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Prospective Mathematics Teachers' Flow Experiences: From High School to University

Matematik Öğretmen Adaylarının Akış Deneyimi: Liseden Üniversiteye

Ayşenur Uyma[*] & Hasan Ünal[**]

Abstract

Flow is a subjective experience that is a state of being totally involved, absorbed by activity and focused while enjoying doing the activity for its own sake. Researchers found out flow experience is effective in learning and teaching process. Therefore, the purpose of the research was to investigate the flow status of prospective mathematics teachers at major courses in university and whether their flow status is changed from high school to university, or not. It is also determined the factors affecting their flow experiences. The design of the longitudinal research conducted with 55 participants is a mixed study including descriptive study and multiple case study. Data collection tools are the form for the degree of difficulty of university entrance exam questions in order to get information students' flow experience in high school, Flow Short Scale developed by Rheinberg, Vollmeyer, and Engeser (2003) and semi-structured interviews are used. Results show a few numbers of student teachers experience flow; the majority feel at ease in accordance with 5 channels flow model designed by depending on 4 quadrants flow model (Massimini & Carli, 1988) and 8 channels flow model (Massimini & Carli, 1988). Moreover, instructor factor, the difficulty level of academic tasks, academic effort, and association between previous knowledge and the objectives of the courses have impacts student teachers' flow status. The other finding is rote learning prevents to experience flow.

Keywords: Motivation, Flow Experience, Instructor Factor.

Öz

Öznel bir deneyim olarak akış, bir etkinliği gerçekleştirirken amacın yalnızca etkinliğin kendisinin olduğu, keyifle tamamen kendini kaptırdığı, etkinlikle bütünleştiği ve odaklandığı bir durumdur. Araştırmacılar akış deneyiminin öğrnme ve öğretme süreçleri üzerinde etkili olduğunu tespit etmişlerdir. Bu nedenle, bu araştırmanın amacı matematik öğretmen adaylarının üniversitede aldıkları alan derslerinde akış yaşama durumlarını incelemek ve liseden üniversiteye akış deneyimlerinde değişiklik olup olmadığını tespit etmektir. Ayrıca, değişikliğin olduğu ve olmadığı durumları etkileyen faktörlerin ne olduğunu belirlemek araştırmanın amaçlarındandır. 55 katılımcı ile gerçekleştirilen uzun süreli çalışmanın araştırma deseni betimsel ve çoklu durum çalışmalarını içeren karma araştırma yöntemi olarak belirlenmiştir. Veri toplama araçları olarak lisedeki akış durumlarını belirlemek amacıyla yükseköğretime geçiş sınavı sorularının zorluk derecelerinin puanlandırılması için bir form, Rheinberg, Vollmeyer ve Engeser (2003) tarafından oluşturulan ve İşigüzel ve Çam (2014) tarafından Türkçe'ye uyarlanan Akış Kısa Ölçeği ve yarı yapılandırılmış mülakatlar kullanılmıştır. Bulgular, az sayıda öğretmen adayının bu dersler kapsamında akış yaşadıkları, 4 kanallı akış modeli (Massimin& Carli,1986) ve 8 kanallı akış modeline (Massimini & Carli, 1988) dayanarak tasarlanan 5 kanallı akış modeline göre öğretmen adaylarının çoğunun rahatlama kanalında olduklarını göstermiştir. Ayrıca, öğretmen faktörünün, yapılan akademik etkinliğin zorluk derecesinin, akademik çabanın ve derslerin kazanımlarını önceki bilgiler ile ilişkilendirme düzeyi öğretmen adaylarının akış yaşama durumları üzerinde etkili olduğu görülmüştür. Bir diğer bulgu ise ezberci yöntemin akış deneyimini engellemesidir.

Anahtar Kelimeler: Motivasyon, Akış Deneyimi, Öğretmen Faktörü.

[*] (YL Öğrencisi); Yıldız Teknik Üniversitesi, aysenur.uyma@gmail.com, ORCID: orcid.org/0000-0002-5579-1634

[**] (Prof. Dr.); Yıldız Teknik Üniversitesi, Eğitim Fakültesi, hunal06@yildiz.edu.tr, ORCID: orcid.org/0000-0002-4661-111X

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Introduction

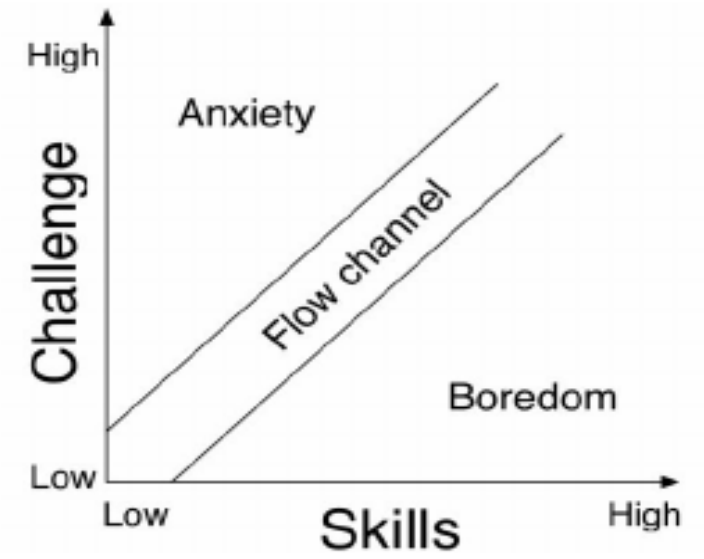
Some of the problems frequently encountered during educational process are students' indifference toward courses, not being involved actively in learning process and being reluctant to learn new information (Csikszentmihalyi, 1997b). These issues appear in classrooms. Although students' bodies are in the classrooms, but not their minds (Steinberg, Brown & Dornbusch, 1996). This situation causes serious problems in mathematics education. The discrete nature of mathematics and biases developed toward it complicate to learn the objectives. Some other reasons for having difficulty in mathematics are which they could not make connection with daily life and not being aware of the importance of developing analytic thinking and problem solving skills via mathematics (Shernoff et al. 2014). These problems are mostly related with affective domain including feelings and motivation. In this paper, motivation as a component of affective domain is elaborated by concerning the solution of the mentioned issues, since motivation plays a significant role in learning process and school achievement (Pintrich & Schunk, 1996).

Ryan and Deci (2000, p.54) described the concept of motivation as 'to be moved to do something.' Another definition of motivation is the process that target-oriented actions are supported and sustained (Schunk, Pintrich & Meece, 2002). Many researches are made on motivation having a significant role to achieve goals and theories are propounded to discover the nature of intrinsic motivation deeply. One of them is flow theory. The theory is conceptualized by Hungarian psychologist Mihaly Csikszentmihalyi in the last half of the 20th century. As a psychological state, flow is being totally involved, being fascinated and getting enjoy while doing an activity (Csikszentmihalyi, 1988). According to Csikszentmihalyi (1997), it is required to achieve and sustain an activity that to recognize one's skills and interests, to be able to control inner life and to determine realistic goals. In such a situation, s/he concentrates completely and in the zone, calls flow, while realizing the lower steps to achieve the goals. Consequently, s/he is motivated while achieving the aims and determines more challenging ones. Shortly, it can be said that flow experience is the output of the mutual relationship between success and intrinsic motivation (Csikszentmihalyi & Rathunde, 1997).

Flow experience has many dimensions, including the conditions and characteristics of flow state. The conditions are having clear goals, immediate feedback and the balance between challenge perceived and skill matching up with the level of the challenge. The features of flow experience are intense concentration, the sense of control over the action, loss of self-consciousness, loss of sense of time and autotelic experience. The initial condition is to have clear goals is that one determines well-defined targets and the actions to achieve them. Individuals overcome the obstacles while reaching the goals under favour of immediate feedbacks and improve the process. The most underlined condition of flow experience is the challenges stretching the skills, but ‘not overmatching or underutilizing’ (Nakamura & Csikszentmihalyi, 2009, p.89). If the level of challenge overmatches someone’s capacity, the person is getting anxiety. In the contrast, if the level of challenge is low with respect to the skills, s/he is getting bored. In the both of the situation, s/he is more likely to leave the activity or not continuing progressively (Csikszentmihalyi, 1990). In addition of the conditions, the first characteristics of flow is to be absorbed and to pay particular attention to the activity. The control on the action belongs to the individuals. S/he recognizes how continuation of the process is. S/he does not care about her/his appearances, the others’ thoughts and s/he has her/his own standards to evaluate the progress. The individual loses the sense of time and perceive that time goes faster in general. Finally, the autotelic experience is that the activity is rewarding in itself. The person does the activity for enjoyment, not for external outcomes (Csikszentmihalyi, 1990; Novak & Hoffman, 1997; Novak, Hoffman, & Yung, 2000).

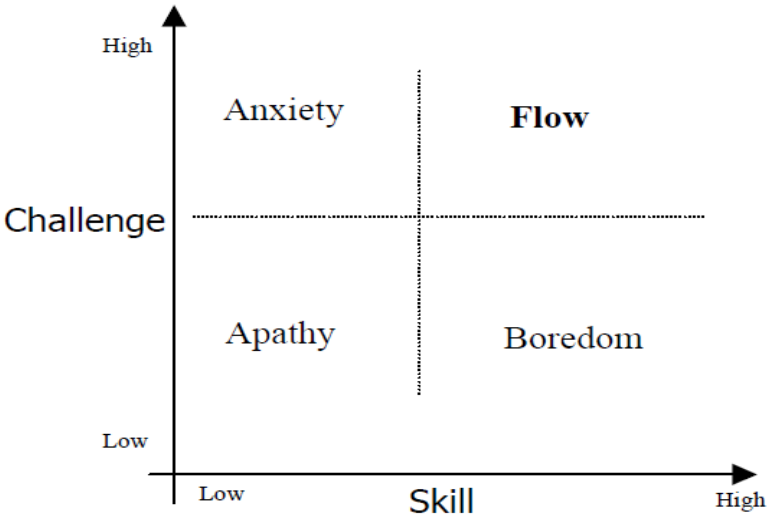
Some models are designed to show psychological situations with respect to challenge and skill balance. The first flow model is shown in Figure 1. According to the model, someone can experience flow when her skills matches the challenge of an activity.

Figure 1. Flow Model (Csikszentmihalyi, 1975)



4 quadrants flow model (Csikszentmihalyi & Csikszentmihalyi, 1988) is developed (Figure 2). A person experience flow when the perceived skill and the perceived challenge is at high level. If the perceived challenge overmatching with the skill, s/he feels anxious, the otherwise s/he gets bored. If the challenge and skill remain the moderate level, it leads to experience apathy. Flow is the one which people experience positive feelings, and the other three channel lead people to experience negative feelings (Jonsson & Persson, 2006).

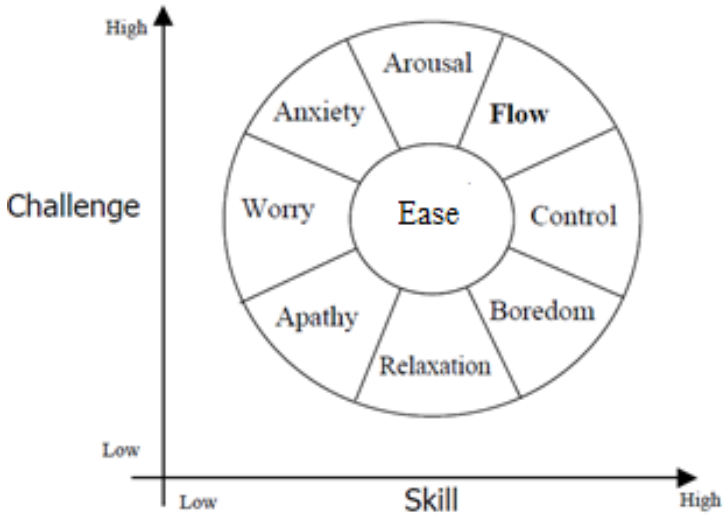
Figure 2. The 4-Channel Flow Model



Massimini and Carli (1988) designed a more complicated flow model that includes 8 channels (Figure 3). The channels are categorized in accordance with the following:

- High level of challenge and skill lead to flow,
- High level of challenge and moderate skill lead to arousal,
- High level of challenge and low skill lead to anxiety,
- Moderate level of challenge and low skill lead to worry,
- Low level of challenge and low level of skill lead to apathy,
- Low level of challenge and moderate level of skill lead to relaxation,
- Low level of challenge and high level of skill lead to boredom,
- Moderate level of challenge and high level of skill lead to control.
- Moderate level of challenge and skill lead to ease.

Figure 3. The 8-Channel Flow Model



As mentioned above, the main precondition of flow state is that one has capacity to overcome the challenges of an action. When the balance between challenge and skill is not found, the activity either is getting boring or is getting worrying. It is not possible flow to occur for both of the two situation (Csikszentmihalyi, 1975a; Schmidt, Shernoff & Csikszentmihalyi, 2014). Flow is an optimal experience occurring the activity whose difficulty allows people manage, control and achieve. For that circumstances, they become "a magnet to learn new information" and improve their skills while the level of challenge increase. If the level of challenge is below the level of skill, it is possible for flow by increasing the former. Otherwise, it is the way for flow by increasing the latter (Csikszentmihalyi, 1997, p.2).

Many researches are made for understanding the dimensions of flow experience. According to Csikszentmihalyi and LeFevre (1989), people need to hope success for flow state. They do not expect the people who avoid failure to experience flow. The research made with junior university students in Switzerland was related to that point (Schüler, 2007). The study was carried out two stages. The purpose of the first stage was to investigate the prediction of flow with the challenge-skill balance and effects of flow on the course. Data were collected from 57 students by means of Flow Short Scale (Rheinberg, Vollmeyer & Engeser, 2003) and Positive and Negative Effect Scale (Watson, Clark, & Tellegen, 1988). According to the data analysis, students who hoped to be successful experienced flow and students who

feared to fail did not. Moreover, it was found that there is a significant relationship between the challenge-skill balance and flow. The aim of the second stage was to examine flow consequences in the related with academic performance. Data were collected by the same materials and exam performances. The results of the study showed that flow experience is a predictor of exam performance.

The longitudinal research conceptualized students' engagement with related to their concentration, interest and enjoyment. It was analyzed that how students spent their time in schools and under which conditions they actively participated to school activities. The sample of the study formed 526 American high school students. The results of the study showed that students experienced flow when both of the challenge of the activity and their skills were higher level, when they interested in that activity and when they could control their environment. In addition, the most frequent activities allowing flow were found as individual works (Shernoff, Csikszentmihalyi, Schneider & Shernoff, 2014).

Various study reached how flow occurs, the features of flow and the factors affecting on the experience. Some topics of the researches in the concept of flow are the following; social class by Allison and Duncan, age groups by Abbott, cultural differences by Massimini, Csikszentmihalyi and DelleFave, and alienation by Mitchell (Csikszentmihalyi & Csikszentmihalyi, 1988). However, the educational studies at mathematics related with flow theory are limited in national literature. Especially any study is not encountered flow status of prospective mathematics teachers during major courses at university level.

It is thought that investigation of flow experiences of mathematics teachers' candidates from high school to university is important since all students attending faculty of education come to university with their experiences, feelings and motivation towards mathematics. If they were happy with mathematics at high school, it must be resumed at university. If they did not experience flow at high school, it needs to provide them to experience flow at university. Since, if teacher candidates do not experience flow during their learning process, they would not lead their students to such an experience (Frase, 1998)

When the mentioned researches are taken account, flow state as an optimal experience is quite important since it provides opportunities to engage students to participate actively in learning process and sustain learning by enjoying. In addition to learn more, students have positive experience during learning process (Deci & Ryan, 1985). Therefore, this purpose of the study was to examine flow experiences of mathematics teacher candidates in the major courses at university and to detect how flow experience changes in from high school to university level, if so. In addition, the study aims to find the source of the changes.

Method

Data collection process and tools, and data analysis were mentioned in this chapter.

Research Design

The research is a mixed study (Morse, 2003) as including quantitative and qualitative research methods in order to identify status of flow experience of prospective mathematics teacher in Primary Education for mathematics and geometry courses during their high school education and to determine whether the participants experience flow at their major courses including analysis, algebra and analytic geometry at university, and what the reasons were. For these purposes, the research was into two parts. Descriptive study was followed to investigate perceived challenge of participants in the university entrance examination in 2017 (YGS 2017) to know their flow experiences in high school. Descriptive study is used to explain extensively of certain circumstances of a group of people (Lambert & Lambert, 2012). Thanks to the description, it is gained the opportunity to select the critical cases. In addition to the descriptive

study, it is aimed that to investigate the causes of changes in flow experience at high school mathematics and geometry courses after university. Therefore, the qualitative part of the research design is endorsed multiple case study (Stake, 2013).

The Sample and Data Collection Process

The research is a longitudinal study taking two periods. The first data were collected in fall semester in 2017 from 36 freshmen primary mathematics teachers and data of the second part of the research collected from 36 junior students at the same department in fall semester in 2019. 17 of the participants attended the two parts of the study. Therefore, the sample forms from 55 prospective mathematics teachers. Interviews were had with six participants. Participants who had semi-structured interviews were chosen by using output obtained from descriptive statistics. These special cases were categorized in accordance with the following:

-Experienced flow at high school and also experienced at university,

-Experienced flow at high school, not experienced at university,

-Not experienced flow at high school, experienced at university,

-Not experienced flow at high school and also experienced at university.

Semi-structured interviews were made for qualitative research of the mixed study in order to investigate the factors underlining changes on the status of flow experience from high school to university. The participants were called as P01, P02, P03, P04, P05 and P06.

All participants were willing to attend the study.

Data Collection Tools

University entrance exam questions was used to gain information about flow experience of the students at mathematics and geometry courses during high school years. The questions were given on a A3 page, individually and a form too fill the degree of difficulty of the questions.

Flow Short Scale (FSS) designed by Rheinberg, Vollmeyer, and Engeser (2003) was used to investigate flow experience of the prospective mathematics teachers at algebra, analysis and analytic geometry courses during university education. The scale formed by the flow and anxiety factors. The scale was adapted in Turkish by İşigüzel and Çam in 2014. Data gathered by FSS used to determine the critical cases who experience flow and anxiety during the major courses at university. Semi-structured interview was used to understand the reasons for the experiences, deeply. Semi-structured interviews provide deep understanding about the participants' their own definitions, expressions and perceptions about certain issues, which is the focus of quantitative researches. The characteristics of the interviews is to give the participants opportunities to express their thoughts (Matthews &Ross, 2010). Interview process was recording completely by courtesy of participants, and researchers analyzed participants' wordings carefully.

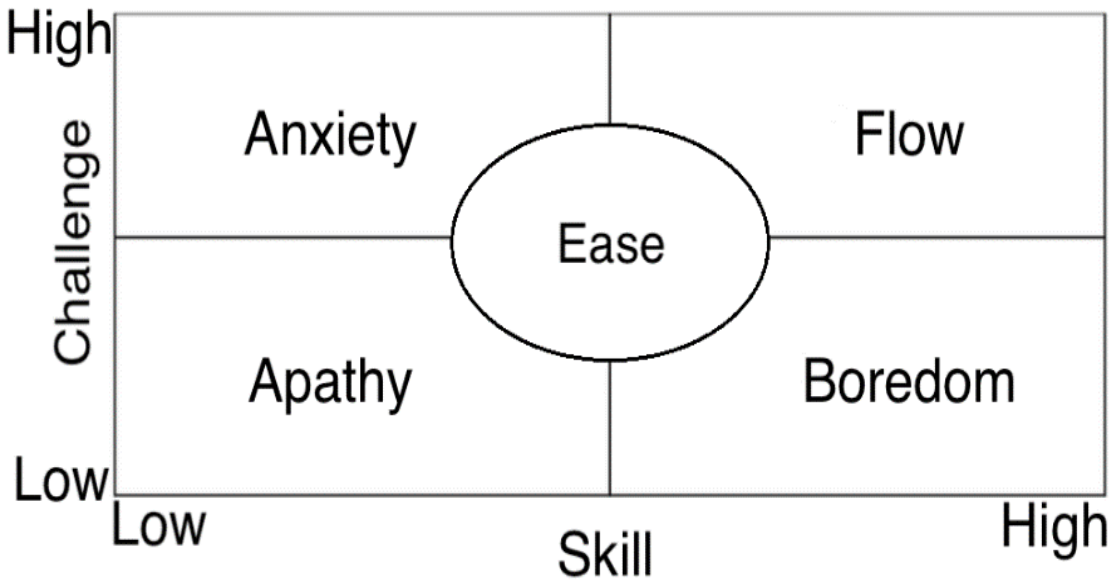
Consequently, the research design was mixed research including descriptive study and multiple case study, and the means of data collections were the form for university entrance exam, Flow Short Scale and semi-structured interviews.

Data Analysis

Column charts were used to analyze quantitative part of the research. The tables show the number of students in each degree of difficulty. Difficulty levels are scored as "1-very easy, 2-easy, 3-moderate difficulty, 4-difficult, 5-very difficult" for mathematics and geometry, separately. Frequency table is used to evaluate both majors at the same table. The levels of difficulty were categorized into three levels as easy, moderate and difficult.

One of the purposes of the research is to investigate flow status of prospective mathematics teachers. Hence, Flow Short Scale was used to collect data. Data were evaluated by 5-channel of flow constituted by inspiring 4-channel (Massimini & Carli, 1988) and 8-channel (Massimini & Carli, 1988) flow models. The 5-channel flow model showed below.

Figure 4. The 5-Channel Flow Model



The characteristics of each channel are the following:

Flow channel: skills matched with high challenge

Boredom channel: skills greater than low challenge

Apathy channel: skills matched with low challenge

Anxiety Channel: skills less than high challenge

Ease Channel: skills matched with moderate challenge

The scores given by the participants to the items of Flow Short Scale for each course are categorized in accordance with the following:

Table 1. The Categorization of Scores for Each Channel

Flow Factor			**Anxiety Factor**	
$6 \leq x$		Flow	$6 \leq x$	Anxiety
$3 < x < 6$	ise	Ease	$3 < x < 6$	Ease
$X \leq 3$	ise	Boredom	$X \leq 3$	Apathy

X: Average score of each factor

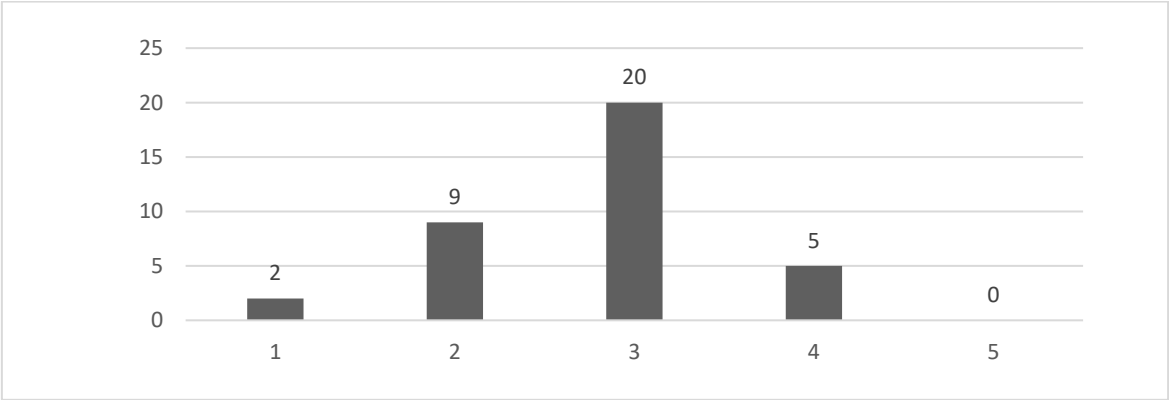
Research questions are below:

1. What are the status of flow experience of prospective mathematics teachers at Algebra, Analysis and Analytic Geometry at undergraduate level?
2. How has the flow status of prospective mathematics teachers at mathematics and geometry courses in high school changed in the university? Why?

The Results

Flow experience is based on the relative state of perceived skill and perceived difficulty on a task. Thoughts of the participants, who achieved YGS 2017 and entered the department of Primary Education in Mathematics at a public university, about the difficulty levels of questions in mathematics and geometry majors were taken as reference in order to obtain information about their flow experience during high school education. The graph below shows the frequencies of the participants' scores on the difficulty level of 29 mathematics questions in the transition to higher education examination. As can be seen in the graph, 55% of the participants found the mathematics field questions to be of “medium difficulty”. In addition, 6% of the prospective teachers considered the questions as “very easy”, 25% of them regarded as “easy” and 14% of them found “difficult”. None of the participants thought that the field of mathematics was “very difficult”.

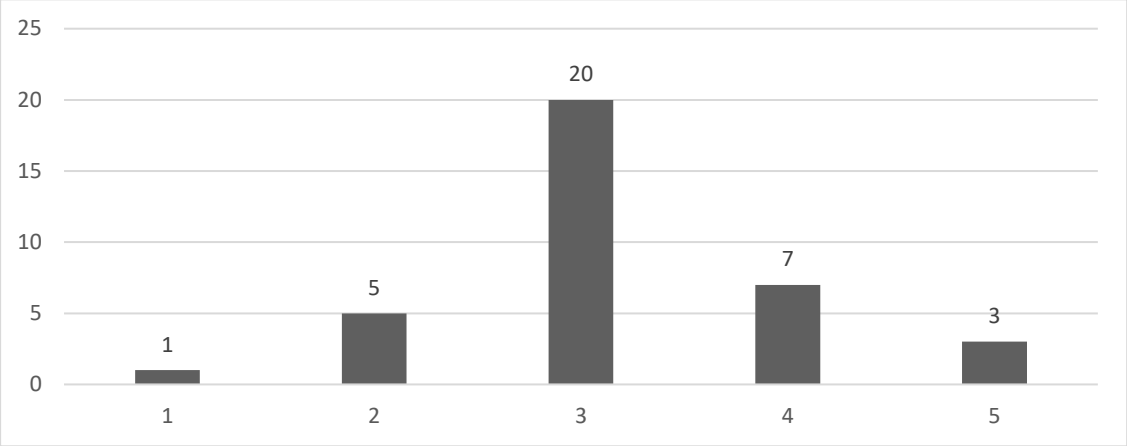
Figure 4. Degree of Difficulty Given to Mathematics Questions in YGS 2017



In order to obtain information about the flow experiences of elementary mathematics teacher candidates in the field of geometry during high school education, they were asked to score the difficulty levels of geometry questions during the entrance exam to higher education. The following graph was attained in accordance with the obtained data. As can be seen in the graph, 55% of the students thought that geometry questions were in the category of “intermediate difficulty”, like mathematics. In addition,

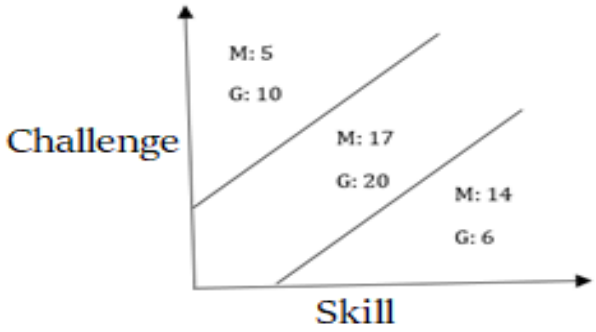
approximately 3% of the participants stated that the questions were “very easy”, 14% of them regarded as “easy”, 20% considered as “difficult” and 8% found as “very difficult”.

Figure 5. Degree of Difficulty Given to Geometry Questions in YGS 2017



Finally, the fields of mathematics and geometry were evaluated together. As can be seen in the table below, 2 participants thought “easy” and 2 participants found “difficult” to both of the mathematics and geometry questions. There are 8 students who thought that the questions were in “moderate difficulty”. There is no one who found mathematics difficult and is not forced in geometry. In contrast, there are 3 students who were forced in mathematics and geometry. As a result, it was seen that the number of the students who challenged in geometry is more than the number of the participants challenged in mathematics. Therefore, the graphs showed similar distributions.

Graph 1. Graph of Students Categorized in Accordance with Degree of Difficulty of Mathematics and Geometry Questions in YGS 2017



The following two tables were formed by 5-channel flow model with data obtained from Flow Short Scale. The first table is based on upper intermediate skill level matching with low and high level of challenge, which the experiences are classified as “boredom” and “flow”, respectively. The second table is based on lower intermediate skill level matching with low and high level of challenge, which the experiences are classified as “apathy” and “anxiety”. Intermediate skill and challenge matching is called as “ease”.

Table 2 displays the number of students involving the channels of flow, boredom and ease. The percentages of students are the following for Algebra; 2% at flow, 40% at boredom and 58% at ease, approximately. For Analysis, 10% of the participants experienced flow, 7% of them felt bored and 83% of them were at ease channel. Lastly, about 13% of students experienced flow, 6% of them at boredom and 81% of them felt ease. Briefly, most of students were at ease channel for all of the three courses.

Table 2. Frequency Table of Students Experienced Flow, Boredom and Ease at Mathematics and Geometry in Accordance with Flow Factor

	Mathematics		**Geometry**
	Algebra	**Analysis**	**Analytic Geometry**
Flow	1	4	5
Boredom	14	3	4
Ease	21	30	29

Table 3 shows the number of students who experienced anxiety, apathy and ease for each course. The percentages of students' experiences at Algebra are about 17% in anxiety, 33% in apathy and 50% at ease. In analysis, 11% of students experienced anxiety, 42% of them felt apathy and 47% of them were at ease. Finally, 6% were anxious, 53% experienced apathy and 41% of them were at ease for Analytic Geometry. In sum, most of students were at ease channel at algebra and analysis, whereas most of them were at apathy channel.

Table 3. Frequency Table of Students Experienced Anxiety, Apathy and Ease at Mathematics and Geometry in Accordance with Anxiety Factor

	Mathematics		**Geometry**
	Algebra	**Analysis**	**Analytic Geometry**
Anxiety	6	4	2
Apathy	12	15	19
Ease	18	17	15

When the national literature is considered, no research has been found about continuity of flow status of prospective mathematics teachers from high school to university education at their major courses. Hence, this study was carried out with the aim of filling this gap. Moreover, it was needed to know the sources affecting the direction of status of flow experience. Therefore, it was tried to retrace the sources by interviewing. Semi-structure interviews help researchers to scrutinize profoundly participants' thoughts.

Table 4. Categorization of participants in accordance with flow status

	High school Mathematics	**University Mathematics**	**High school Geometry**	**University Geometry**
Experienced flow	K02- K04- K05-K06	K02- K03-K06	K02-K03-K04-K05-K06	K03-K06
Not experienced flow	K01-K03	K01-K04- K05	K01	K01 - K02- K04 - K05

Factors below affecting the participants' flow status concentrated as taking into consideration their wordings. These are:

- Instructor factor including personal features and expectancy from students
- Perceived difficulty level of academic tasks
- Academic effort
- Association between previous knowledge and the objectives of courses

Description of P01

P01 scored 75 points out of 145 for mathematics questions and 39 points out of 55 for geometry questions as degree of difficulty. The profile of flow at university is on the table:

Table 5. The Flow Profile of P01

Algebra	**Analysis**	**Analytic Geometry**
Boredom	Ease	Boredom
Apathy	Apathy	Apathy

According to data, P01 experienced flow in mathematics and not experienced flow in geometry at high school. S/he has not experienced flow at university level for algebra, analysis and analytic geometry.

Firstly, instructor factor is seen as an important role for status of flow. P01 thinks that she was good at mathematics during high school because it can be understood that she liked her mathematics teacher's teaching style was effective, since the teacher drilled and memorized previous topics, frequently. Besides, she thinks that she had difficulties to understand geometry because of the geometry teacher. Her wordings about teaching style are the following:

"My Mathematics teacher was very good. He was doing it all over again. That's why we learnt the topics. We didn't even have to do it again at home. We could learn everything from him and focus on testing."

"In high school, my geometry teacher was not good. (….) When the geometry teacher was changed at 3rd grade, I tried to progress in Geometry but I couldn't progress and, then I stopped studying soon."

When she considered her performance at university, she feels more comfortable at Algebra and Analysis than Analytic Geometry. She linked to the instructor including teaching style, personal features and difficulty of the exams at these courses. She can concentrate during lessons and feel at ease during exams at Algebra because of not being challenged. She also can focus at Analysis, related with the teacher's personal features. However, she does not like Analytics Geometry at university, even if the grade of the first midterm is higher than previous ones, associated with memorizing.

"Algebra is harder than the previous ones (Linear Algebra 1 and Linear Algebra 2), because it is so abstract. (…) It doesn't have meaning for me.

"Our teacher is fine. So, I can focus. There's no time to fall, it's moving so fast. You have to take notes. I'm taking notes." (Algebra)

"The questions (of midterm) are usually related to what they solved in the lessons. That's why it's not hard. I'm not worried" (Algebra)

"I focus on. The teacher is a bit of a relaxed person. I love casual people." (Analysis)

"The midterm went better. We are constantly memorizing." (Analytic Geometry)

"The grade (of the first midterm) is higher but, still, I don't like it." (Analytic Geometry)

The perceived outcome of Mathematics is another factor on P01's motivation to study Mathematics at high school. She mentioned she wanted to enter a good university to get better opportunity to find a job after university.

"The most important lesson was mathematics for the university entrance examination. That's why I've always studied mathematics. You know, the coefficient of mathematics is higher than other majors."

She has studied mathematics courses in order to undergraduate from university. The main motive is to pass the exams. Therefore, she stated she does not study out of exam periods.

"I think it's because we study for the exam, not to learn. I guess I think it will be useless for the future."

"I don't work outside the exam period."

"…I know I have to study. Hence, I do."

Description of P02

P02 scored 59 points out of 145 for mathematics questions and 20 points out of 55 for geometry questions as degree of difficulty. The profile of flow at university is on the table:

Table 6. The Flow Profile of P02

Algebra	Analysis	Analytic Geometry
Boredom	Flow	Boredom
Anxiety	Ease	Apathy

P02 thinks teachers have an important role his learning process at mathematics. He thought he was good at mathematics since his teacher used effective ways to teach and had a positive relationship with his students. On the other hand, he thinks the instructor's role is weak, so the success at geometry is more related with students' ability.

"It's the teacher who gives information at the beginning. The better instructors teach, the better we learn."

"My teachers were very good." (High school mathematics)

"It was my math teacher at primary school. I liked his teaching style and his approach to us. He was telling mathematics in a beautiful way. I was looking forward to math. As a result, that's why I like mathematics." (High school mathematics)

"I loved to study mathematics, I was just studying to enjoy." (High school mathematics)

"Geometry ends in the person…. I don't think geometry depends on the teacher." (High school geometry)

When he takes his performance at university level into consideration, he feels better at analysis than algebra and analytic geometry associated with teaching methods, personal characteristics of the instructor and expectancy from students in exams. He thought that both of the courses requires memorizing, therefore he does not feel the need to study.

"I think the teacher factor is very important. If a teacher makes me like to the course, I will greedily work on that lesson. Nevertheless, most of the instructors at the university are not like that."

"The lesson is so boring. (…) Everything is about memorizing. I listen to the instruction, I write and I go. I don't remember anything after the exams. (…) I just memorize some theorems and proofs for exams. That's why it's so boring." (Algebra)

"All three of them (Linear Algebra 1, Linear Algebra 2 and Introduction to Algebra) entered the same teacher, and the grades were not good in all three." (Algebra)

"I like analysis as I like the teacher. You love that lesson when you have teachers." (Analysis)

"The teacher is comfortable. The lesson is enjoyable. After he tell main theoretical issues, he solves the samples. It's fun." (Analysis)

"In the formula, you just substitute for the exam. I don't think that kind of thing evaluates anything. For example, I got 95 on the analytical geometry exam. If you ask me one question from the midterm, I can't do, right now. I'm bad at analytic geometry"

"Memorizing is expected for some courses, so I don't need to study except from exam period."

Description of P03

P03 scored 84 points out of 145 for mathematics questions and 27 points out of 55 for geometry questions as degree of difficulty. The profile of flow at university is on the table:

Table 7. The Flow Profile of P03

Algebra	Analysis	Analytic Geometry
Flow	Ease	Ease
Anxiety	Anxiety	Ease

Teachers plays an important role for P03's feelings toward Mathematics and geometry. Although she was not confident about doing mathematics, her teachers changed her feelings and provided her to develop self-confidence. At university, P03 is the one who expressed Algebra as 'love'. On the other hand, she did not have difficulties in geometry, she did not consider herself as successful and happy, related with the instructor.

"I had low self-esteem on mathematics and geometry because of my elementary school teacher, I couldn't like him. I had bad experiences with him. (…) Also, I couldn't even love mathematics in middle school, since I couldn't like my teacher, again."

"Thanks to my teacher at high school, I studied hard, so, I was good at Mathematics and Geometry. They supported to me by saying "You can do it!" and I did."

"I love the teacher of Algebra, so I love the lessons." (Algebra)

"Again, I will connect to the teachers, I did not like the teacher of geometry." (Analytic Geometry)

Besides, she has some problems in Introduction to Algebra since she could not make a connection with previous knowledge, she tries to understand and study regularly. She is the only one who experience flow in the aspect of absorption by activity. She thinks that she has more challenged on Algebra than Analysis, she feels at ease more.

"I couldn't understand the logic of Algebra; I have tried to understand. (…) I study notes day-to-day not to forget."

"Algebra is challenging for me."

"Algebra is harder than Analysis, however, I feel more comfort at Algebra."

P03 will repeat Analysis 2 at the spring semester. She linked the failure with challenges faced in Analysis 1 on the previous semester. She had difficulties Analysis 1, hence, she thinks she will face similar problems on the other Analysis courses. Even, she knows Analysis 3 is not a hard one, she got into a panic during the midterm of Analysis 3.

"I failed Analysis 2. I couldn't like Analysis 1. I couldn't understand the topics. (…) Therefore, I had some problems. I know, Analysis 3 is easy, but I got panic during lectures and exams. For this semester, Analysis 3 is the hardest course."

The participant thought that she was good at mathematics and geometry at high school and it is reinforced at university.

"The courses I have attended at university reinforce my love for mathematics and geometry. Nevertheless, I fear to fail."

Apart from these, she feels anxious when she does not know how to study for any course. Additionally, she has fear of exam.

"I couldn't anything in the first half an hour (at the exam of analytic geometry). I felt panic."

P03 has been motivated to study at high school and university because she thinks the success will provide advantageous in the future.

"The main reason to study Mathematics was to enter a good university."

Description of P04

P04 scored 47 points out of 145 for mathematics questions and 21 points out of 55 for geometry questions as degree of difficulty. The profile of flow at university is on the table:

Table 8. The Flow Profile of P04

Algebra	Analysis	Analytic Geometry
Boredom	Ease	Ease
Anxiety	Anxiety	Anxiety

The factor of instructors is found as an important component of P04's academic performance and motivation. She mentioned her teacher at primary education was very nice teacher, so, she loved mathematics. However, teachers at secondary and high school were not good, hence, she thinks that her performance at mathematics was low because of them. Additionally, she noted that she likes algebra, since she likes the teacher; and she does not like Analysis, because she does not like the teacher. Consequently, it can be said that if she has good feelings towards instructors, she wants to listen the lectures and to study.

"My teacher in elementary school was also very good. My math teachers at high school and middle school were not good. .... They were writing on the board and telling somethings. They weren't too interested with us."

"University professors did not meet my expectations."

"I loved algebra because of his teacher. I love the teacher, so I'm listening to her lesson."

"I don't understand (Analysis) at this semester. It is very important for me to like the teacher, but, I don't like the instructor of Analysis."

"Our teacher is a person who takes points off, perfectionist. the teacher expects us to write the same solutions from notes. Also, s/he does not accept different ways to solutions." (Analytic Geometry)

P04 does not have difficulty at Analytic Geometry because the course, as she mentioned, requires to memorize and her memorizing skill is good. Hence, she feels at ease.

"I don't have difficulty (at Analytic Geometry), because it is expected from us to memorize the rules and proofs."

She avoids challenges. She did not try to understand topics that she had difficulties or did not try to resolve questions that she couldn't solve.

"I don't like strive hard questions, even to ask teacher."

"I loved very much Mathematics at primary education. (…) I preferred to solve mathematics tests rather than other majors."

Her main motivation to study hard mathematics and geometry at high school was to make her parents happy.

"My family always struggles for me to fulfill my needs. Therefore, I wanted them to make happy and studied hard."

Description of P05

P05 scored 60 points out of 145 for mathematics questions and 26 points out of 55 for geometry questions as degree of difficulty. The profile of flow at university is on the table:

Table 9. The Flow Profile of P05

Algebra	**Analysis**	**Analytic Geometry**
Ease	Ease	Ease
Ease	Anxiety	Apathy

P05 expresses that s/he had good at mathematics and felt at ease for primary school. Teachers played an important role for the situation. S/he advocated teachers as guidance must support their students to take responsibilities in their learning process. Moreover, s/he thought that the relationship between teachers and students affects students' motivation.

"… since my primary school teacher gave special attention to me, I was successful"

"I think teachers must guide us to achieve solutions rather than to give solutions."
"… we lead to rote learning at university. They (the instructors) do not teach conceptually.
"I like linear algebra because of the instructor."
"The teacher mentions just the notes. On the other hand, my friends also can solve the questions in notes. Thus, the presence of instructors is not necessary for me." (Analysis)

P05 mentioned the one source of problems in mathematics major is the association level of previous knowledge and the objectives of courses. As the topics which needs higher mathematical thinking skill did not teach conceptually and students lead to rote learning rather than showing the proofs of formulas in high school, s/he has problems at analysis course in university.

"I was not successful at the topics Math2 (requiring higher mathematical thinking) since teachers did not explain where formulas come from. (…) I think we can be more successful if teachers learn the origins of formulas."

"I did not understand algebra."

"Basic mathematics skill is not enough to achieve." (Algebra)

"I have difficulty to understand." (Analysis)

P05, as his/her wordings, is not used to study regularly. Since s/he did not encounter challenges and could got the sufficient point in exams, s/he did not need to study. when s/he saw that effort is not enough, s/he had problems to study, since s/he did not have study habit. The situation leads her/him to rote learning.

"I could achieve even if I did not study, therefore, I did not need to study. this process lasted until the 10th grade. Then there was a stumbling. But now I'm so used to not working, it's a big hardship for me."

"I stopped studying a long time ago, and I studied the exams last night."

"I sit down on the last day and work with my friends to get notes that can pass exams. When this is the case, there is no need to work hard. Nobody appreciates me for the extra effort I make, and nobody even knows it."

"There is something expected from me, if I can fulfill it, there is no problem, if I cannot, I have to work."

"I'm terrible about linear algebra, my mediocre, I don't know anything, but I've passed the lesson."

When s/he was studying and listening to the university, s/he experienced happiness. When s/he talks about these moments, s/he emphasizes that s/he has succeeded in achieving some degree of difficulty and that s/he can activate his own capacity.

"I had a lot of fun studying derivative and integral. (…) I studied, I had fun because I realized I could." (Analysis)

I was stuck in a question. Then I was able to solve the question. I was very happy when I solved the question." (Analysis)

"I feel happy when I feel the creativity." (Analytical geometry)

Description of P06

P06 scored 62 points out of 145 for mathematics questions and 29 points out of 55 for geometry questions as degree of difficulty. The profile of flow at university is on the table:

Table 10. Flow profile of P06

Algebra	**Analysis**	**Analytic Geometry**
Ease	Flow	Flow
Ease	Apathy	Ease

The participant considers that his favorite courses in high school were mathematics and geometry. The reason for this is the subjects are related with each other and progress in a certain integrity. The highest score in university entrance exam was these courses. In summary, s/he studied mathematics and geometry for its own sake.

“My favorite lesson was math. It made sense, I could understand the logic. (…) Among the subjects I could establish meaning in mathematics. He was enjoying it. I understood because I enjoyed it.”

“I used to solve geometry with pleasure.”

“In high school, my highest course was mathematics. (…) My main concern when studying mathematics or geometry classes was not to get high marks. I was happy to see that I could do it.”

Teachers are effective in her/his engagement and motivation. Teachers' relationship with students, teaching techniques used, expectations from the students in the exam have roles in the stress level of this participant.

“But the teacher gives the theorem and does not solve the example. This is a little oppressive. (…) In short, there is a lack of lecture style.” (Analysis)

“The teacher did not mention the meanings of mathematical terms he used in the beginning. When these concepts were used in other titles, I did not understand since I did not know the concepts." (Analysis)

"Sometimes I try to learn from my respect for the teacher. (…) I also love the teacher. It is very labor-intensive.” (Algebra)

When there is the slightest thing, it draws directly. (…) Exam reading of the instructor is problematic. And that's stressing. I don't trust myself when I take the exam, I know she will take points off in final exam. It's not about not knowing, but getting the teacher to accept it.” (Analytic Geometry)

Participant 6 appears to spend academic effort required by taking responsibility in his / her learning process. When s/he does not understand, s/he tries to solve problems by asking for help from his / her friends or teachers or by his / her own work.

"I wasn't giving up when there was something I couldn't do; I was thinking about how to do it. ”(High School Mathematics and Geometry)

"I'm really trying to understand Algebra. I work outside the classroom. I'm trying to explore the points that I don't understand.” (Algebra)

“We do research with our friends and see how we can find examples." (Analysis)

“Then I started to understand better when I worked and closed that gap.” (Analysis)

"I've been studying regularly for high school years.

"When I was studying mathematics or geometry, my main concern was not to get high marks. He was happy to see that I could work and do it.

"I'm really trying to understand Algebra.”

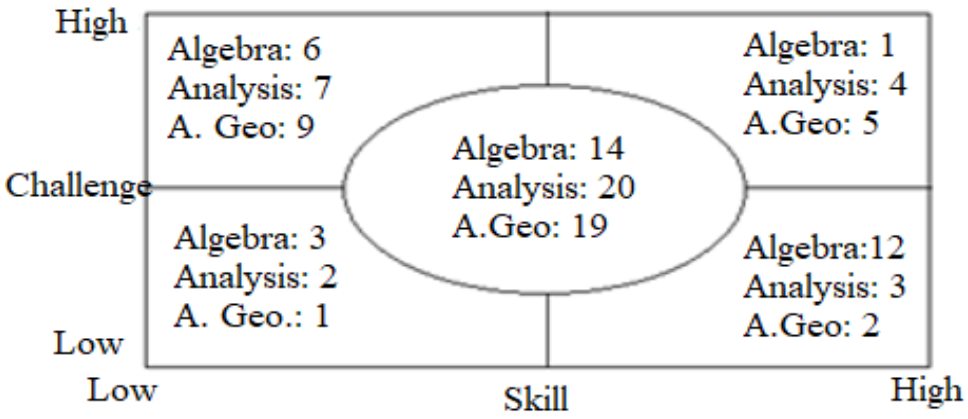
Discussion

When the national literature is considered, no research has been found about the status of the flow experience of prospective mathematics teachers during major courses at undergraduate education. Additionally, researches on the sources of flow experiences of students who attend the department of primary education in mathematics could not be encountered in national and international literature, even if researches are investigated effects of flow experience on learning process (Shernoff & Csikszentmihaly, 2009: 133), and on teaching process (Keller, Giasiranis ve Sofos, 2017), motivation for continuity of academic tasks leading flow (Schmidt,2010: 607; Kiili ve diğerleri, 2012: 89). Therefore, this study was carried out to fill this gap.

Question 1*: What are the status of flow experience of prospective mathematics teachers at Algebra, Analysis and Analytic Geometry at undergraduate level?*

The quantitative data gathered by using Flow Short Scale displays that majority of the prospective mathematics teachers feel at ease at the three courses in accordance with both factors which are flow and the perceived importance or perceived outcome. In other words, the mathematics teacher candidates do not experience flow while their major courses. The finding is parallel to the study investigating flow experience of university students. Data analysis of the research shows that students from department of Mathematics feel *control*, according to 9-channel flow model (Ermiş, 2013; Ermiş & Bayraktar, 2014). The feelings of being competent may be a reason for that result. The person who is in the *control* region of 8-channel flow model or *ease* region of 5-channel flow model is in a situation to success an academics task and does not seek more challenge or improving skill (Deci, 1980). The similar results are found in the research examining flow experience of college students in daily life (Clarke & Haworth, 1994). However, the result conflicts with the study which determining flow experience of prospective English teachers. The research showed that English teachers have optimal experience while their major courses (Belce, 2019). Differences of the departments may cause the confliction.

Table 11. Frequencies of participants in 5-channel flow model



Question 2: *How has the flow status of prospective mathematics teachers at mathematics and geometry courses in high school changed in the university? Why?*

Table 12. Attributions of participants towards their flow status

	Locus of control			
	Intrinsic		**Extrinsic**	
Stability	**Controllable**	**Uncontrollable**	**Controllable**	**Uncontrollable**
Stable	Effort	Skill	Teacher factor	Ease/ Difficulty of course Nature of course
Unstable	Association between previous knowledge and objectives		Use of teaching methods Relationship with teacher	Luck

The table is formed with respect to the findings obtained from interviews. Initially, instructor factor was mostly repeated by the participants. Personal characteristics of instructor influence students' engagement and motivation. They articulated that if they do not like the teacher, they do not like the course, too. The participants who experienced flow have a good relationship with the instructors and the others do not. This is similar with the outcome of the study investigating students' and teachers' thoughts on students' engagement (Cothran & Ennis, 2000). Additionally, teaching style is another element of instructor factor. The students mentioned they were getting bored while lectures which is teacher-centered. However, researches display that students are more engaged in learner-centered lectures than the former (Butler & Shibaz, 2014; Han, Yin, & Wang, 2015; Marks, 2000). Hence, teachers affect students' flow status (Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2014).

Students tend memorizing when they do not happy during lectures (Hourigan & O'Donoghue, 2007). Rather to fill the gap between prerequisite knowledge and the knowledge which students have already known, they choose to memorize in order to pass the courses (Weiner, 1992; Baştürk, 2016; Bütüner, 2017). The similar finding is investigated in a qualitative research identifying high school students' beliefs about their problem-solving skills and their achievement in mathematics (Mason, 2003). Data show that students believe memorizing may just a useful way to get a good mark on exams, not to understand the mathematical concepts. In this study, the participants who did not experience flow tend to memorize rather than spending effort to learn. Therefore, it can be said that rote learning prevents to experience flow.

Most of the participants mentioned in interviews that they have difficulties with Algebra to making connections between their previous mathematical knowledge from high school or the former courses that they attended at university, and the subjects involved Introduction to Algebra. Since the topics of that course are perceived as discrete, they think they could not understand conceptually. Introduction to Algebra includes definitions, mathematical rules and their proofs which is unlike with mathematical concepts taught previously. It requires advanced mathematical thinking level. The situation may cause the students to have difficulties with that course (Habre & Abboud, 2006; Moore, 2005). The finding is parallel to the studies linked with lack of preparedness (Slavin, 1995; Hourigan & O'Donoghue, 2007). Many reasons for this issue like increase in the number of students who have dissimilar education background accepted universities, crowded classes, instruction methods and also lack of effort and lack of studying out of exam periods can be shown (Engelbrecht, 2010; Liebendörfer ve Schukajlow, 2016). It is striking among the results of the research that the only one participant, who is P04, who experience flow at Algebra studies day-to-day. In contrast, the wordings of participants during interviews indicate problems with Algebra, the majority of students' experiences expresses that they feel at ease at that course. The expectation from the students by the instructor as they mentioned so, can be evaluated as the reason for this variance. Because most of them said including the participants who experienced flow that memorizing is enough to achieve the exams.

Academic effort is found as a clue about the perceived importance of courses. Academic effort determines students' engagement and how to endeavor (Deci & Ryan, 2003). Except P03 who experience flow at Algebra, even the participants have optimal experiences at these course, they expressed they do not make any effort for the conceptual understanding of mathematical constructs. The lack of effort is related to teacher expectancy, memorizing as a way to pass exams and being exam-oriented. The three elements are mutually linked with the others. The instructors request them to write the definition and the proofs like notes, that lead to memorize them. Hence, the circumstance causes students to be exam oriented.

Another factor affecting flow status of prospective mathematics teacher is perceived difficulty level of academic tasks. The participants who experienced flow mentioned they challenged during the activity that leads them flow. The perceived challenge matches with their skills. On the other hand, the participants who did not experience flow mentioned the academic tasks were very hard or too easy to do. The studies support the findings (Csikszentmihalyi & Csikszentmihalyi, 1988; Delle Fave & Massimini, 1988; Privette ve Brundrick, 1991; Basom & Frase, 2004; Moneta, 2004; Schüler, 2007; Csikszentmihalyi, 2009, 2014a, 2014b; Nakamura & Csikszentmihalyi, 2009; Seifeddine, 2014; Ermiş, 2013).

The results show that most prospective mathematics teachers are in the *ease* region. The rest is clustered at *boredom* and *apathy*. That means they tend not to stretch their skill by increasing in challenges. Their motivation is to get a mark that is enough to pass the courses. The situation may be interpreted as most student teachers' goal construct is oriented from performance goal rather than mastery goal (Harackiewicz and others, 2000). On the other hand, the participants P03, P04 and P06 who experienced *flow* at the ones of the major courses stated they want to improve their skill and to develop their understandings, rather than grades. The finding is parallel to the study conducted by Stavrou and his colleagues (2018). Consequently, it is needed to notice that there is a relationship between flow status and goal orientation (Jackson & Csikszentmihalyi, 1999).

To sum up, the results of the research determining the status of flow experience of prospective mathematics teachers at major courses including Algebra, Analysis and Analytic Geometry in university show that the most students feel at ease with respect to 5-channel flow model. A few number of students experiences flow at these courses. Additionally, the factors affecting their motivation are found as instructors as a component of learning process, preparedness, academic effort and goal orientation.

Suggestions

Some suggestions for instructors are the following:

- Support students to take responsibilities in their learning process to exceed their academic effort,
- Lead to develop mastery goal orientation rather than performance goals,
- Communicate with students effectively,
- Increase in the challenges of academic tasks including the questions asked during lectures and in exams,
- Consider students' preparedness in instructional design.

Some suggestions for future research are the following:

- To investigate flow status of mathematics teachers candidates' in mathematics and educational courses with larger sample.
- To investigate the flow status of students from other departments in Faculty of Education
- To investigate the relationship between flow experience and academic achievement of student teachers in mathematics education,

References

Basom, M. R., & Frase, L. (2004). Creating optimal work environments: Exploring teacher flow experiences. *Mentoring & Tutoring: Partnership in Learning*, *12*(2), 241-258.

Baştürk, S. (2016). Secondary school mathematics student teachers' causal attribution for success and failure in mathematics. European Journal of Science and Mathematics Education, 4(3), 365-379.

Belce, Ö. (2019). *Flow experiences of EFL instructors in Turkey* (Doctoral dissertation, Bilkent University).

Butler, R., & Shibaz, L. (2014). Striving to connect and striving to learn: Influences of relational and mastery goals for teaching on teacher behaviors and student interest and help seeking. *International Journal of Educational Research, 65*, 41–53. http://dx.doi.org/10.1016/j.ijer.2013.09.006

Bütüner, S. Ö. (2017). Öğretmen Adaylarının Geometri Alan Bilgilerinin Belirlenmesi: Açı, Köşegen, Yükseklik, Dörtgen. *Amasya Üniversitesi Eğitim Fakültesi Dergisi*, *6*(2), 501-530.

Clarke, S. G., & Haworth, J. T. (1994). 'Flow'experience in the daily lives of sixth-form college students. *British Journal of Psychology*, *85*(4), 511-523.

Csikszentmihalyi, M. (1997a). Application of flow in human development and education. New York: Springer.

Csikszentmihalyi, M. (1997b). Flow and education. The NAMTA Journal, 22, 3-35.

Csikszentmihalyi, M. & Csikszentmihalyi, I.S. (1988). Optimal experiences: Psyhological studies of flow in consciousness. New York: Cambridge University Press.

Csikszentmihalyi, M. (1988). The flow experience and its significance for human psychology. In M. Csikszentmihalyi & I. Csikszentmihalyi (Eds.), *Optimal Experience: Psychological Studies of Flow in Consciousness* (pp. 15-35). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511621956.002

Csikszentmihalyi, M. (1990). Flow: The psychology of optimal experience. New York, NY: Harper and Row.

Csikszentmihalyi, M., & LeFevre, J. (1989). Optimal experience in work and leisure. *Journal of Personality and Social Psychology*, *56*, 815–822.

Csikszentmihalyi, M. & Rathunde, K. (1997). Application of flow in human development and education. New York: Springer.

Cothran, D. J., & Ennis, C. D. (2000). Building bridges to student engagement: Communicating respect and care for students in urban high schools. *Journal of Research & Development in Education.*

Deci, E., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Springer Science & Business Media.

Deci, E. L., & Ryan, R. M. (2003). Intrinsic Motivation Inventory. Self-Determination Theory [On-line].

Delle Fave, A., & Massimini, F. (1988). Modernization and changing contexts of flow in work and leisure. In M. Csikszentmihalyi & I. Csikszentmihalyi (Eds.), Optimal Experience (pp. 193-213). Cambridge, England: Cambridge University Press.

Engelbrecht, J. (2010). Adding structure to the transition process to advanced mathematical activity. *International Journal of Mathematical Education in Science and Technology*, *41*(2), 143–154.

Ermiş, E.N. (2013). Üniversite Öğrencilerinin Akış Deneyimlerini Etkileyen Faktörlerin İncelenmesi. İstanbul: Haliç Üniversitesi Sosyal Bilimler Enstitüsü.

Ermiş, E. N. & Bayraktar, S. (2014). Flow experiences in university students. *Procedia-Social and Behavioral Sciences*, *152*, 830-834.

Frase, L. E. (1998). An Examination of Teachers' Flow Experiences, Efficacy, and Instructional Leadership in Large Inner-City and Urban School Districts.

Goulding, M., Hatch, G., & Rodd, M. (2003). Undergraduate mathematics experience: Its significance in secondary mathematics teacher preparation. *Journal of Mathematics Teacher Education*, *6*(4), 361-393.

Habre, S., & Abboud, M. (2006). Students' conceptual understanding of a function and its derivative in an experimental calculus course. *The Journal of Mathematical Behavior*, *25*(1), 57-72.

Han, J., & Yin, H. (2016). Teacher motivation: Definition, research development and implications for teachers. *Cogent Education*, *3*(1), 1217819.

Harackiewicz, J. M., Barron, K. E., Tauer, J. M., Carter, S. M., & Elliot, A. J. (2000). Short-term and long-term consequences of achievement goals: Predicting interest and performance over time. *Journal of educational psychology*, *92*(2), 316.

Hourigan, M., & O'Donoghue, J. (2007). Mathematical under-preparedness: the influence of the pre-tertiary mathematics experience on students' ability to make a successful transition to tertiary level mathematics courses in Ireland. *International journal of mathematical education in science and technology*, *38*(4), 461-476.

İşigüzel, B., & Çam, S. (2014). The adaptation of Flow Short Scale to Turkish: A validity and reliability study Flow Yaşantısı Ölçeği Kısa Formunun Türkçeye uyarlama, geçerlik ve güvenirlik çalışması. *Journal of Human Sciences*, *11*(2), 788-801.

Jackson, S. A., and Csikszentmihalyi, M. (1999). Flow in Sports: The Keys to Optimal Experiences and Performances. Champaign, IL: Human Kinetics.

Jonsson, H., & Persson, D. (2006). Towards an experiential model of occupational balance: An alternative perspective on flow theory analysis. *Journal of Occupational Science*, *13*(1), 62-73.

Lambert, V. A., & Lambert, C. E. (2012). Qualitative descriptive research: An acceptable design. *Pacific Rim International Journal of Nursing Research*, *16*(4), 255-256.

Liebendörfer, M., & Schukajlow, S. (2017). Interest development during the first year at university: do mathematical beliefs predict interest in mathematics?. *ZDM*, *49*(3), 355-366.

Marks, H. M. (2000). Student engagement in instructional activity: Patterns in the elementary, middle and high school years. American Educational Research Journal, 37, 153–184.

Mason, L. (2003). High school students' beliefs about maths, mathematical problem solving, and their achievement in maths: A cross-sectional study. *Educational psychology*, *23*(1), 73-85.

Massimini, F., & Carli, M. (1988). The systematic assessment of flow in daily life. In M. Csikszentmihalyi & I. Csikszentmihalyi (Eds.), Optimal experience: Psychological studies of flow in consciousness (pp. 266–287). New York: Cambridge Universtiy Press.

Matthews, B., & Ross, L. (2010). *Research methods*. Longman/Pearson Education.

Moneta, G. B. (2004). The flow model of intrinsic motivation in Chinese: Cultural and personal moderators. *Journal of Happiness Studies*, *5*(2), 181-217.

Moore, J. (2005). Undergraduate mathematics achievement in emerging ethnic engineers programme. International Journal of Mathematical Education in Science and Technology, 36(5), 529-537.

Morse, J. M. (2003). Principles of mixed methods and multimethod research design. *Handbook of mixed methods in social and behavioral research*, *1*, 189-208.

Nakamura, J., & Csikszentmihalyi, M. (2009). Flow theory and research. In C.R. Snyder & S.J. Lopez (Eds.), The Oxford handbook of positive psychology (2nd edn., pp. 195–206). New York: Oxford University Press.

Novak, T. P., & Hoffman D. L. (1997). Measuring the flow experience among web users. Paper Presented at Interval Research Corporation, Vanderbilt University, Tennessee, USA.

Novak, T. P., Hoffman, D. L., & Yung, Y.-F. (2000). Measuring the costumer experience in online environments: A structural modeling approach. Marketing Science, 19, 22-42.

Pintrich, P. R., & Schunk, D. H. (1996). Motivation in education: Theory, research, and practice. *Chapter*, *5*, 153-197.

Privette, G., & Brundrick, C. M. (1991). Peak experience, peak performance, and flow: Correspondence of personal descriptions and theoretical constructs. *Journal of social behavior and personality*, *6*(5), 169.

Rheinberg, F., Vollmeyer, R., & Engeser, S. (2003). Die erfassung des flow-erlebens.

Ryan, R.M & Deci, E.L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary Education Psychology, 25, 54-67.

Schmidt, J. A., Shernoff, D. J., & Csikszentmihalyi, M. (2014). Individual and situational factors related to the experience of flow in adolescence. In *Applications of flow in human development and education* (pp. 379-405). Springer, Dordrecht.

Schunk, D.H., Pintrich, P.R. & Meece, J.R. (2002). Motivation in Education: Theory, Research and Applications, 2,5-6, New Jersey:Merrill Prentice Hall.

Schüler, J. (2007). Arousal of flow experience in a learning setting and its effects on exam performance and affect. *Zeitschrift für Pädagogische Psychologie*, *21*(3/4), 217-227.

Seifeddine, F. (2014). Predictors of Student Motivation to Succeed in First-Year College Mathematics: A Quantitative Analysis. *The Journal of Educational Thought (JET) / Revue De La Pensée Éducative, 47*(3), 204-235. Retrieved from http://www.jstor.org/stable/43932841

Shernoff, D. J., Csikszentmihalyi, M., Schneider, B., & Shernoff, E. S. (2014). Student engagement in high school classrooms from the perspective of flow theory. In *Applications of Flow in Human Development and Education*, 475-494. Springer Netherlands.

Steinberg, L. D., Brown, B. B., & Dornbusch, S. M. (1996). Beyond the classroom: Why school reform has failed and what parents need to do. New York: Simon & Schuster.

Stavrou, N. A., Psychountaki, M., Georgiadis, E., Karteroliotis, K., & Zervas, Y. (2015). Flow theory–goal orientation theory: positive experience is related to athlete's goal orientation. *Frontiers in psychology*, *6*, 1499.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology*, *54*(6), 1063.

Weiner, B. (1992). *Human motivation. Metaphors, Theories, and Research.* Newbury Park, CA: Sage Publications.