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Title:

ACADEMIC CHALLENGES OF FIRST-YEAR STUDENTS AT THE DEPARTMENT OF APPLIED MATHEMATICS AND CYBERNETICS OF BAKU STATE UNIVERSITY

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STATEMENT OF AUTHENTICITY

We have read ADA's policy on plagiarism and certify that, to the best of our knowledge, the content of this paper, entitled "Academic Challenges of First-Year Students at the Department of Applied Mathematics and Cybernetics of Baku State University" is all our own work and does not contain any unacknowledged work.

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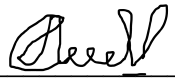
Signed: 

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Abstract

Every year thousands of students are enrolled in higher education institutes in Azerbaijan. Students enter Universities with certain prior knowledge, personal background, and expectations. At the same time being a first-year student is often associated with numerous challenges to be addressed during the adaptation period. In light of this transition process, the transition from mathematics as a school subject to the scientific discipline is challenging for most math students.

This project explores the factors that lead to the first-year math students' challenges and also, the existing support that those students receive at the Department of Applied Mathematics and Cybernetics of Baku State University. The researchers employed surveys and interviewees to identify the factors that contributed to the academic challenges of the first-year math students, solutions for those challenges, and the support that they would like to receive from the University. The factors that lead to the difficulties of students include a lack of prior knowledge, lack of communication skills, students' irresponsibility, students' shyness, lack of time management skills, and low level of foreign languages.

The findings of this study highlight that first-year math students receive support from the University, mostly from the administration (dean, deputy dean, tutors) and the instructors of that Department. The research reveals that first-year math students need more support in the adaptation process, related to their low level of prior knowledge and soft skills, the relevance of course material and teaching methods.

The support that those students would prefer was having face-to-face lessons and improving teachers' methods, involving young teachers in their education, providing extra classes and additional materials, reducing the number of topics to be taught for one semester, and at the same time explaining the practical side of the lesson.

A special type (a mechanism) of support - establishing an Applied Mathematics (AM) Club was suggested depending on the results of the study which aims to assist first-year

students and make connections between students and the department staff, and also operate as a social club.

Keywords: first-year math students, academic challenges, factors that lead to academic challenges, academic support, social events, academic events.

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Also, we are grateful to all the research participants, Baku State University staff including Applied Mathematics and Cybernetic department. We were inspired by their detailed answers and all the energy they have been giving to improve students' capacity.

Finally, we are frankly thankful to our family members for their support during the whole study period. We want to dedicate this work to the Martyrs of Azerbaijan who did get the whole of Azerbaijan together.

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Chapter 1: Introduction

Students acquire new knowledge, perspectives, and experiences during their first year of university education (Simpson & Frost, 1993). Nevertheless, being a first-year student is often associated with numerous challenges to be addressed (Dyson & Renk, 2006; Pittman & Richmond, 2008). The new group, study environment, and requirements, as well as the inability to exercise personal freedom and manage time effectively, all lead to problems with learning and communication with students and teachers (Birzina et al., 2019; Reznik et al., 2017). Therefore, freshmen's successful adaptation to the difficulties of university study is crucial to the development of each student not only as a person but also as a future specialist (Reznik et al., 2017).

Statement of the Problem

In the context of current research, the problem of college students' difficulties during their first years has gained greater significance (Handley & O'Donovan, 2016; Reznik et al., 2017). Several authors assert that universities and faculties should create an environment that enables first-year students to overcome obstacles (Anthony, 2000; Sevinj & Gizir, 2014; Reznik et al., 2017; Yunusova, 2020). Despite the ongoing efforts of higher education institutions to develop students' academic performance, the number of students succeeding in first-year courses, especially in math remains alarmingly low (Kizito et al., 2016). The first-year university students experience stress in many areas such as course selection, assessment system, the course content, and communication with teachers (Anthony, 2000; Kizito et al., 2016; Sevinj & Gizir, 2014). All these key issues can have a detrimental effect on first-year college students' academic achievement (Anthony, 2000; Kizito et al., 2016), and as a result, they get more anxious and depressed (Prescott & Simpson 2004) even it may lead to the drop-out of the students (European Commission/EACEA/ Eurydice, 2018).

The above-mentioned challenges have also been observed in the math department where one of our team members work as an instructor for ten years. The preliminary data show that the newly admitted math students experience problems related to course selection, time management and deficiency of support by the faculty members. Generally, students have adaptation problems in their first year, leading to academic challenges. In addition, students face some difficulties regarding the course content which is quite overloaded and requires problem-solving skills different from what they have been taught in secondary schools. To be specific, the students' prior math knowledge is not enough to get new mathematical information from subjects such as discrete mathematics, mathematical analysis, linear algebra introduced in their first year. These challenges create a gap in their knowledge, which also leads to academic challenges.

Purpose Statement

The purpose of this study is to reveal the factors that lead to the first-year math students' academic challenges and to explore how the universities support these students. The findings of the study will contribute to developing guidelines for universities and department on how to assist students who are experiencing difficulties. Financial difficulties and the psychological state of the students are not subjects of this study.

Research Questions

This study is guided by the following research questions:

1. What are the factors that contribute to academic challenges for the first-year math students?
2. How does the university support the first-year students' academic challenges?

Definition of the Key Terms

Academic challenges can be defined as the difficulties that students have throughout the academic year when they face some technical challenges (course selection, time management skills, assessment strategies) and content related problems (problem-solving skills, application, analysis)

Academic support is a different instructional methods, educational services, or resources provided to students in the effort to help them accelerate their learning progress, catch up with their peers, meet learning standards, or generally succeed in their studies.

Significance of the Study

The problem discussed in this study is the academic challenges faced by first-year students in the mathematics department. Various pieces of literature demonstrate how these difficulties have a detrimental effect on students' academic achievement and, in some cases, even result in students dropping out of university (Anthony, 2000; Kizito et al., 2016). However, existing research does not adequately understand the main factors contributing to first-year students' academic problems and offers innovative solutions (Birzina, et al., 2019; Quinn, 2013). Very little emphasis has been placed on this actual problem in Azerbaijan's higher education institutions, and only a few investigations (Yunusova, 2020) have been carried to examine the challenges faced by first-year undergraduate students. As a result, the issue of support seems to become essential, which has been indicated in a number of useful policies that can provide educational services and enable newcomers' integration into university education.

Literature review proclaims that first-year students face different academic challenges and still there is not a unified approach for supporting these students (Anthony, 2000; Birzina, et al., 2019; Kizito et al., 2016; Quinn, 2013; Sevinj & Gizir, 2014) Therefore, addressing this issue and providing measures is important.

The significance of this study is as follows:

• The end product of the project – a Manual/Guidelines for the faculty on how to assist first-year students can be used as a source by the math departments of Baku State University

• First-year students will get familiar with the main factors leading to their academic challenges in their first year and can take into account those factors depending on them in their upcoming semesters.

• Teachers can also apply to the findings of the study in order to redesign their instructional strategies to meet the students' needs.

Chapter 2: Literature Review

Transitioning from high school to university is a difficult period in a first-year student's life (Sotardi, & Brogt, 2016; Van der Meer et al., 2010). Despite the fact that challenges associated with the transition from secondary to higher education are being investigated and efforts are being made to eliminate them, the problems of student 'underpreparedness' when entering higher education continue to manifest themselves in a variety of subjects, most notably in mathematics (Harwell et al., 2009; Kajander & Lovric, 2005; Parker, 2005). The pace and level of mathematical concepts instructed in the first year are difficult for most high school graduates (Kizito et al., 2015; Lithner, 2011). To comprehend the primary reasons that impede successful mathematics studies and result in students dropping out in the first year or avoiding math courses in the future, it is necessary to first define the key factors that affect students' learning mathematics (Birzina et al., 2019). Students struggle because there is an enormous gap between their foundational mathematical skills and subsequent mathematics-intensive courses they take at the university level (Hourigan, & O'Donoghue, 2007). Additional factors such as workload, teaching quality and methods, assessment, and support from teachers and department staff all have an impact on student academic achievement (Kizito et al., 2015; Lizzio et al., 2002).

The purpose of this literature review is to present possible factors that contribute to first-year students encountering challenges in their studies, as well as the effects of these difficulties and strategies proposed by scholars to help students in overcoming them. This chapter is divided into three sections. In the first section, the factors contributing to academic challenges faced by students during their first year of study are discussed. The second section is devoted to the impact of these difficulties on the academic lives of students. The final section describes possible methods and solutions provided by various scholars to universities

and faculties in order they will be able to assist students in overcoming obstacles to academic success.

The Factors Contributing to the First-Year Students' Academic Challenges

There are numerous factors that can influence a student's educational success, but they are often classified as either personological (e.g., background knowledge, learning strategies) or contextual variables (instructional practices, as well as evaluation processes) (Zeegers, 2004).

One transition issue for first-year students is developing better time management and self-study skillsets for the university education system. Time management and self-study are viewed as two sides of the same coin in terms of organizing and managing to keep up with a variety of study responsibilities. A study by the UK Higher Education Academy (Yorke & Longden, 2007) clearly suggested that students have challenges in controlling their time. Similarly, the results of survey conducted by Meer, Jansen, and Torenbeek (2010) show that one of the most frequently expressed concerns was keeping up with the study requirements. There was a strong emphasis on the particular difficulty of first-year students in understanding the new study requirements, the apparent lack of support in their transition to more independent study at university, and understanding the study and time management expectations (Meer, Jansen, & Torenbeek, 2010). Students' perception that they need to do a huge amount of work does not always translate into understanding how to address the study load. Krause and Coates (2008), in interpreting the findings of a classroom learning instrument, stated that "the ability to manage one's time, study, and techniques for achievement as a student is absolutely central to excellence during the first year" (p.500).

The presage factors of learning, such as students' background knowledge and prior learning experiences, are also identified as vital factors that affect student success in the university setting (Anthony, 2000). Students enrolling in first-year university courses

frequently lack adequate technological and arithmetical awareness, logical conceptual understanding, and are not skilled at reading and thinking about mathematics using computational texts (Kajander & Lovric, 2005; Wolmarans, et al., 2010). According to Venezia and Jaeger (2013), the level of student under-preparedness is a research issue negatively affecting academic achievement. They argue that, "too many students attend college without the fundamental subject knowledge, expertise, or mental habits required to successfully complete coursework" (p. 118).

The disparity between high school curricula and university anticipations is one factor associated with students' lack of preparedness for the higher education system (Venezia & Jaeger, 2013). Similarly, Tewari (2014) completed a study in South Africa that academic institutions still do not have a clear picture of how or whether school-level reforms have improved mathematics mastery at the college level. School teachers, according to Harwell et al. (2009), do not sufficiently equip learners for university mathematics. Exams drive school mathematics curricula, which encourage a surface method of learning with a focus on grasping algorithms and procedures. According to Sæle et al. (2016), a surface learning method may be most adaptable if a student is struggling to deal with the volume of work required, or if he/she is investigating for an exam that requires the reproduction of material. In addition, the authors state that first-year students' learning approaches are also influenced by inadequate assessment methods, which direct them to take surface learning.

University learning, on the other hand, necessitates a more in-depth learning approach that includes conceptual knowledge and creative thinking. Self-efficacy, defined as a student's belief in his or her ability to complete the mathematical tasks properly, has been identified as an important factor in improving student mathematical efficiency (Chemers et al., 2001). According to Richardson et al. (2012), some of the most important predictors of student tertiary performance levels are primary motivations such as students' own perceptions and

personal growth, self-efficacy, or conceptions of academic potential, and self-regulatory aspects such as effort regulation, or dedication and commitment when directly confront with challenging academic situations.

In addition, relationships with faculty and faculty teaching quality emerged as prominent variables negatively impacting the academic adaptation of first-year university students (Sevinj & Gizir, 2014). According to the findings, freshmen who are having difficulty adjusting characterize their faculty as being less caring, welcoming, and appreciative. The findings also revealed that both formal and informal interactions between students and faculty were uncommon.

In terms of faculty teaching quality, freshmen perceived their professors as unintentional lecturers who lacked instructional expertise and classroom discipline skills (Sevinj & Gizir, 2014). Correspondingly, research shows that faculty quality is a vital instructional issue, and that undergraduate students place a higher value on various teacher characteristics that are related to academic success and adjustment, either negatively or positively (Aulls, 2004; Brown, 2004; Lammers & Smith, 2008; Okpala & Ellis, 2005). Lecturers place more importance on poor teaching strategies and have incomplete mathematics basic knowledge. Therefore, understudies rated considerably higher items such as monotonous lecture presentations, and a perceived lack of relevance of paper content; all of these indicators were connected to lectures and course structures (Anthony, 2000).

To conclude all the points made by the scholars, the leading causes of first-year students' academic difficulties are mainly related to student and departmental factors.

The Result of First-Year Students' Academic Challenges

This section will discuss the possible effect of the students' academic challenges such as, mismatch of the expectations of first year students, poor time management skills, not having prior knowledge, lack of this organizational culture.

Research indicates that drop-out rates are the highest at the end of the first academic year (European Commission, 2018). Recent Bologna Process Implementation Report (2018) reviled that first-year students are particularly vulnerable to dropping out of higher education, since their expectations might be very different from what they actually encounter. Such mismatch can stem from the wrong choice of courses or study programme as well as the feeling of helplessness and failure at the start of higher education studies (European Commission, 2018).

Another reason why the students have academic procrastination is that they do not have proper time management skills. The results of the study conducted by Ocak and Boyraz (2016), indicate that due to the lack of time management skills students are not decisive about their behaviors of procrastination while doing academic tasks. Thus, they conclude that there is a significant correlation between academic procrastination and time management.

Also, in the math learning process, having previous knowledge about theory has an impact on conceptual learning. Students who have background knowledge about the concept of math are more successful than the students that do not have this knowledge (Booth, 2011). Hudson and Rottmann (1981) investigated that prior mathematical ability influences performance in the course. Furthermore, it has a secondary influence on the tendency to drop out of the course.

Furthermore, in the teaching process, faculty has superiority on students' learning in the university, therefore it is important to have communication between faculty and students. Interaction between faculty members and students impact on students' transition period and

retention. Ongoing communication, interaction, and active engagement among faculty and students sustain an active learning community and the lack of this organizational culture demotivates students through the learning process (Sevinj & Gizir, 2014). If the communication and mutual understanding between faculty and students are poor, it will lead to failures in the students' learning. Moreover, instructor's role should be reinterpreted for the learners and newcomers of the university to escape from periodic tension and conflict (Etzkowitz et al., 2000).

How the First-Year Students Are Supported to Overcome Their Academic Challenges

Different models and strategies are listed in literature regarding the solutions of the academic challenges of students (Kizito et al., 2015; Reznik et al., 2017; Van der Meer et al., 2010; Yunusova, 2019).

Van der Meer, Jansen, and Torenbeek (2010) argue that universities have an important role to play in assisting students to develop the required skills. They mention that "students cannot be expected to apprehend straight away what teachers expect from students, what skills students are meant to employ to, for example, read 'around' a subject, and how to effectively respond to the changed teaching and study time patterns in the context of a semester" (p.788). Considering the challenges first-year students experience in managing their time, and the considerable transition students go through on entering university, the authors suggest that teaching and other support staff should play an active role in helping students to make sense of the expectations related to time management and self-study (Van der Meer et al., 2010).

According to the authors (Papanastasiou & Bottiger, 2016), one of the most effective ways of ensuring students' academic success is through the formation of math clubs. In general, their participation in various clubs or extracurricular activities helps them to improve their educational outcomes and behavioral skills in university life, which appears to be an

actual growth in the long run. Club activities are defined as student experiences and activities that are unrelated to an academic act or set of courses. In an indirect way, these efforts contribute significantly to a university program. It has been demonstrated in all aspects of students' lives that club activity is as important as consistent courses for skill development (Tenhouse, 2003). As stated by Eccles (2003), the club activity has been able to provide practical lessons for increasing students' skills and experiences, as well as theoretical knowledge. Inherently, the relationship between club activity and student achievement has been continuing, with students' benefits for higher education advancing.

Recent studies related to students' challenges and their adaptation (Reznik et al. 2017; Sevinç & Gizir, 2014) in neighboring countries like Turkey and Russia which have common historical and cultural similarities with Azerbaijan, also suggests that universities should develop an effective advisory system and mentoring programs for new students to establish natural and successful social networks with peers, faculty, and other university personnel, through the orientation and information sessions, forming interest groups.

Peer tutoring in mathematics can provide students with numerous academic benefits (Huber and Carter, 2019; Sarid et al., 2020). According to Flores and Duran (2013), most of the time students like the suggestion of receiving assistance from their classmates during the learning experience. Peer tutors have or have had the same academic materials as their peers, so they truly understand the challenges their peers may face while learning them. Peer tutoring has been defined in various ways over the years. Peer tutoring is defined by Topping (2009) as "people from similar social groups, who are not qualified teachers, assisting one another to gain knowledge by teaching." During this procedure, classmates with greater ability or knowledge typically serve as tutors. In this technique, collaboration in pairs is required. As a result, a professional designs an asymmetric learning relationship with their students with a single goal in mind: the acquisition of curricular content (Abdurrahman,

2020). The advantages of peer tutoring have been described for a variety of subjects and education levels. These advantages are not limited to proficient or skillful students; struggling, learning disabled, and at-risk students have all been shown to benefit from peer tutoring (Huber and Carter, 2019; Mahoney, 2019; Sarid et al., 2020). Academically, the influence of peer tutoring on students' mathematics performance appears to be reasonable. Alegre-Ansuategui et al. (2018) conducted a meta-analysis on peer tutoring and mathematical academic achievement. The average effect size reported was reasonable, and the majority of studies included in the meta-analysis reported significant improvements.

Conclusion

In most cases, transition from schools to universities has problematic sides for the first-year students. One of those sides has been investigated by Rach and Heinze (2017), in the teaching process of Mathematics. As background knowledge is important in math, the lack of this information creates problems in the students' understanding (Rach & Heinze, 2017). Communication in the learning community, learners' age, learning practices, and university's instructional strategies are the main causes of the problem that first-year students face in the universities (Zeegers, 2004). This problem has negative effects on students such as demotivation, lack of communication, not well understanding of the subject, and failure in math and related subjects (Etzkowitz et al.,2000). There are some solutions that are offered to solve the problems which happen in the first-y students such as academic advising, mentoring, coaching and advisory sessions, applying innovative teaching methods, and clear evaluation criteria (Van der Meer et al., 2010, Kizito et al., 2015, Reznik et al., 2017, Yunusova, 2019).

Gaps in the Literature

Although different definitions and factors that lead to academic challenges are developed in the relevant literature, not all factors are well categorized and solutions provided in order to overcome them. The limitations also appear, because all reviewed literature were

related to foreign countries and there is no material regarding the experience related to Azerbaijan.

Chapter 3: Research Methodology

The qualitative research method was applied for this study since qualitative methods are particularly essential in interpreting the significance that people assign to events that they encounter (Creswell, 2014). The qualitative technique is a method of study that enabled us to gather information in a natural setting; rather than giving the questionnaire of narrow questions, we could obtain information by meeting participants in person or online and speaking with them explicitly (Creswell, 2013; Hatch 2002; Marshall & Rossman, 2010). As a result, we could investigate and developed a thorough understanding of the key factors influencing first-year university math students. In order to get significant direction for our research questions, our research was based on the participants' opinions (Creswell, 2014).

The qualitative research methods that were used for this study included one-on-one interviews and open-ended questions on surveys. As Creswell (2014) pointed out, in a qualitative project, interviews allowed us to ask study questions and record responses from only one study participant at a time. This method allows researcher to investigate and prompt things that we cannot observe, researchers can probe an interviewee's thoughts, values, prejudices, perceptions, views, feelings and perspectives (Wellington & Szczerbinski, 2007). In addition, our research participants felt secure and formulated their ideas comfortably. The use of open-ended questions on surveys also allowed us to investigate the critical factors affecting first-year math students, and we looked for overlapping concepts in the data obtained from those survey questions.

Since the study explores the factors contributing to academic challenges of the first year math students, the study employed exploratory research design.

Research Site and Population

This study was conducted at the Applied Mathematics and Cybernetics Department of Baku State University. The population of this project was first-year students of this faculty. Currently, there are approximately four hundred first-year students in this department in sixteen groups of three (Azerbaijani, Russian and English) sections.

Also, instructors (n=15) who are teaching math courses to the first-year students and faculty administration (deputy dean and tutors) are the population of this study.

Sample Size and Sampling Strategy. A sample is a subgroup of the target population that the researcher plans to study for generalizing about the target population (Creswell, 2012). Throughout the project, a hundred-fifty of students were involved to participate in the survey through random sampling. Yin (2015) argues that if the study intends to generalize its findings numerically to the entire population of the unit, random sampling - selecting a statistically defined sample of units from a known population of units are applicable.

Considering the fact that numerous researchers effectively investigate the phenomenon using smaller sample sizes (Creswell, 2013; Dukes, 1984; Moustakas, 1994; Polkinghorne, 1989), we decided the sample size of interviews for this research be six. The teachers for the interview were selected through the convenience sampling strategy. Because when inviting teachers to participate in the interview factors such as free time availability, willingness to participate in research, and the ability to formulate ideas precisely should be considered (Bernard, 2002).

Data Collection

Data collection is the process of gathering relevant information in order to find answers to the research questions (Creswell, 2013). There are several methods for obtaining this information, and depending on the exploratory nature of our research, we used interviews

and survey to collect the data (Creswell, 2012). To begin the data collection process, we asked our course tutor from ADA University's Education department to draft an official letter that we presented to the applied mathematics and cybernetics faculty's dean. Our group member who works in that department met with the dean and presented him with a letter requesting permission to conduct research in that department. Due to the fact that students and teachers were on winter break until February 15th, we had planned to meet with the dean a couple of days before the spring term began. After gaining his permission, our group member talked with the tutor of the first-year students and obtained a list of the department's first-year students and teachers who teach the first-year students, along with their mobile phone numbers. The same time, we built a rapport with the deputy dean of the faculty in order to turn him into the gatekeeper of this research at the faculty. According to Hammersley and Atkinson (199the 5), gatekeeper is an individual who has an official or unofficial role at the site, provides entrance to a site, helps researchers locate people, and assists in the identification of places (as cited in Creswell, 2012, p. 211). We began collecting data by surveying students, and on February 20th, our group members spoke with students and invited them to participate in the survey.

Survey

In this research, a cross-sectional survey type was applied to gather information from the first-year students. The purpose of this type of survey was to examine current beliefs, opinions, perceptions, or experiences (Creswell, 2014). Thus, a survey was conducted to determine first-year students' perceptions or experiences about the factors that contribute to their academic difficulties and their opinion regarding the type of support that could assist them in overcoming those obstacles. The survey questions included both open-ended and closed-ended questions. We conducted the survey among the first-year students studying Applied Mathematics and Cybernetics department. One group member met with each of the

sixteen groups to explain the survey's purpose and invited them to participate. In order to ensure the diversity of ideas, students studying in all three sections – Azerbaijani, Russian and English streams were included in this research. Considering that the majority of respondents' native language is Azerbaijani, the survey questions were written in that language. The piloting tools were applied in order to check whether the survey questions could help us get the answers to our research questions. Two first-year students who were not going to participate in our research were piloted in our survey questions, and depending on their answers, we decided to modify our survey questions again. We selected randomly one hundred fifty first-year students and sent them the link to the survey via mail. Ninety-four students participated in our survey.

Interview

Another method that was used to gather information for this research was the interview. Using the interview method gives the opportunity for researchers to collect data that enable them to better understand participants' experiences, how they describe them, and the meaning they assign to those experiences (Rubin & Rubin, 2012). We used semi-structured interviews in our study. The reason for choosing this type of interview is that it enables the researcher to prepare questions in advance and to ask follow-up questions during the interview in order to induce detailed information (Creswell, 2012). As a result, we could gain greater control over the direction of the interview (Brinkmann & Kvale, 2018) which enabled us to gain a better understanding of the nature of the difficulties encountered by students during their first year of study. Four instructors who teach first-year students were chosen at random for an interview. Additionally, a deputy dean and one tutor who works with first-year students were interviewed to derive detailed information. All of the interviews were conducted in Azerbaijani because their English language knowledge was not satisfactory. Hence, a one-on-one type interview was the optimal method for interviewing participants who

were confident in their ability to speak, articulate, and open to sharing ideas (Creswell, 2012), each of the seven interviews was conducted one-on-one. Our interview lasted for 30 minutes, and before the interview, we piloted one teacher who was not added to our interview process so as to check the effectiveness of the interview questions.

Data Analysis

We used Google Doc tool while analyzing data that collected from students. Provided tables and charts represented all participant responses for each survey question. Collected data was interpreted and summarized in a form of discussion via those tables and charts. Considering that this is an exploratory qualitative study, content analysis was an effective method to analyze the responses. Content analysis is a research analyzing tool used to determine certain words, themes, and concepts in a collected data (Drisko & Maschi, 2016). There were four steps to analyze interviews that collected from teachers for the study. Those steps were transcribing, manual coding, forming categories, and preparing narrative discussion which were taken from Creswell (2014).

Validity and Reliability

Reliability and validity are considered essential parts of the research; therefore, special attention will be paid to maintain the process of data analysis. Reliability indicates that the results of the research are error-free and consistent so that "the observed score of the measure reflects the true score of that measure" (Mohajan, 2017, p.10). Validity indicates “whether the results obtained meet all of the requirements of the scientific research method” (Mohajan, 2017, p.14).

Content Validity

According to Creswell (2005), content validity, being one of the types of validity, aims to show to what extent the questions on the instrument can represent all the questions related to the content of the research. It should be mentioned that there is no specific

statistical test to measure the extent to which questions can cover the content area; therefore, the feedback of the experts is needed in this case (Mohajan, 2017, p.15). In this study, the survey and interview questions of this research study were presented to participants only after they had been reviewed by the supervisor.

Internal Validity

Internal validity aims to investigate whether the design, analysis of the study, and the way it is carried out provide reliable answers to the research question (Andrade, 2018, p.499). To ensure the internal validity of this research with the reality, two strategies were utilized: triangulation and member check.

Triangulation. Triangulation is the concept related to geography and here it means conducting three measurements to know the exact position of the point; however, in this research, this concept states conducting matching procedures to increase the credibility of the research (Meijer et al., 2002, p.146). The researcher can use multiple data sources, data collection methods, and theories to ensure the validity of the data. To strengthen the validity of our research, we collected data from several participants through surveys and interviews, triangulating with the literature.

Member Checking. In this process, participants of the study were asked to confirm the notes taken during the interview, propose alternatives, and comment on what was needed to be so that their feedback regarding the changes could be taken into account later on (Kornbluh, 2015). It is one of the effective ways to increase the credibility of the collected data (Merriam & Tisdell, 2016).

Ethical Considerations

Ethical Considerations play a vital role in improving the trustworthiness of the research. In this research, the identity of participants was kept confidential which means their identities will be only known to the researcher, but will not be revealed to third parties. By

taking into consideration the importance of "informed consent", the participants were informed about the content of the questions, how their responses would be used, and about their rights in advance (Fleming & Zegwaard, 2018). Also, all participants received consent letters in a written form to sign and indicate their willingness to participate in this research.

Chapter 4: Findings

The focus of this research was to uncover the factors that contribute to first-year math students' academic problems and to investigate how universities assist these students.

The current research is structured around the following research questions:

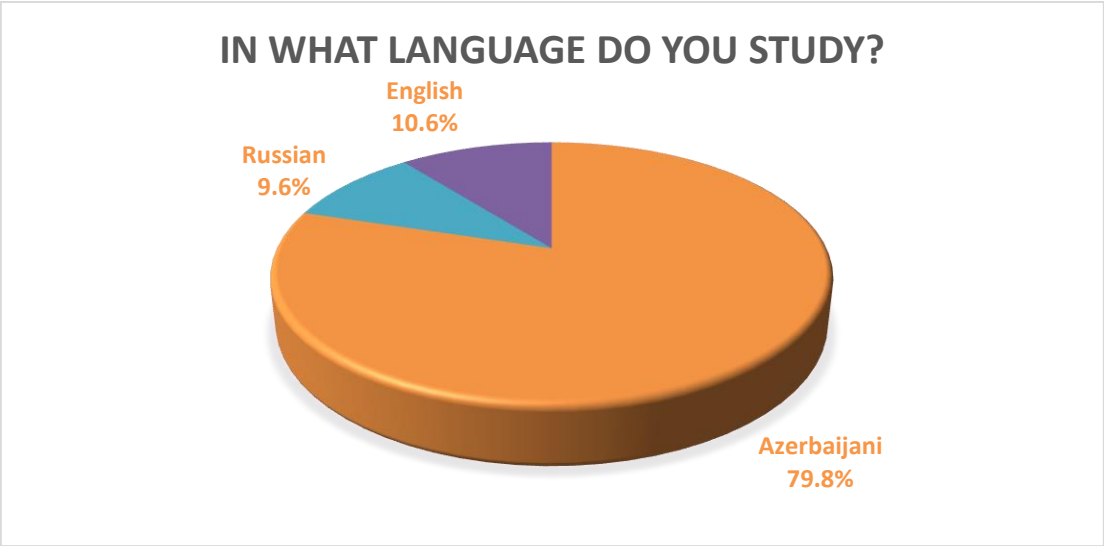
1. What are the factors that contribute to academic challenges for first-year math students?
2. How does the university support the first-year students' academic challenges?

We gathered information through a survey and one-on-one interviews. The research project was carried out in order to find answers to the research questions, and this chapter discusses the findings obtained from students via an online survey and interviews. The survey had a total of nine questions and participants were first-year students at the Applied Mathematics and Cybernetics Faculty of Baku State University. The questions were mainly related to students' challenges, the reasons for these challenges, and the assistance they received from teachers. We created four open-ended questions and five closed-ended questions. The participants of the interview were teachers and faculty members of the Applied Mathematics and Cybernetics Faculty of Baku State University. We used a semi-structured interview and our interview tool consisted of ten questions.

Findings of the Survey

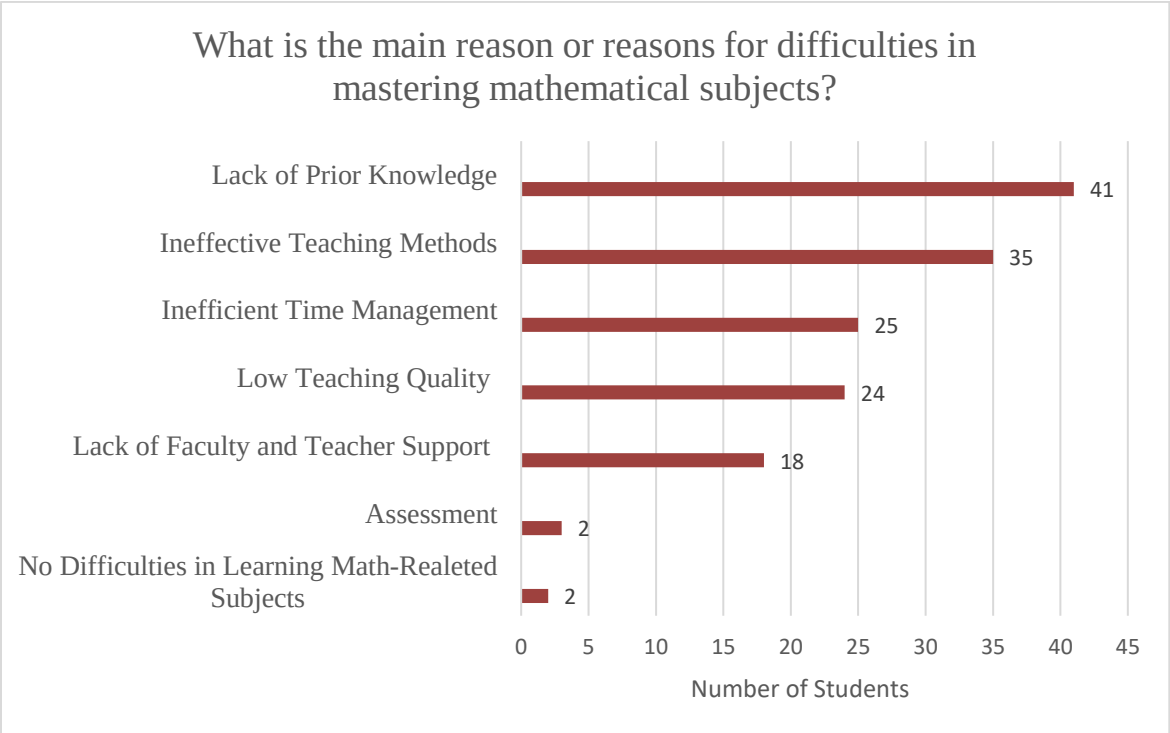
In order to learn students' opinions about their academic challenges and the factors leading to them, we surveyed 94 students from the applied mathematics and cybernetics faculty of the Baku State University. They were all first-year university students. 75 (79.8%) of the students were from the Azerbaijani sector, 9 (9.6%) from the Russian sector, and 10 (10.6%) were studying in the English mainstream (Table 1).

Table 1



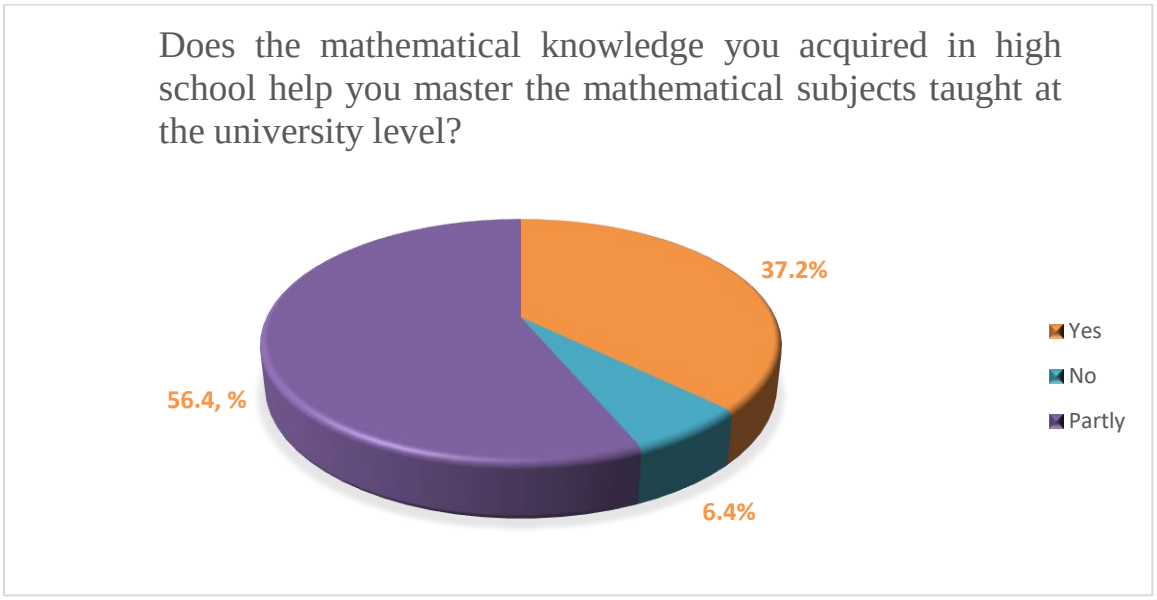
Reasons for First-Year Students' Challenges. The first question that we designed was about the main reason or reasons for students' difficulties in mastering mathematics. 41 (43.6 percent) the students out of 94 stated a lack of prior knowledge, 35 (37.2 %) -ineffective teaching methods, 25 (26.5 %) - inefficient time management, 24 (25.5 %) - low teaching quality and 18 (19.1 %) reported a lack of faculty and teacher support as the primary reason. The minority group (3.2 %) mentioned summative assessment tasks as the primary source of their academic difficulties. However, 2 (2.2 %) students stated that they do not face any problems in math-related subjects (Table 2).

Table 2



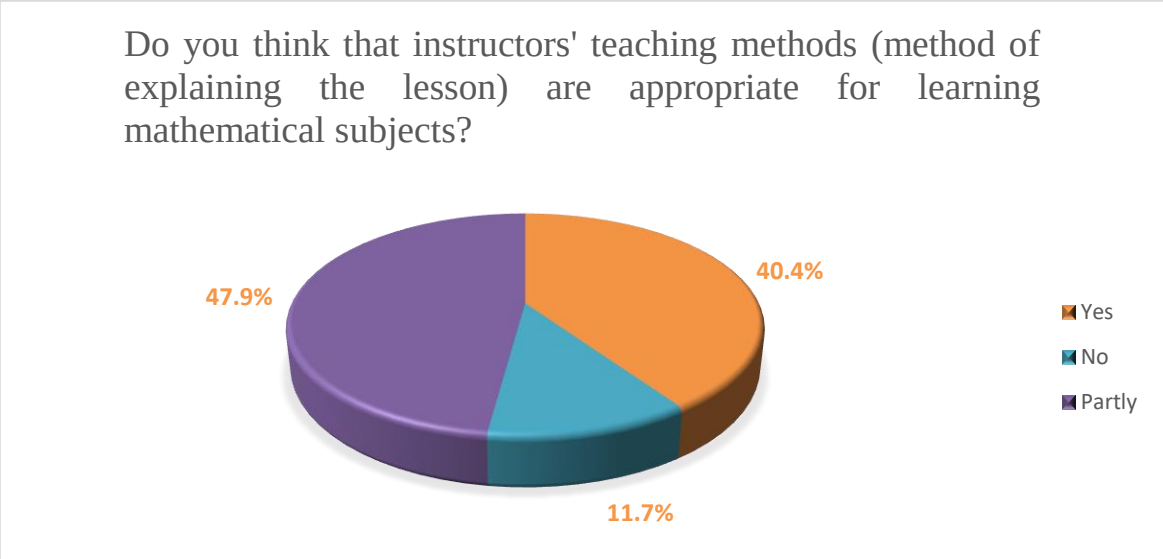
Students' Prior Knowledge. The second question was whether or not their high school math knowledge helps them master the math subjects taught at universities, 53 (56.4 %) answered partially, 35 (37.2 %) answered yes, and 6 (6.4 %) answered no (Table 3).

Table 3



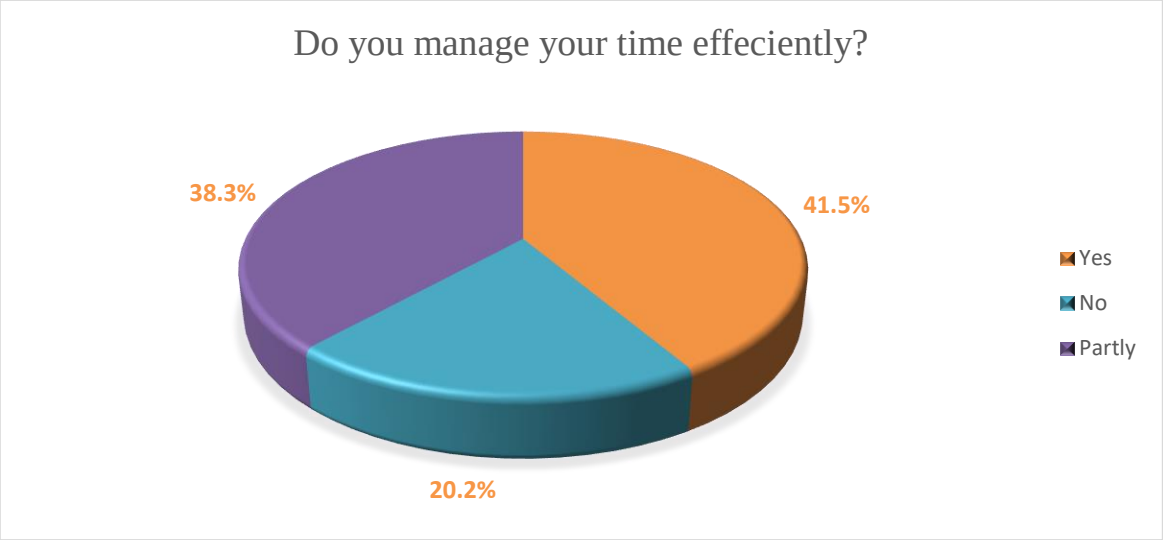
Teaching Methods. The learners also answered the question about the role of classroom instruction in understanding the main concepts of mathematics, 45 (47.9 %) and 38 (40.4) responded partly and yes, respectively. 11 (11.7 %) of them stated that an ineffective teaching method is one factor leading to their academic challenges (Table 4).

Table 4



Time Management. Based on the review literature, we have found that lack of time management skill one of the factors that contributed to the academic challenges. Therefore, one of the survey questions was about students are able to manage their time effeciently or not. According to Table 6, 39 (41.5 %) and 36 (38.3%) of students have enough time to master the curriculum, prepare for seminars, and take exams. However, approximately 19 (20.2%) of students think that the time allotted is insufficient for learning the topics and preparing for the exams (Table 5).

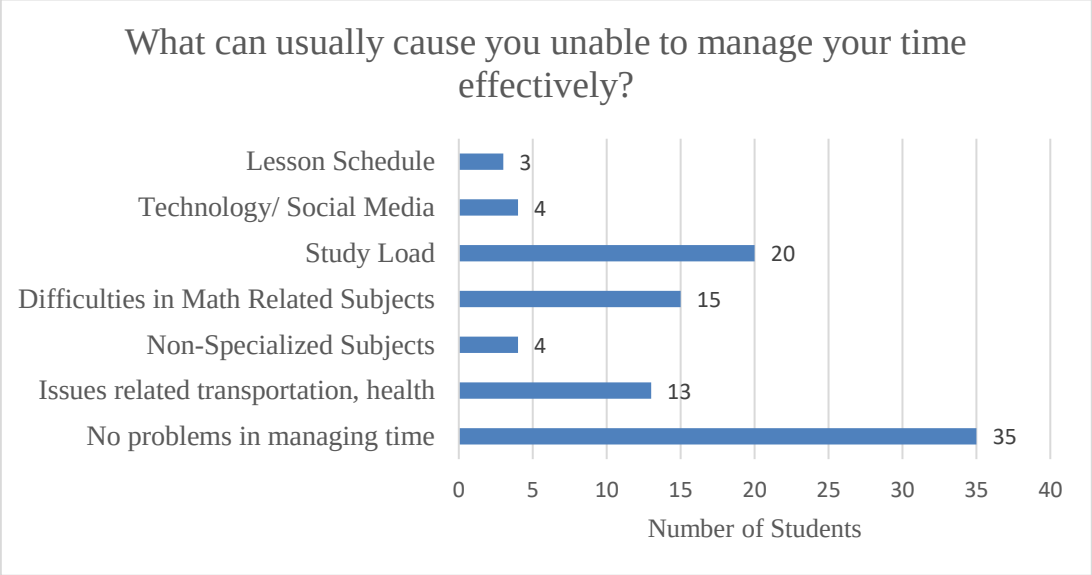
Table 5



The Causes of Students' Ineffective Time Management. In order to learn the reason why students are unable to manage their time efficiently, we included one open-ended question in the survey. 35 students stated that they have no problems managing their time. However, 15 students reported that due to the difficulty of the topics of the math-related subjects, they need to read several times to understand the topics. Therefore, they often spend too much time reading one subject and do have not enough time preparing for another one. In terms of other issues related to transportation or health, approximately 13 students are not able to effectively manage their time. Because some students live in Sumgait or suburban areas, they spend too much time on the road and this makes it difficult for them to manage their time effectively. In addition, 20 students highlighted study load as one of the factors. The number of students who are unable to effectively manage their time due to non-specialized subjects is four. They mentioned that they have economics, politics, and history classes where teachers give them a lot of lessons to learn that take up the majority of their time. Four students answered the question that they spend more time on social media such as Instagram and Facebook, and therefore cannot devote enough time to the lessons. The minority group of students (3) reported that the main issue with their time management was the lesson schedule.

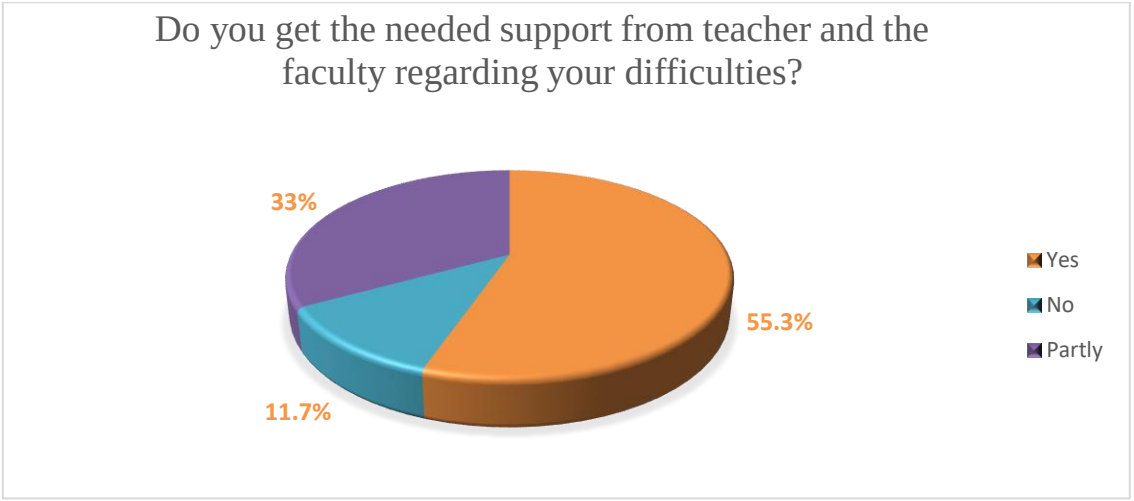
For example, they mentioned that one day they have one lesson, another day they have three lessons. This makes it difficult for them to manage their time in preparation for the lessons.

Table 6



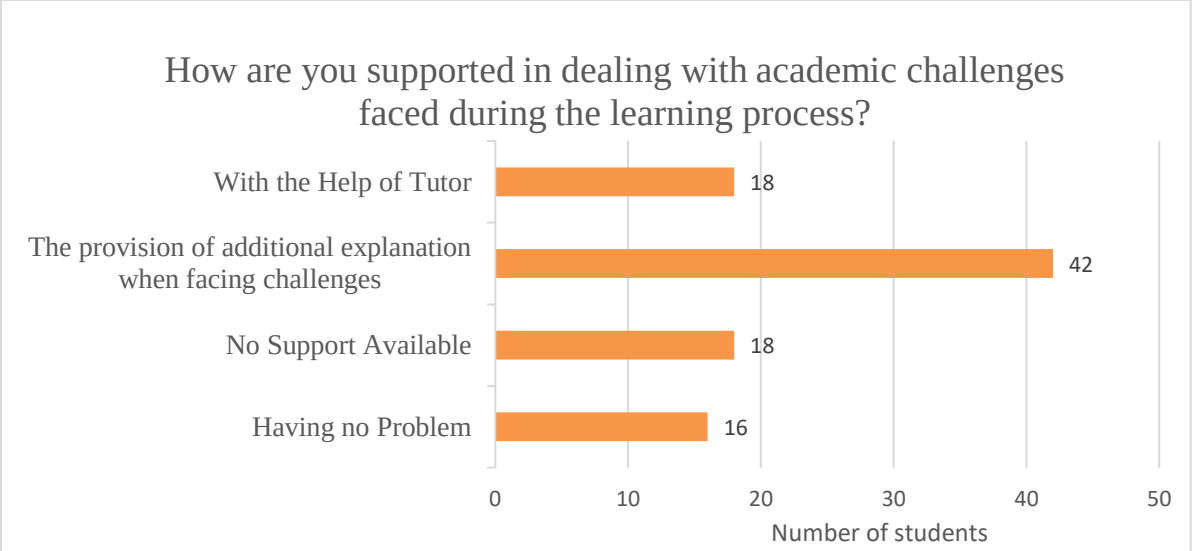
Teachers' and Faculty Members' Support. Table 8 illustrates that 52 (53.3 %) students say that they are provided with the necessary support when they ask a teacher or faculty (dean's office, tutors) for their difficulties. 31 (33%) and 11 (11.7) % of the students, respectively, reported that they receive partial and no assistance from the teachers or faculty members to overcome their challenges (Table 7).

Table 7



Supporting Students. Table 9 depicts how students are assisted in dealing with academic challenges encountered during the learning experience. A large number of students (42) stated that when they have a problem with the topic, the teacher starts explaining it again. 18 students think that they overcome their challenges with the assistance of a teacher. In contrast, the same number of students (18) claim that they do not receive any additional support. Furthermore, 16 students are not confronted with academic problems (Table 8).

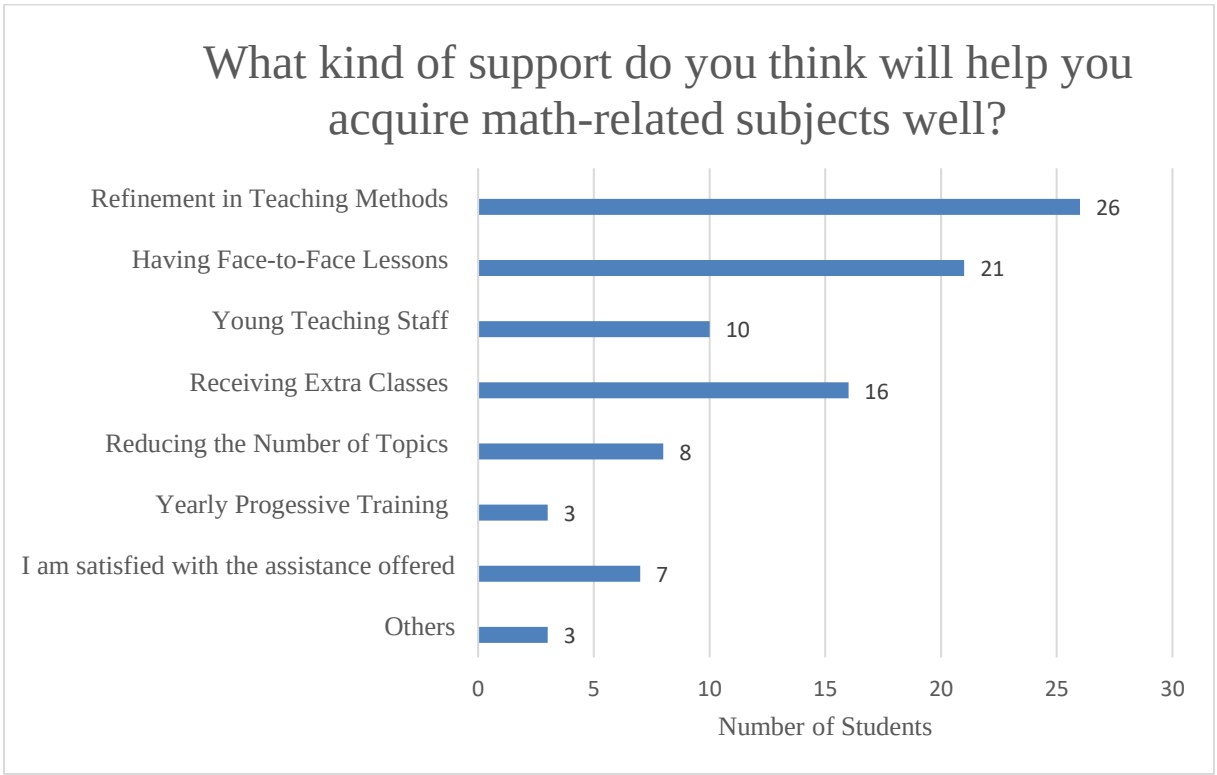
Table 8



Students' Suggestions. Table 10 shows what types of assistance can help students perform better in math-related subjects. 26 students think that if teachers should implement different teaching methods, it will help them to overcome their difficulties related to understanding the topics. 21 students believe that having offline lessons can minimize their math challenges. In the Applied Mathematics and Cybernetics department, all lectures are delivered online. Students of this department think that replacing online lectures with face-to-face lectures would be beneficial for them and they can better understand the topics. 16 students think that they need extra classes in which the topics they did not understand are taught again. 10 students believe that if they have young teachers, they will perform better in math subjects. That is because they are afraid of asking older teachers questions a second time

because they are impatient, and do not want to elaborate on the lesson again. Young teachers, on the other hand, are more patient and explain everything to us in great detail. As each course covers a wide range of topics for one semester, which can present challenges for students. Therefore, 8 students believe that teachers can assist students by reducing the number of topics to be taught for one semester. Yearly progressive training was only mentioned by 3 of the learners. They want internship or training programs where they can put what they learned during the semester into practice. In general, 7,4 % (7) of the learners are satisfied with the support provided by teachers and academic staff (deputy dean and tutor). 3 students think that they need extra information about exams and additional help in doing homework. (Table 9).

Table 9



Interviews with teachers and administrative staff

To identify the problems faced by the first-year university students studying in the faculty of Mathematics, we have interviewed four teachers and two administrative staff members from the Applied Mathematics and Cybernetics Department of Baku State University. Through in-depth interviews, we managed to get detailed information. It was a semi-structured interview. They mainly had similar questions but we asked follow-up questions based on their answers. The name of the respondents will not be indicated in this study and the brief information about their teaching experience is given below:

Table 10

Participant Information

Participant Information	
Respondent 1	Academic background: Ph.D. in math Teaching experience: 13 years Job: Administration staff, deputy dean
Respondent 2	Academic background: Ph.D. in math Teaching experience: 16 years Job: Full-time math instructor
Respondent 3	Academic background: Ph.D. in math Teaching experience: 17 years Job: Full-time math instructor
Respondent 4	Academic background: Ph.D. in economics Experience: 14 years Job: Administration staff, tutor

Respondent 5	Academic background: Ph.D. in math Teaching experience: 9 years Job: Full-time math instructor
Respondent 6	Academic background: Ph.D. in math Teaching experience: 17 years Job: Full-time math instructor

Taking into account the purpose and research questions of our research, we organized the findings from the interviews into two themes: (1) the factors that contributed to the academic challenges of first-year students, and (2) the suggestions regarding the supports that the first-year students would like to receive to overcome their academic difficulties.

Theme 1. The Causes of Academic Challenges Faced by First-Year Math Students

The first question in our research seeks the answers regarding the factors that contribute academic challenges of first-year math students. During the interviews, we asked several questions regarding the challenges faced by first-year students and most of the respondents considered lack of prior school knowledge as the main factor that contributed to the academic difficulties of first-year students. We organize the findings from interviews related to the factors that contribute to academic difficulties of first-year math students into the following subthemes:1. Lack of prior knowledge; 2. Lack of communication skills; 3. Students' irresponsibility; 4. Students' shyness; 5. Lack of time management skills; 6. Language problems (table 11).

Table 11

Factors that lead to Academic Challenges	Result
	• Difficulties in understanding the

Lack of Prior Knowledge	topics • Low level of problem-solving skills
Lack of Communication Skills	• Difficulties in communication with teachers • Difficulties in communication with classmates • Difficulties in asking questions during the lesson
Students' Irresponsibility	• Unpreparedness for the lessons and exams
Students Shyness	• Difficulties in responding to the questions in front of classmates • Not asking for an additional explanation from teachers
Lack of Time Management Skills	• Procrastination • Unpreparedness for the lesson
Language Problem	• Difficulties in understanding additional reading materials in foreign languages

Subtheme 1.1. Lack of Prior Knowledge. Respondent 2 (Teacher 1) also supports the idea that students do not learn mathematics well in school, also adds that they even have difficulties with making simple sentences and they do not read a lot.

Respondent 5 (Teacher 3) highlights:

> Əgər biz ali təhsil müəssisələrindən danışırıqsa əsas çətinliklər orta məktəblərdən gəlir. Riyaziyyat üzrə verilən bilgilər öyrənmək üçün kifayət deyil.
>
> [As we are talking about the higher education institutions, the main difficulties come from the secondary schools. The basic knowledge is not enough and mathematics is the main subject].

Respondent 3 (Teacher 2) did not consider the lack of school knowledge as a challenging factor for students by saying "The school curriculum does not have such a significant impact on our subjects" and mainly focused on the lack of attention of students.

Respondent 6 (Teacher4) claimed that education program impacts students learning. He said

> Məktəbdə Universitetdə lazım olan mövzular məsələn törəmə, inteqralların hesablanmasına kifayət qədər vaxt ayrılmır. Məktəb proqramında bu çatışmamazlığı nəzərə alıb, onları aradan qaldırmağa çalışmaq lazımdır.
>
> [In the school programs, speared time for the topics such as derivatives and integrals are not enough. This problem should be under the consideration of school management]

Respondent 2 (Teacher 1) also mentioned that multiple-choice questions also negatively impact students learning. While solving tests, students focus on finding the correct answer instead focusing on the solution.

Subtheme 1.2. Lack of Communication Skills. According to the thoughts of Respondent 4 (Tutor), the students cannot understand the professors because they got

so used to the test system and yes/no answers that they cannot even communicate, express their opinions and respond orally.

Respondent 6 (Teacher 4) supports and says:

> Onların danışıq bacarıqları yoxdur. Sadəcə öyrənməyə cəhd edirlər. Onlar əsas biliklərə yiyələnməyiblər.
>
> [They do not have speaking skills. They do not try to learn. They lack primary knowledge."]

Respondent 3 (Teacher 2) mentioned that when he asks questions, students are not able to use mathematical terminology correctly. Students also have difficulties when they talk with him, they cannot express their thoughts properly.

Subtheme 1.3. Students' Irresponsibility. Respondent 3 (Teacher 2) highlighted the fact that the reason for students having difficulties is their irresponsibility and laziness to study:

> Mən deyərdim ki onların riyaziyyatı yaxşı qavramaq qabiliyyəti var. Onlara izah edəndə yaxşı başa düşürlər və öz üzərlərində işləyirlər. Çətinliklər evdə olur çünki çox hallarda tələbələr evdə özləri öyrənmirlər.
>
> [I would say that they have a good perception of mathematics, they understand when you explain to them and they do better if they work hard. These difficulties simply occur because they do not do self-study at home.]

Subtheme 1.4. Shy Students. Respondent 2 (Teacher 1): Bəzi tələbələr utancaq olur və bu onları bilməklərini soruşmağa mane olur

Respondent 2 (Teacher 1): [Some students are shy and it prevents students to ask questions]

Also, another factor was about the personalities of students, as some of them were just shy or reluctant to actively participate in the class. Respondent 2 (Teacher 1) points out that some students are shy and cannot solve the problems in front of the other students, also they want to express their opinion but they cannot do it and it is understandable. The main reason is that they are freshmen and they will get used to it. After the first semester, the respondent says, 90 percent of them put such fears behind.

Subtheme 1.5. Lack of Time Management Skills. Regarding the materials, the respondents mentioned that the university has enough materials to provide students; however, they either do not have enough time to spend on reading them or they are not so willing to read materials, especially additional books. Of course, not all students are the same. For instance, Respondent 2 (Teacher 1) pointed out that the students can be divided into two parts: responsible and less responsible ones. Some students cannot manage their time effectively. The ones who are responsible usually go to the library and look for additional materials, the other group thinks the materials provided by professors are sufficient, but they will not be able to understand materials in-depth as they are not doing research on the topic. By highlighting the availability of materials both in the library and in electronic format Respondent 2 (Teacher 1) also mentioned:

> Dərs vəsaitləri siyahısında kifayət qədər material var. Əvvələr ədəbiyyatlar rus dilində idi. Ancaq müstəqillik dövründən sonra öz dilimizdə də materiallar yazılıb.
>
> [There are many materials given in the course materials list. The literature used to be in Russian, but after independence, our professor wrote the books in our native language]

While talking about the materials, Respondent 1 (Deputy Dean) talked about the smart boards that the classes were provided to help students to understand the materials better.

As for the effect of the methodology used by the faculties, the respondent's opinions were positive and they considered the methodology satisfactory, except Respondent 4 (Tutor) mentioned that because of the adaptation problem that students are facing, they have difficulties understanding the professors, although the professors are explaining well. Respondent 6 (Teacher 4) also mentions that students usually do not spend enough time for studying. They say "I just read one time and did not understand".

Respondent 5 (Teacher 3) added family problems also influence students to manage their time efficiently. Apparently, the students who have problems in their families cannot concentrate on lessons, therefore they are not able do homework on time which later causes them difficulties in the colloquiums and final exams.

Respondent 5 (Teacher 3): Bəzi tələbələrin ailəvi problemləri onların vaxtlarını effektiv idarə etməsinə təsir edir və bu da onların öyrənməsinə mənfi təsir edir

Respondent 5 (Teacher 3): [Some students' family problems impact their management t time effectively and influence their learning negatively]

While talking about the family problems, Respondent 1 (Deputy Dean) mentioned the financial problems of some students as well.

Respondent 1 (Deputy Dean): Bəzi tələbələrin maddiyat ilə bağlı sıxıntıları olur və buna görə də onlar işləməyə məcbur olurlar. Onlar boş vaxtlarının müəyyən hissəsini işləməyə sərf etdiklərinə görə dərslərinə kifayət qədər vaxt ayıra bilmirlər

Respondent 1 (Deputy Dean): [Some students are obliged to work due to financial difficulties. Because students spend part of their leisure time working, they are unable to dedicate more time to study.]

Subtheme 1.6. Language Problem. Respondent 5 (Teacher 3) brings the language problem by saying that most of the books in foreign languages in the field of mathematics are in Russian and it sometimes causes a problem:

> Bu günlərdə tələbələrə inglis dilinə daha çox diqqət edirlər. Ona görə də onların rus dili bacarıqları zəifdi və çalışırlar ki rus dilindən yayınsınlar.
>
> [Nowadays students pay more attention to English so they have poor Russian skills and that's why they avoid the Russian language]

Theme 2. First-year Students' Support Suggestions

During the interview, we asked each of our respondents how they identified the challenges of first-year math students and they indicated several ways of identifying the challenges faced by first-year math students, such as professors questioning them, observing their behaviors in class, or students themselves.

We also asked math instructors and administrative staff about their suggestions on how the department can help first-year students to overcome their academic challenges and we had both similar and different answers. The most notable solutions are additional classes and providing students with additional materials, solving math problems based on difficulty level step by step, building relationships with the real-world problems and using them in their future jobs, etc. (table 12).

Table 12

Suggestions by teachers	Suggestions by administrative staff
Additional Materials	Using İCT during the lessons
Extra Classes	

Relate topics to the real-world	
Individual approach	

Subtheme 2.1. Observing Students. One of them expressed like as it is given below:

Mən hər bir tələbəyə individual yanaşıram. Auditoriyada gəzirəm və müşahidə edirəm ki tələbələrin hansı çətinlikləri var.

[Generally, I have an individualistic approach towards students. I walk in the auditorium and observe what the students are doing to see whether they have difficulty].

Subtheme 2.2. Asking Questions. Respondent 3 (Teacher 2) points out the individualistic approach for each student to make them be more active and share their problems, and Respondent 2 (Teacher 1) states that students express their problems while the professor questions them to understand whether they are ready for the class or not.

Respondent 3 (Teacher 2): Hər tələbəyə individual yanaşıram

Respondent 3 (Teacher 2): [I have an individualistic approach to each student]

Respondent 2 (Teacher 1): Sual cavab edərkən tələbələrin problemlərini başa düşülür

Respondent 2 (Teacher 1): [Main problems appear while addressing questions]

Subtheme 2.3. With the Help of the Tutor. Respondent 4 (Tutor) pointed out that students themselves are approaching and saying their problems while Respondent 1 (Deputy Dean) stated that tutors usually notify of the problems of students, not the students themselves. Respondent 1 (Deputy Dean) also mentions the usual visits to classrooms, as

much as possible, to motivate students to share their problems, not only regarding education but also general problems.

> Respondent 4 (Tutor): Tələbələr mənə yaxınlaşaraq öz problemlərini söyləyirlər, mən də lazım olduqda o problemləri müəllimlərə deyirəm ki, onlar problemləri həll etməyə köməklik etsinlər
>
> Respondent 4 (Tutor): [Students contact me and tell me about their problems; if necessary, I communicate those difficulties to the professors in order for them to be resolved.]

Subtheme 2.4. Providing Additional Materials and Classes. For example, Respondent 5 (Teacher 3).

> Biz tələbələr dərsi yaxşı başa düşə bilsin deyə onlara materiallar veririk və onlayn təhsil zamanı olan dərsləri izah etmək üçün əlavə dərslər təşkil edirik.
>
> [We provide students with materials, and extra classes for covering the materials taught in online classes.]

Respondent 6 (Teacher 4).

> Biz tələbələrin suallarına cavab vermək üçün əlavə vaxt sərf edirik və elektron formadan dərslər veririk.
>
> [We spend extra time answering the questions of students and provide students with lectures in electronic form.]

Respondent 4 (Tutor).

> Pandemiyadan əvvəl biz bütün birinci kurs tələbələri üçün prezentasiya hazırlayırdıq və onlara Boloqna prosesini izah edirdik. Həmçinin biz tələbələrə sinif təmsilçisini təqdim edirik ki onlar sonra bir birlərini xəbərdar edə bilsinlər.

[Before the pandemic we made a presentation for all freshmen and explained the Bologna Process, also we gather class representatives and explain it to them so that they can later explain it to their classmates.]

Subtheme 2.5. Building Relationships with the Real-World Problems. Respondent 3 (Teacher 2) describes the solution in the following way:

> Müəllim dərsi izah edə bilmək üçün dərsə hazırlıqlı gəlməlidir. Dərsi başa düşməyi ancaq kollekvum ilə öyrənmək mümkün deyil. Tələbələrə dəstək verilməlidir. Məsələn öyrəndikləri dərslər real həyatda necə tədbiq edilir. Gələcəkdə işlərində öyrəndiklərini necə tədbiq edəcəklər. Sonra onlar özləri başa düşəcək ki əgər onlar yaxşı oxusalar öyrəndiklərini işdə tədbiq edə biləcəklər və yaxşı maaş qazanacaqlar.
>
> [The professor should explain to the student that he/ she must be prepared for the classes. However, it is not possible to understand the subject well only by studying for colloquiums. Students need to be encouraged. For example, how these topics can be used in real life. How this knowledge will be needed in future jobs. Then they think that if they study and apply this subject, they will have a good job and decent salary. The students should be given additional advice and explained that it is important to study the topics now for their future]

Subtheme 2.6. Teachers' Methodology. In order to help students easily adapt to online classes Respondent 2 (Teacher 1) says:

> Dərslər Blackboard üzərindən onlayn keçirilir. Dərsdən sonra biz tələbələrdən teoremləri onların izahlarını faktları və xarakterikaları soruşuruq. Sonra isə biz buna aid tapşırıqlar veririk. İlk suallar asan, növbəti suallar orda, sondakı suallar isə çətin olur. Bu birinci kurs tələbələrin təhsilə adaptasiya olmasına kömək edir.

[Lectures are held online in Blackboard… After the lecture, we ask students definitions, theorems, facts, and characteristics… After we assign them math problems related to that topic. The first problems are easy, the next ones are normal, and then difficult examples. It helps in the adaptation of the freshmen.]

Respondent 2 (Teacher 1) thinks colloquiums are the ideal way to reveal the knowledge of each type of student as they ask different types of questions to them:

Birinci kollekvumdan sonar biz başa düşdük ki şagirdlərin dərslərdə nəyi öyrənməyə ehtiyacı var. Bəzi şagirdlər utancaqdır, lövhədə qarşısında danışmağa utanırlar və sinifdə sakit otururlar. Ancaq onlar dərslərini yaxşı oxusalar biz bunu kollekvumda görə biləcəyik. Buna görə də uşaqların psixologiyasını başa düşmək çox çətindir.

["After the first colloquium, we identify the needs of students, of course, we get to know all the students this way. Some students are shy and do not want to come in front of the blackboard and they are usually quiet in the classroom. But if they study well, we will identify it with the help of colloquiums. It is difficult to understand the psychology of all children"]

Subtheme 2.7. Approach to Shy Students. Respondent 3 (Teacher 2):

Utancaq tələbələr ilə işləmək çətindir, onlar digər tələbələrin qarşısında sual verməkdən çəkinirlər.

[It is important to not give up on a student who is shy to solve the problems in front of the students and ask him/her several times to go forward.]

Respondent 5 (Teacher 3):

Qrup yoldaşları onların qavrama potensialının zəif olduğunu fikirləşər deyə hamının qarşısında misal həll etməkdən utanırlar. Ona görədə mən onlara deyirəm ki dərsdən sonra qalın sizə fərdi izah edim.

[Some students are shy to solve the problems in front of everyone because they think that if they do it wrong the others will think poorly of them, I ask them to stay after class to clarify the problem individually].

Subtheme 2.8. Using ICT during the lessons. During the interview Respondent 1 (Deputy Dean) said that it would be better if the instructors use ICT when they explain a new topic.

Tələbələrin çox hissəsi vizual daha yaxşı öyrəndiklərindən, müəllimlər yeni dərsi prezentasiya üzərində izah etsələr, onlar üçün dərsi qavramaq daha asan olar.

[Because most students are visual learner, it will be easier for them to grasp the lesson if teachers explain the new lesson through a presentation].

Chapter 5: Conclusion

In conclusion, this research has studied the academic challenges of the first- year students at the department of Applied Mathematics and Cybernetics of Baku State University, and the current practice of this department on supporting the students. More precisely, this research study has investigated different factors that lead to the first-year students' challenges and also solutions for these challenges. The significance of this study is the creation of the guidelines of the Math Club for the Department for assisting the academic challenges of the first-year students and contributing to the existing literature, which is limited in the context of Azerbaijan.

Firstly, the review of the literature and interview/survey results has shown that there is a negative correlation between different factors and students' academic success. Secondly, the study also found that there were different factors that lead to the academic challenges, which can be classified as personological or contextual variables. Although interview and survey results find out factors related the financial difficulties, housing problems and psychological state of the students (less motivation, laziness) they were not considered in designing guidelines of the Math Club as these factors were not subjects of this study.

In addition to that, different factors lead to different academic challenges, like drop-out, low performance in assessments and other. Thirdly, the study has concluded that different types of support should be provided by the department in order to assist to the students. Lastly, based on the study findings, the Guidelines of the Math Club has been developed, which includes quite wide range of events that have been found to be effective by the literature and participants of this study. These events can be classified as social and academic types of and the main purpose of organizing them are to support academically weak students and build collaboration among students and faculty. As a result, the research questions of this study has been answered.

Limitations

This study has some limitations:

- The main focus of our study was the first-year students in the math department. This means that the findings of this research cannot be applied to other departments and students as well.
- The study was conducted at a single research site at Baku State University, and the sample size was insufficient to generalize the findings to mathematics departments at other universities.

Chapter 6: End Product. Applied Mathematics (AM) Club

As we mentioned above, the purpose of our study was to reveal the factors that lead to the first-year students' academic challenges and explore how the universities support these students. In order to explore the factors and also find out the current practices, we interviewed the faculty members and surveyed students. These tools allowed us to detect key factors and practices in the research site.

Based on our findings and an examination of the literature, we propose to establish a math club for Applied Mathematics and Cybernetics department. We called this club as Applied Mathematics (AM) Club.

The Purpose of Establishing AM Club. The main functions of the AM Club are to assist first-year students who are facing various academic challenges and make connections between students and the department staff. The Club will also operate as a social club, hosting a range of events throughout the year to help first-year students get acquainted with the department and meet math-interested undergraduates from different groups of the department.

Establishing AM Club. In order to begin the process of establishing the AM Club firstly, the management board should be elected. The management board will consist of the Club's president and three vice-presidents. All members of the board will be elected from third-year students in order to manage the Club for two years. Elections are conducted in September and contain the following procedure:

- Tutors meet with each group of third-year bachelor's students and say them to select three or four students to serve on the Math Club's management board. Candidates should have strong management and communication abilities, as well as a good GPA.

--After each group introduces its candidates, the academic staff (tutor, deputy dean, and dean) will interview them and select the board's composition.

Members of the management board are responsible for organizing events, informing first-year students about the club, responding to club members' questions, and monitoring the event's accomplishments.

Membership. During the first week of the academic year, vice-presidents with the tutor organize a meeting for all first-year students and introduce them to information about the AM Club. But before the meeting, posters about the AM Club will be hung at the department. At the end of the meeting, students are given a mail and phone number to which they may contact and send information about themselves (phone number, math level) if they choose to join the Club.

AM Club organizes two types of events: social and academic.

Social Events. As discussed in the literature and also found out during this project main challenges of first-year students are also connected with their low level of soft skills – time management, communication, self-study, and other skills. In order to support students to enlarge their soft skills, the AM Club can organize different social events such as the first day. Pi day celebration, movie time, and guest speaker session. These events also will help first-year students to build a relationship with their classmates, academic staff, and instructors.

The First Day. In this event, senior students talk about the challenges that they face in their first academic year and give advice on how to overcome them. The management board should take into account the following thoughts:

- Speakers should be from all three streams: Azerbaijani, Russian, and English. Because students who study in one section have their specific problems. For instance: students who study in the English stream may have language difficulties.

- Speakers should have a different level of GPA: good and bad.

The duration of this event is two hours.

Pi Day Celebration. Mathematicians and scientists all around the world celebrate March 14 as a holiday for the mathematical constant. In order to build a friendly relationship between club members, the AM Club will organize an event devoted to Pi Day. During the event, a little competition will be organized. This competition will help first-year students to develop critical thinking and networking skills.

The rules of this competition will be following:

- Before one week, AM Club will send an email regarding the event and the rules of competition. The main purpose of competition is to find the method for how to remember the digits of the mathematical constant pi.

- Two days before the event, the members who want to participate in the competition should send mail to the management board and write their ideas. In case, if the number of candidates is more than 20, the management board will choose only 20 participants.

- The competition's registration fee will be between three and five manats. It will depend on the number of participants. The collected money will be used to purchase a voucher from bookshop, which will be given as a prize to the winner.

- During the Pi Day event, all participants will share their methods with the AM Club members and the winner will be determined by an anonymous poll conducted among club members. After the competition, the AM Club members will have tea time with apple pie.

- If March 14 will be on Saturday or Sunday, the Pi Day event will be organized on Friday before March 14.q

Movie Time. Educators claim that movies are a great resource for visual learners because they can understand the concept without any obstacles to learning. The use of appropriate film clips and short films as the context of mathematical inquiry has great potential for improving student involvement in mathematics and realizing abstract mathematical ideas (Russo & Russo, 2020). Many films have powerful mathematical

elements that stimulate discussion and help students learn in class.The purpose of this event is to motivate students and help them deeply engage to mathematic learning.

Movie Time event will be organized in the following way:

-AM Club will organize movie time for first-year students once a month.

-It can be each last Friday of the month. An announcement (poster or e-mail) should be provided about the date and the movie that will be played.

-After watching the movie students will have a discussion about it and try to explore mathematical elements that are described in the movie.

-The list of mathematics movies is offered.

Stand and Deliver

The Man Who Knew Infinity

Pi

A Brilliant Young Mind

Good Will Hunting

The Imitation Game

Codebreaker

A Beautiful Mind

A Brief History of Time

N Is a Number: A Portrait of Paul Erdös

Travelling Salesman

Fermat's Room

Guest Speaker. Inviting successful alumni as guest speakers to share their experiences can be an effective method to motivate the first-year students and deepen their interest in their chosen major. This event is organized every two months and lasts between one to two hours.

Academic events. Academic events should be organized regularly depending on the need of students. As our findings overlap with the literature regarding the influence of students' prior mathematical knowledge to their academic success in the first year, we suggest following academic events organized by AM Club:

First Support. The majority of first-year students have difficulties in learning math at the university because a lack of prior knowledge, AM Club will organize sessions in order to fulfill this gap. The members who want to participate in these sessions will divide into three categories. A short test will be provided among the students in order to determine their level. The club members choose one of the following categories based on the result of test.

First Category- the weakest students will be in this category.

The Second Category will consist of students who have an average level of prior knowledge.

The Third Category will consist of students who are above average level of prior knowledge but still need help.

-The sessions will start in the second week of the academic year

-For the 1st category group the lessons will last three weeks

- For the 2nd category group the lessons will last two weeks

- For the 3rd category group the lessons will last one week

- Lessons will be held 5 days in a week and will last one hour

-When the number of students in a category is large, they will be divided into several groups

- Second, third, and fourth year of bachelor degree students who have good GPAs will teach in this session. These students will be chosen with help of tutors. They will participate voluntarily.

Peer Tutoring. Peer tutoring is defined as a collaborative and proactive learning strategy in which two students help each other and learn at the same time (Alegre & Moliner, 2017). Different types of peer tutoring can be implemented, depending on student skills, academic achievement, organizational status, resources, and personal resources. Studies show that, from an academic point of view, peer tutors have a moderate effect on a student's math performance (Alegre et al., 2019).

AM Club will define the number of most academically competent students who will serve as the tutor to the first-year students who have difficulties in comprehending university-level math subjects. The tutors can be chosen from all bachelors' degree students. The procedure of defining the tutors will be as follows:

- The tutors of the department will talk with the instructors and ask them to choose students who want and will be able to help the weak students.

- The tutors will talk with all groups of the department and ask them to select students in their group who want and will be able to help the weak students.

- The tutors will give the list of students who were selected both from instructors and groups to the management board of the AM Club. In order to engage students who participate as a tutor AM Club will issue a certificate.

Peer tutoring sessions will be organized in the following ways:

-The duration of the peer tutoring program will be

from September (from the third week of the academic year) till December

from February till May

- Peer tutoring sessions will be organized every week regularly

-Duration of the peer tutoring sessions will be 1-2 hours, usually Saturdays

- One tutor will help two weak students, but AM Club will issue a certificate to the students who teach weak students.

Seminars. Because in the survey, first-year students want extra classes in order to overcome their academic challenges, AM Club will organize seminars two times in a month in order to support students in better understanding of different complicated math topics.

Seminars will be organized in the following ways:

- In the fall term, seminars will start from the third week of the academic year till December. During this time, seminars on two subjects: mathematical analysis and analytical geometry will be organized

- In the spring term, seminars will start from February year till May. During this time, seminars on three subjects: mathematical analysis, linear algebra, and discrete mathematics will be organized

- For Azerbaijani and Russian streams seminars will be held separately

- Seminars will be held by teachers who teach first-year students or their ph.D students

- If the number of students who wants to participate will be big, they will be divided into two groups, and seminars for each group will be held separately.

- Seminars will start with an explanation of topics that are covered during the lectures. After that teacher will solve several problems related to the topics and then students will ask the teacher to solve the problems that they have difficulties

-The duration of the seminars will be from one to two hours

Study groups. As our findings also opened up first year students' low level of communication (even existence of shy students who refrain coming to the desk and solving the problems during the seminars) and collaboration skills, AM Club will facilitate forming and running different study groups among first year students. Studies show that students studying in groups often have the highest grades and the least academic problems (Gardner & Barefoot, 2012). As the saying goes, "two heads are better than one." Students usually learn faster when working in groups than when working alone. Working in groups gives students

the opportunity to explain concepts, review materials, share ideas, and discuss / discuss why one person's answer is different from another. In this way, you can seek explanations within the group and learn more quickly. The study group is more interested in specific activities than general issues, and the participants share common interests and goals related to the work environment (Sanacore, 1993).

In the beginning of academic year, AM Club will announce and initiate the creation of study groups (SG) among first year students. AM Club will assist students in forming SG's considering following criteria:

- Students themselves will define the purpose of different groups (for example: doing the home tasks together; supporting each other in most difficult math subjects; preparing for exams and competitions together and etc.);

- Number of participants in each SG should be three to six students. Participants should be defined not based on students friendship relations bat their academic needs;

- Meetings of SG will be at least once a week (during the weekdays after the lessons) and last up to 2 hours. Sessions should be provided in a friendly and informal atmosphere where healthy snakes and drinks are allowed. Depending on the weather it can be organized outside;

- During the exam periods, when students have limited time, meetings of SG can be organized online or through the social networks;

- Before gathering, one member will prepare questions or topic based on participants requests to discuss. SG will assign one student to lead each session and keep the group focused on the material;

- During the meeting students will ask questions, answer them, and explain why the answers are correct, help each other in understanding difficult math topics.

AM Club and SG members will periodically evaluate the performance of SG, AM Club will support SG to better communicate and develop. AM Club will also share the experience of successful SG among the students. Based on the exam results of SG members, most successful SG will be defined and announced at the end of academic year. They will also get prize from AM Club.

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Appendices

Appendix A. Survey questions for students.

1. Siz hansı dildə təhsil alırsız?
   - Azərbaycan
   - Rus
   - İngilis

2. Riyazi fənləri mənimsəməkdə çətinliklərniz səbəbi və ya səbəbləri nədir?
   - ☐ Orta məktəbdən öyrənilən biliklər
   - ☐ Tədris metodları
   - ☐ Tədris keyfiyyəti
   - ☐ Qiymətləndirmə sistemi
   - ☐ Fakültə və müəllim dəstəyinin olmaması
   - ☐ Vaxtın effektiv idarə edilməməsi
   - ☐ Digər _____

3. Orta məktəbdə əldə etdiyiniz riyazi bilik universitetdə tədris olunan riyazi fənləri mənimsəməkdə kömək edirmi?
   - Bəli
   - Qismən
   - Xeyr

4. Sizcə müəllimlərin tədris metodu (dərsin izah etmək üsulu) riyazi fənləri öyrənmək üçün əlverişlidirmi?
   - Bəli
   - Qismən
   - Xeyr

5. Tədris proqramını mənimsəmək, seminarlara və imtahanlara hazırlaşmaq üçün vaxtınız kifayət edirmi?
   - Bəli
   - Qismən
   - Xeyr

6. Siz nə səbəbdən vaxtınızı düzgün idarə edə bilmirsiz?

   _____

7. Çətinliklərinizlə bağlı müəllimə, yaxud fakültəyə (dekanlıq, tyutorlar) müraciət etdikdə, sizə lazımi dəstək göstərilir?
    - Bəli
    - Qismən
    - Xeyr

8. Ümumiyyətlə tədris prosesi zamanı qarşılaşdırğınız çətinliklərlə bağlı sizə hansı formada dəstək göstərilir?

_____

9. Fikrinizcə hansı formada dəstək Sizə fənləri daha yaxşı mənimsəməyə və imtahanlarda daha yaxşı nəticə əldə etməyə kömək edər?

_____

Appendix A. Survey questions for students (translation).

1. In what language are you studying?
    - ○ Azerbaijani
    - ○ Russian
    - ○ English
2. What is/are the primary cause(s) of difficulties in mastering mathematical subjects?
    - ○ Lack of Prior Knowledge
    - ○ Teaching Methods
    - ○ Low Teaching Quality
    - ○ Assessment
    - ○ Lack of Faculty and Teacher Support
    - ○ Inefficient Time Management
    - ○ Other
3. Does your high school mathematical knowledge help you learn the mathematical subjects taught at the university level?
    - ○Yes
    - ○Partly
    - ○No
4. Do you assume that the methods employed by teachers to teach mathematics are appropriate?
    - ○Yes
    - ○Partly
    - ○No
5. Do you manage your time effectively?
    - ○Yes
    - ○Partly
    - ○No

6. If no, why can't you manage your time effectively?

_____

7. Do you get the needed support from the teacher and the faculty regarding your difficulties?

○Yes

○Partly

○No

8. How are you supported in dealing with academic challenges faced during the learning process?

_____

9. What kind of support do you think will help you acquire math-related subjects well?

_____

Appendix B. Semi-structured interview questions for teachers.

Duration: 25-30 minutes

1. Neçə müddətdir müəllim işləyirsiniz? Bu fakültədə nə vaxtdan tədris edirsiniz? Hansı fənni tədris edirisiniz?
2. Tələbələrin çətinliklərinin olduğunu necə müəyyən edirsiniz?
3. Tələbələr əsasən hansı çətinlikləri ilə bağlı sizə müraciət edirlər?
4. Fikrinizcə bu çətinliklərin əsas səbəbləri nədir?
5. Sizin fikrinizcə tələbələr tədris materiallarını mənimsəmək üçün vaxtlarını düzgün idarə edə bilirlərmi?
6. Sizin fikrinizcə istifadə etdiyiniz qiymətləndirmə sistemi tələbərin bilik və misal həll etmə bacarıqlarının hansı səviyyədə olduğunu göstərməkdə onlara çətinlik yaradırmı?
7. Sizcə tələbələrin məktəbdə riyaziyyat fənnindən qazandığı bilik bazası onlara ali riyaziyyatı mənimsəməsi üçün yetərlidirmi?

8. Fakültədə istifadə edilən tədris materialları və metodologiya tələbələrin fənni mənimsəmələrinə kömək edirmi?
9. Tələbələrin sizin tədris etdiyiniz fənni mənimsəməklə bağlı çətinliklərinə nece dəstək olursunuz?
10. Tələbələrin riyazi fənləri mənimsəməklə bağlı olan çətinliklərinə dəstək olmaq üçün fakültəyə hansı tövsiyyələriniz var?

Appendix B. Semi-structured interview questions for teachers (translation).

Duration: 25-30 minutes

1. How long have you been working as a teacher? How long have you been teaching at this faculty? What subject do you teach?

2. How do you identify the difficulties of your students?

3. What are the most common issues that students bring up with you?

4. What do you think are the main reasons of these difficulties?

5. In your opinion, can students manage their time effectively enough to master the teaching materials?

6. In your opinion, does the assessment system you use make it difficult for students to demonstrate their level of knowledge and problem-solving skills?

7. Do you believe that students' school-based mathematics knowledge is sufficient for them to master higher mathematics?

8. Do the faculty's teaching materials and methodology assist students in mastering the subject?

9. How do you assist students who are having difficulty mastering the subject you teach?

10. What suggestions do you have for faculty to help students who are struggling to master mathematics?

Appendix C. Semi-structured interview questions for administrative staff.

Duration: 25-30 minutes

1. Neçə müddətdir bu fakültədə işləyirsiniz?
2. Tələbələrin çətinliklərinin olduğunu necə müəyyən edirsiniz?
3. Tələbələr əsasən hansı çətinlikləri ilə bağlı sizə müraciət edirlər?
4. Fikrinizcə bu çətinliklərin əsas səbəbləri nədir?
5. Sizin fikrinizcə tələbələr tədris materiallarını mənimsəmək üçün vaxtlarını düzgün idarə edə bilirlərmi?
6. Sizin fikrinizcə istifadə edilən qiymətləndirmə sistemi tələbərin bilik və misal həll etmə bacarıqlarının hansı səviyyədə olduğunu göstərməkdə onlara çətinlik yaradırmı?
7. Sizcə tələbələrin məktəbdə riyaziyyat fənnindən qazandığı bilik bazası onlara ali riyaziyyatı mənimsəməsi üçün yetərlidirmi?
8. Fakültədə istifadə edilən tədris materialları və metodologiya tələbələrin fənni mənimsəmələrinə kömək edirmi?
9. Tələbələrin riyazi fənləri mənimsəməklə bağlı çətinliklərinə nece dəstək olursunuz?
10. Tələbələrin riyazi fənləri mənimsəməklə bağlı olan çətinliklərinə dəstək olmaq üçün fakültəyə hansı tövsiyyələriniz var?

Appendix C. Semi-structured interview questions for administrative staff (translation).

Duration: 25-30 minutes

1. How long have you been working at this faculty?
2. How do you identify the difficulties of your students?
3. What are the most common issues that students bring up with you?
4. What do you think are the main reasons of these difficulties?
5. In your opinion, can students manage their time effectively enough to master the teaching materials?
6. In your opinion, does the assessment system you use make it difficult for students to demonstrate their level of knowledge and problem-solving skills?
7. Do you believe that students' school-based mathematics knowledge is sufficient for them to master higher mathematics?
8. Do the faculty's teaching materials and methodology assist students in mastering the subject?
9. How do you assist students who are having difficulty mastering the math-related subjects?
10. What suggestions do you have for faculty to help students who are struggling to master mathematics?

Appendix D. Interview Consent Form

MÜSAHIBƏYƏ RAZILIQ FORMASI

Tədqiqatçıların adları: Asya Quliyeva, Xədicı İsmayilova, Samirə Məmmədova, Zahid Məmmədov

Tədqiqatın adı: BDU-nun Tətbiqi riyaziyyat və kibernetika fakültəsinin birinci kurs tələbələrinin akademik çətinlikləri

Tədqiqatın məqsədi: Bu tədqiqatın məqsədi 1-ci kurs riyaziyyat tələbələrinin akademik çətinliklərinə səbəb olan faktorları aşkara çıxarmaq və Universitetlərin bu tələbələri necə dəstəklədiklərini tədqiq etməkdir. Tədqiqatın nəticələri fakültə üçün çətinlikləri olan tələbələrə dəstək məqsədi ilə tövsiyələrin hazırlanmasına töhfə verəcəkdir.

• Mən təsdiqləyirəm ki, bu tədqiqatda könüllü olaraq iştirak edirəm

• Mən başa düşürəm ki, məni narahat edən hər hansı müsahibə sualına cavab verməmək hüququm var

• Mən başa düşürəm ki, müsahibənin səs yazısı aparılacaq, səs yazısı ancaq məlumatların təhlili üçün istifadə olunacaq və bütün şəxsi məlumatlar silinəcək. Mən başa düşürəm ki, səs yazısı üçüncü tərəflə paylaşılmayacaq.

• Mən təsdiq edirəm ki, müsahibə təqribən 20-25 dəqiqə çəkəcək.

• Mən təsdiq edirəm ki, mənim şəxsi kimliyim anonym saxlanılacaq.

• Mən başa düşürəm ki, bu müsahibədən toplanılmış məlumatlar üçüncü tərəflə paylaşılmayacaq.

• Mən bu sənədi oxudum və başa düşdüm.

İştiakınız üçün təşəkkür edirik!

Bu sənədi imzalamaqla mən müsahibədə iştirak etməyə razılıq verirəm.

_____	_____	_____
İştirakçının adı	**Tarix**	**İmza**
_____	_____	_____
Tədqiqatçının adı	**Tarix**	**İmza**

Appendix D. Interview Consent Form

INTERVIEW CONSENT FORM

Researchers' names: Asya Guliyeva, Khadija Ismayilova, Samira Mammadova, Zahid Mammadov

Research title: Academic Challenges of First-Year Students at Applied Mathematics and Cybernetics Faculty of BSU

Purpose of the research: The purpose of this study is to reveal the factors that lead to first-year math students' academic challenges and to explore how the universities support these students. The findings of the study will contribute to developing guidelines for the department on how to assist students who are experiencing difficulties.

• I confirm that I voluntarily participate in this research.

• I understand that I have a right not to answer any interview question if I feel uncomfortable.

• I understand that the interview process will be recorded, the recording will be used only for data analysis, and all personal data will be deleted. I understand that the recording will not be shared with a 3rd party.

• I confirm that the interview will last approximately 20-25 minutes.

• I confirm that my personal identity will be kept anonymous.

• I understand that the data collected from this interview will not be shared with 3rd parties.

• I have read and understood this document.

Thank you for participating!
By signing this document, I agree to participate in this interview.

_____	_____	_____
Participant Name	**Date**	**Signature**
_____	_____	_____
Researcher Name	**Date**	**Signature**