29 %	18	85.71 %	21	100 %
Urban	17	39.53 %	26	60.46 %	43	100 %
SDI						
Highest level	7	35.00 %	13	65.00 %	20	100 %
Medium level	10	32.26 %	21	67.74 %	31	100 %
Low level	3	25.00 %	9	75.00 %	12	100 %
Very low level	0	0.00 %	1	100.00 %	1	100 %

Source: Prepared by the authors based on data from the UNA Registry Department.

Table 2

UNA. Distribution of academic variables and SDI, according to enrollment status. 2016 Cohort of students in the program for Mathematics Teaching.

Variable	Dropped out		Did not drop out		Absolute value of differences in averages
	Average	Standard deviation	Average	Standard deviation	
Number of courses taken	4.65	0.73	4.77	0.73	0.12
Credits for courses	12.9	6.35	16.89	2.72	**3.99**
Credits received	3.11	3.25	10.09	4.27	**6.98**
Admission exam[1]	639.69	75.82	645.79	68.00	**6.10**
High-school score	83.9	5.63	85.12	6.04	1.22
SDI Score	67.86	8.77	66.04	12.86	1.82
Standardized score	58.41	10.25	58.79	10.68	0.38

[1] The scale of the admission exam is 200 to 800, but the standardized score ranges from 200 to 900. The other scales have ranges of 0 to 100.
Source: Prepared by the authors based on data from the UNA Registry Department.

Case 1: This is an 18-year-old female, who came from a rural area, had a scholarship to pay for her studies, was a resident of an area with a medium level of development and belonged to stratum two. In addition, she had graduated from a public high school with a grade average of more than 90 points (on a scale of 0 to 100), had one of the best admission averages (standardized score) for the UNA in 2016, and her first program choice was the Bachelor's and Licentiate's Degrees in Mathematics Teaching program at the UNA.

Despite her good academic performance in secondary education, during the first semester of 2016 her weighted average in the UNA was lower than 3.70 (on a scale from 0 to 10). However, when carefully considering the grades she obtained in the courses enrolled, in particular Logic and Theory of Sets (considered for many years as one of the most difficult in the program), it was found that she obtained good grades both in the first partial exam and in the first short test, but strangely she did not show up to take the other course exams. In addition, of the 18 credits she enrolled for, she only earned three. This atypical behavior was one of the reasons for including her as a case for analysis to obtain in-depth information about the circumstances that led her to drop out of the program.

When asked about her decision, the student said: "... I didn't like it, I think the program is very stressful, it was not my thing; I wanted to change programs".

However, in the second semester of 2016, she continued to attend the UNA and enrolled in four courses of the General Studies Center, which showed her desire to continue studying – that is, she dropped out of the program but not from the institution.

Case 2: A 17-year-old male, from a private school in an urban area, without a scholarship, belonging to stratum one, with a good average grade in secondary education (higher than 88), and an admission score lower than the average for his entry cohort. In addition, his average in the courses of the mathematical component of the program during the first semester was poor; his average grade in these courses, on a scale of 0 to 10, was less than 1. He only earned six of the 17 credits he enrolled for and his weighted average during the semester was less than 4. In spite of this, he completed the first semester of 2016. His case is of interest due to the reasons he gave for his decision to drop out, among which was that the Bachelor's and Licentiate's Degrees in Mathematics Teaching program was not his first choice of study, and that its enrollees came from a segment of the student body with a high socioeconomic level and educational opportunities.

When asked about the reasons that led him to drop out, he stated that the main reason was: "I did not feel comfortable with some teachers, and I did not feel it was my vocation. Actually, I wanted to study medicine at the University of Costa Rica (UCR), and I wanted to practice for the admission exam for the UCR; I basically enrolled to practice." Other factors pointed out by the student were: lack of motivation, difficulties in learning, teaching methods, beginning to fail or getting bad grades, as well as his relationship with teachers.

In the interview, it was also found that during his time in school, he considered himself to be a good student in mathematics, and his parents had completed university studies.

Notwithstanding his dropout status, he mentioned that he might return to the program, depending on his results in the next

year's AAT, and he continues to enroll in courses at the UNA, although not related to the Bachelor's and Licentiate's Degrees in Mathematics Teaching program.

Case 3: An 18 year-old male who graduated from a public school in an urban area (stratum 2), whose mother has a high school diploma, although his father did not complete his secondary education, and comes from an area with a low level of relative development. With respect to academic factors, his high school score was slightly more than 75 on a scale of 0 to 100, and his admission exam score was slightly lower than the average for the cohort analyzed. However, he did not receive any grades for the first semester of 2016, because before the first evaluations for the mathematics courses started, he obtained permission for a justified withdrawal from the five courses he had enrolled in.

On the other hand, he considered himself to be a good student of mathematics during his time at school, which is why he chose the Bachelor's and Licentiate's Degrees in Mathematics Teaching program as his first academic option. He stated that "I had good mathematics teachers in the school, I identified with the university, and I liked the program." When asked why he dropped out, he commented: "I dropped out of the university for economic reasons; they didn't give me a scholarship and in my home there was barely enough money. I couldn't ask for money every week, and a lot of money was spent at the university." Other factors that he mentioned were: his lack of vocation, the teaching methods used, that he had started to work, lack of motivation, and lack of previous knowledge about the program. Although he had dropped out of the UNA, at the time of the interview he was getting ready to take the admission exam again and said that he

wanted to return to the UNA, but to study in a different area.

Analysis of the cases

As can be seen, while each of the cases discussed had particularities that clearly differentiated them in terms of the reasons leading these students to drop out, there were also similarities among the cases.

More specifically, the principal factors for dropping out included: unmet career expectations (case 1), pursuing an unattractive career (case 2), and economic problems (case 3). Common factors in these cases were teaching methods, lack of motivation, and poor academic performance at the end of the semester.

Analyzing case 1, the student was initially motivated to pursue the career, and in spite of performing well in the courses, experience with what it takes to devote oneself to the teaching of mathematics, the work necessary, and the demands of the courses ended up discouraging her, hindering her social and academic integration. Therefore, she chose to pursue another career.

On the other hand, this student did not fit most of the characteristics of dropouts described in Tables 1 and 2, except for being a female with an average relative level of development and having earned only a few credits. The other variables, such as residing in a rural area, having a scholarship, having an above-average AAT score, and being enrolled for many credits, are more in line with the characteristics of a non-dropout.

This shows that not all students of the 2016 cohort who dropped out fit a single profile, and that having good academic performance in exams does not always "protect" a student from dropping out; other factors are also important. Among these factors is that

of feeling comfortable with a career and with classmates, which in turn promotes good social interaction, according to Tinto (1997), and makes a significant difference when deciding whether or not to continue studying and complete the program of studies.

In case 2, initially the student wanted to pursue a career in medicine, enrolling in a program offered by another university, but when he was not admitted, he decided to enter the Bachelor's and Licentiate's Degrees in Mathematics Teaching program of the UNA, hoping that he could better prepare himself to take the entrance exam for the program in Medicine and request admission to that program the following year. Since Mathematics was not his first option and he did not have good relationships with the teaching staff, his lack of motivation is understandable. In addition, coming from a wealthy household, he did not need to work, and dropping out of the UNA program had no immediate impact for him, since he could decide to enroll in a private university, if necessary. Based on this finding, the School of Mathematics should consider the possibility of conducting interviews with applicants entering the Mathematics Teaching program to prevent this type of situation from happening in the future.

On the other hand, this student (as well as the student of case 3) has many of the characteristics of the students of the 2016 cohort who dropped out – he does not have a scholarship, he comes from an urban area, he has a below-average AAT score, and earned only a few credits in the courses he enrolled in. Therefore, cases 2 and 3 suggest that these factors should be taken into account when considering how to reduce dropout rates.

Unlike the previous case, in case 3 the economic factor is the main reason for dropping out of the program, since due to the fact that the student did not have a scholarship, he had to start working. The difference in economic levels is reflected in family data, since in one case the parents only have secondary or incomplete secondary education and, in the other, the parents have an education at the university level. This, together with dissatisfaction with teaching methods and lack of information about the career, led the student to drop out of the program.

It is not known why the UNA did not give the student a scholarship, but perhaps better management or guidance on the procedures and options for a scholarship could have made a difference in this case. As in case 2, the student considered himself a good mathematics student in high school and was motivated to enter the program, however, as in case 1, the discovery of what it takes to be a student in a mathematics teaching program and the commitment that this implies discouraged him. This makes it evident that it is not enough to consider oneself good in mathematics to be successful in the program, since it requires commitment and other characteristics beyond mathematical knowledge.

Discussion

The phenomenon of dropping out of the Bachelor's and Licentiate's Degrees in Mathematics Teaching program is not new, but in the literature there are only two studies that have addressed the subject in detail. Chaves (2003) carries out a descriptive investigation of the cohorts for the period between 1995 and 1998, and found that the dropout rate for the first year was 39.6%, mostly males, whose main reason for dropping out is low academic performance.

On the other hand, Pascua-Cantero (2016) carries out a combined investiga-

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tion for the 2007, 2008 and 2009 cohorts, in which she finds that the percentages of dropouts in the first year do not differ significantly from the study by Chaves (2003), and that men continue to have the highest dropout rate. Likewise, in her analysis, Pascua-Cantero (2016) includes interviews with dropouts, which allowed her to identify academic, individual and institutional factors, rather than socioeconomic factors, as most important in determining if a student will drop out. In addition, she found that students were uncomfortable with environment in which the classes are delivered, and the attitudes of teaching staff.

The relevance of the present study is that it provides recent information on the factors that affect dropout of the Bachelor's and Licentiate's Degrees in the Mathematics Teaching program of the UNA, based on both quantitative and qualitative variables which had not been included in previous studies, and that interviews were conducted with dropouts from a single cohort, shortly after they dropped out. In addition, it compares the characteristics of dropouts and non-dropouts of the cohort studied.

Based on the results obtained from descriptive data, the dropout percentage during the first semester was 31.25% and, in contrast to the results of the studies by Chaves (2003) and Pascua-Cantero (2016), it was found that that females dropped out proportionally more often, as well as students coming from urban areas who do not have a scholarship. It is necessary to carry out further research about these results, especially regarding the gender gap, because although most of the new students who enter the program are male, women are those who drop out most often.

The dropout rate for students who reside in urban areas and do not have a scho-larship is another result that should be studied in more detail, since many of the efforts and support of the School of Mathematics and the UNA have been directed towards students with a scholarship coming from rural areas.

With regard to academic factors, it was found that most of the students enroll in the regular block of five courses. It was also determined that the greatest differences between dropout and non-dropout students occur in the number of credits that the students enroll for, the AAT admission score, and the number of credits earned (see Table 2).

Therefore, with respect to the findings of previous research, this study makes its contribution on the subject of dropping out of the Bachelor's and Licentiate's Degrees in the Mathematics Teaching program of the UNA by including new factors in its quantitative analysis that may influence dropout rates, such as the SDI, the average high school grade, the number of credits enrolled for and earned, the AAT score, the stratum and the standardized score. The last three variables have been available since 2009, when the UNA redefined its admission process, using the AAT developed by the UCR along with the creation of the stratification system.

In the qualitative component of this study, conducting interviews with dropouts in the semester immediately after students dropped out, and applying an instrument used at the institutional level and adapted for the program permits a more contextualized and updated perspective on dropping out. In addition, interviews with dropouts revealed their reasons for dropping out of the program, permitting the identification of important factors such as unmet expectations, lack of vocation, economic problems, dissatisfaction with teaching methods, and lack of motivation.

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Likewise, the results of in-depth interviews showed that there is no single reason that leads students to drop out, although it should be noted that low levels of personal interaction with professors and other students were mentioned, which according to Tinto (1989) hinders social and academic integration in the program. Except for case 2, it was also observed that expectations about the program were not fully met and, in some cases, there was a perception that being a good math student in secondary education was sufficient to assure success in a mathematic teaching career.

Another relevant finding was the way in which cases 2 and 3 reflect many of the characteristics of dropouts, which are found through the descriptive analysis, since they represent males from urban areas, with admission scores below the cohort average. In addition, it was very difficult for these students to understand the concepts and the way in which mathematics is presented at the university level, in spite of the fact that the dropouts considered that they were good mathematics students.

The reasons for dropping out mentioned in the interview in case 1 were interesting, since there were few similarities with the variables associated with dropping out identified in the quantitative analysis. It was not difficulties in understanding the subject matter (as evidenced by the grades obtained in the first evaluations) that led to dropping out of the program, but rather factors associated with unmet expectations and lack of information about the methods used in the classes.

The analysis of these cases also helped to make visible the important impact that teaching methods can have on the academic and social integration of students in the classroom. In this sense, the new program of studies for Bachelor's and Licentiate's Degrees in Mathematics Teaching, implemented as of 2017, offers an opportunity to investigate in greater depth the effects of new and better methods for the teaching of mathematics at the university level.

Similarly, this study shows the need to consider evaluating applicants with respect to the implications of pursuing a career in teaching mathematics. In this sense, conducting interviews or tests on students' aptitudes for teaching before admission could be helpful. In particular, it must be kept in mind that to consider oneself competent in mathematics does not necessarily imply that one is capable of teaching mathematics; therefore, having strategies to guide students' vocational decisions would be relevant.

On the other hand, the study shows that it is important for the School of Mathematics to be constantly in contact with the students entering the program for the first time, to guide them in obtaining a scholarship, enrolling, and study techniques (both in groups and individually) for the courses in the program.

In summary, dropping out of the Bachelor's and Licentiate's Degrees in Mathematics Teaching program is a multi-causal and complex phenomenon, and taking steps to control it requires commitment by the relevant authorities, to be able to direct their efforts appropriately; first in understanding the phenomenon, and then in the creation of measures to reduce it. The great opportunity provided by the new version of this program should be emphasized, and further investigations in this program should be encouraged to improve decision making in this and other areas of interest to the School of Mathematics.

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Acknowledgments

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