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RESEARCH ARTICLE

The Involvement of Learning Mathematics Via Teachers' Autonomy Support and The Fulfilment of Basic Psychological Needs

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ABSTRACT

Mathematics is one of the compulsory subjects for high school students in Indonesia. However, not many of them like mathematics. Students' low learning engagement in mathematics is affected by the social contexts of friends, teachers, and parents and the fulfilment of the basic psychological needs of the students themselves. Teachers' autonomy support to improve students' engagement is essential, especially in mathematics learning. This research was aimed at looking into the roles of the fulfilment of basic psychological needs as the element mediating teacher autonomy support and student engagement. The number of respondents in this research was 162. They were students of various high schools in Indonesia. The instruments were the autonomy support scale for measuring the teachers' autonomy support, the "feeling I have" scale for measuring the fulfilment of basic psychological needs, and the engagement scale for measuring the students' engagement. The employed analysis technique was the simple mediation model analysis. The results of this study indicate the partial mediation of the fulfilment of basic psychological needs between the teachers' autonomy support and the students' engagement. This finding implies that teachers should understand better that every student has basic psychological needs which can be fulfilled through teacher autonomy support, which, in turn, leads to learning engagement.

Study which conducted by Programme For International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) found that Indonesia's students ranked under the international standard score. Finding of PISA (2018) showed that Indonesia having graded score 379 in mathematics subject which is classified on 75th ranked out of 81 nations mathematics subject. Previously TIMSS (2015) found that Indonesia's students had a score of 397 on mathematics which is further down with international average score 500. Due to this result, Indonesia was ranked 44th out of 49 countries.

Researcher in this study conducted a survey with sample 43 senior high school students in some areas in Indonesia. The results demonstrated 52.1% stated that they did not like mathematics. They even suggested mathematics be erased. Most of them regard mathematics as a complicated, difficult, and boring subject. Most also said that when learning mathematics, they tended to prefer sleeping, playing games, chatting, pretending to pay attention, and even defacing their books. The students thought that mathematics would be easy enough to grasp if the teacher explained the lessons in a pleasant way, that in which a game was involved so that it would not be too dull.

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Mathieson *et al.* (2022) state high school students in England mostly view mathematics as unconnected with other subjects, so they tend to drop a mathematics class. It is apparent that they are forced to follow mathematics classes. The respondents even said that they hated mathematics classes and they should not be in the classes. Kyttälä and Björn (2021) portray mathematics learning engagement as being affected by cognitive skills and material understanding. Some students have a tendency to feel anxious and avoid mathematics classes. The study also asserts that female students are more likely to get high scores on mathematics than male ones.

In looking at the achievement concept, Ames (1992) explained achievement goals as a combination of beliefs, attributions, and emotions which could determine the individual's orientation toward task accomplishment. Similar to that, Dweck (1996) pursued that achievement goals could be seen by the individuals trying to do so as a manifestation of their effort. The argument was strengthened by Elliot and Thrash (2001) which insisted that achievement is a complex concept in which individuals showed their engagement in a struggling situation pursuing the achievement.

Based on the explanation of achievement goal concept above, it can be concluded that learning engagement is a vital element for students as not only is it needed to master skills taught in school, but it also helps students adapt to their educational requirements as well (Skinner and Belmont, 1993). Learning engagement is defined as the involvement of constant positive behaviors in and attitudes towards learning activities in class (Skinner and Belmont, 1993). In Skinner et al., (1993) concept, three levels of engagement have been studied and one of the most important levels is student learning engagement. This study focused on student learning engagement in mathematics which based on the previous survey results and findings on mathematics, showed that students mostly dislike mathematics and their learning engagement in this subject is low.

Learning engagement is the time, effort and participation in learning which is shown by students to achieve results desired by school (Fredricks and Paris, 2004). Learning engagement is divided into three types; behavioral, emotional, and cognitive engagement. Behavioral engagement refers to the participation and engagement in academic and social context. Emotional engagement refers to the behaviors, attachment, value, and affective actions of a student in and to their class, teachers, and peers in school. Cognitive engagement refers to the motivation to learn and make use of cognitive skills in thinking and learning. There are three social contexts regarded as influential to student engagement, especially that in mathematics, i.e. family (parents), teachers, and peers (Fredricks and Paris, 2004). Interpersonal interaction is considered to develop learning engagement in school (Fredricks and Paris, 2004) and certain forms of teacher support can affect student engagement (Deci and Ryan, 2000).

Grolnick et al., (1997) found that teacher behavior has an impact on emotions and learning engagement students in class. The learning environment in the classroom sometimes makes students depressed, bored, and unmotivated to follow lessons. On the other hand, it can make students active and enthusiastic in learning. The learning environment in lecture halls facilitated by lecturers can have an influence on the relationship between lecturers and students, which can then be inspiring student motivation during learning (Reeve, 2006).

Current studies have proven that one of the teachers assistance which can enhance learning engagement in mathematics subjects is autonomy support. Study conducted by Liu, Yao, and Li (2021) revealed that teacher autonomy support has a positive relationship with academic engagement both in mathematics and literacy subjects. Also, a study conducted by Flunger et al., (2022) showed that teacher autonomy support could increase student’s engagement in Math and German through stimulating the students' interest in the classroom. Research by Benita, Roth, and Deci (2014) showed that teacher autonomy support, which is accommodated by providing interest and enjoyment in the classroom, will boost student’s academic engagement.

Teacher autonomy support is an active process involving a teacher’s acceptance of students’ perceptions, like a teacher’s willingness to listen to their students (Kaur, 2017). A teacher also gives chances to students to choose and make decisions on class learning activities and the teacher also delivers the material clearly so that the students will be able to do their tasks optimally. The forms of teacher autonomy support for

mathematics learning could deliver the conceptual teaching which used learning media, application, and methods which the aim is to increase students' understanding of the subject material. Teachers expected not only to provide students with theory, but also with practice which is in line with the mathematics' theory.

According to the perspective of Self-Determination Theory (SDT) every student is a person who has knowledge and love learning, which social context have an important role in determining students' constructive involvement in learning (Deci & Ryan, 2000). Teacher's autonomy support can force autonomy behavior on student's which is based on intrinsic motivation. This perspective believed that when teacher's showed autonomy facilitation in the classroom, the student's academic achievement and perceived competence could be elevated (Reeve, 2002).

Pointing to the student's objectivity, Honstra et al., (2018) stated that when a student's basic needs are fulfilled in social context they could be inherently engaged in learning. There are three types of basic psychological needs required in order for students willing to be involved in activities, that are the need for relatedness, the need for competence, and the need for autonomy (Deci & Ryan, 2000). Research conducted in the school environment has proven that teacher's support autonomy and the existence of behavioral control within certain limits are associated with positive impacts on students, including intrinsic motivation, increased satisfaction, and improved student's well-being (Deci & Ryan, 2000). In addition, experimental research conducted by Reeve and Deci (1996) found the benefit of teacher's autonomy support in the competition puzzle solving. The study revealed that not just stressful conditions which can reduce intrinsic motivation or the condition of being free from driving control competition, but there is participants' perceived autonomy that influences the results obtained in competitions designed within experiment.

In related needs aspects, LaGuardia and Patrick (2008) insisted that the relationship between teachers and students is the underlying psychological well-being in students. Creating good relationships based on motivational nature which comes from within oneself can facilitate how the students perceive and resolve incompatibilities and conflicts between them (Patrick, Knee, Canevello, & Lonsbary, 2007). In other words, the comfortable bond and being emotionally dependent on others can predict relationships well, because the processes in relationships between individuals facilitate fulfilling basic needs within the person concerned (Chirkov et al., 2011).

Based on the previous theories and research findings, it is reasonable to state that teacher autonomy support and the fulfillment of basic psychological needs influence student learning engagement. Teacher autonomy support affects the fulfilment of the needs for autonomy, relatedness, and competence, which eventually affect student learning engagement. The purpose of this research was to explore the role of the fulfilment of basic psychological needs as the mediator of the correlation between teacher autonomy support and student's learning engagement.

Method

Research Design

Based on its objectives, this research is classified as quantitative research. This research attempts to explain and describe each variable in detail and look at the relationships or connections between these variables (Cozby & Bates, 2012) and also the values of the mediation effects. This research was also categorized as a non-experimental research in which the researcher only conducted a survey and did not manipulate the research variables. Then, his research used one shot study design which is the selection process data carried out once over a certain period of time on an individual (or group of people) selected for observation (Cozby & Bates, 2012).

Participant Characteristics

The participants of this research were 162 students with an age range of 15-18 years old. Purposive and convenience sampling technique was used to collect data from high schools students across Indonesia. The adolescents who participated in this study were predominantly female 76.5% (N = 124) and male with percentage 23.5% (N = 38). For age range, the adolescents participated in this study predominantly in age 17

with percentage 34% (*N* = 55), age 16 with percentage 27.8% (*N* = 45), age 18 with percentage 22.2% (*n* = 36), and age 15 with percentage 16% (*N* = 26).

This research tried to collect data from adolescents across Indonesia's province which we distributed the scales with online form. From the response, most of the adolescents come from the capital city of Lampung Province which is Bandar Lampung with percentage 37% (*N* = 60), 25.9% (*N* = 42) percent from South Sumatera Province ,14.8% (*N* = 24) percent from district within Lampung Province, 13.6% (*N* = 22) percent from West Java Province, 2.5% (*N* = 4) percent from Jambi, Jakarta and Tangerang, 1.9% (*N* = 3) percent from Central Java, 1.2% (*N* = 2) percent from East Java, and Kalimantan 0.6% (*N* = 1).

Table 1. Characteristics of Particpants (*N* = 162)

Demographic variable	***N***	**%**
Domicile		
Bandar Lampung	60	37.0
District in Lampung Province	24	14.8
South Sumatera	42	25.9
Jambi	4	2.5
Jakarta and Tangerang	4	2.5
West Java	22	13.6
Central Java	3	1.9
East Java	2	1.2
Kalimantan	1	0.6
Age		
15	26	16.0
16	45	27.8
17	55	34.0
18	36	22.2
Gender		
Male	38	23.5
Female	124	76.5

Instruments

Learning Engagement. Learning engagement was measured on the engagement scale of Fredricks and Paris (2004), which consisted of 19 items for the measurement of the students' engagement in class learning activities with four answer choices, i.e. completely disagree = 1, disagree = 2, agree = 3, and completely agree = 4. The reliability testing result was a Cronbach alpha value of 0.738 and the validity testing result was $p<0.05$, which was 0.00.

Teacher Autonomy Support. Teacher autonomy support was measured on the autonomy support scale of Kaur (2017), which comprised 20 items for the measurement of the students' perception of whether their teacher gave choices, appreciating their ideas and suggestions, and explaining the relevance of their class learning activities. The scale offered four answer choices, i.e. completely disagree = 1, disagree = 2, agree = 3, and completely agree = 4. The reliability testing result was a Cronbach alpha value of 0.882 and the validity testing result was $p<0.05$, which was 0.00.

Fulfilment of Basic Psychological Needs. The fulfilment was measured on the "feeling I have" scale of Deci and Ryan (2004). This measuring instrument contained 21 items measuring the students' perception of the fulfilment of basic psychological needs. This scale has four answer choices, i.e. completely disagree = 1, disagree = 2, agree = 3, and completely agree = 4. The reliability testing result was a Cronbach alpha value of 0.705 and the validity testing result was $p<0.05$, which was 0.00.

Data Analysis Techniques

The data of this research were processed through three analyses, i.e. descriptive, regression, and mediation analyses.

Descriptive statistics are used to determine the frequency distribution and percentage of the participant's demographic data and variables. In this research, the demographic data that will be processed are domicile, age, and gender. Apart from that, descriptive statistics are also used to process the learning engagement, teacher's autonomy support and basic psychological needs data.

The researcher aims to know the relationship between the three variables and wants to see the influence of the independent variable (teacher's autonomy support) and the mediator variable (basic psychological needs) on the dependent variable (learning engagement). This analysis was carried out to prove that each independent variable is related to the dependent variable, which became the basic assumption to proceed to the mediation effect analysis.

The mediation effect analysis was conducted to know the mediation effect of basic psychological needs variable in the relationship between teacher's autonomy support and learning engagement through Hayes process (Hayes, 2013).

Results and Discussion

The General Description of the Research Variables

The researcher tested the descriptive data for each variable, that are learning engagement (M = 56.54, SD = 6.489), teacher autonomy support (M = 61.71, SD = 7.974), and fulfilment of basic psychological needs (M = 57.64, SD = 6.336).

Table 2. Description of Research Results

Descriptive Statistics					
	N	**Min**	**Max**	**Mean**	**SD**
Student Learning Engagement	162	41	73	56.54	6.489
Teacher Autonomy Support	162	37	80	61.71	7.974
Fulfilment of Basic Psychological Needs	162	42	73	57.64	6.336

Based on mean and standar deviation value on Table 2 above, then we categorized each variable in high, medium, and low category.

Table 3. Categorization

	High	**Medium**	**Low**
Student Learning Engagement	19.8% (N = 32)	61.7% (N = 100)	18.5% (N = 30)
Teacher Autonomy Support	17.9% (N = 29)	70.4% (N = 114)	11.7% (N = 19)
Fulfilment of Basic Psychological Needs	13.6% (N = 22)	72.2% (N = 117)	14.2% (N = 23)

As seen Table 3 above, most of the students have medium learning engagement with percentage 61.7% (N = 100), 19.8% (N = 32) students in high category, and 18.5% (N = 30) students in low category. For teacher autonomy support variable, most of students got medium category of autonomy support from their teachers

with percentage 70.4% (*N* = 114), 17.9% (*N* = 29) students got high category of autonomy support from their teachers, 11.7% (*N* = 19) students got high category of autonomy support from their teachers.

In the fulfilment of basic psychological needs variable, most of students were also in medium category. There are 72.2% (*N* = 117) students were in medium category of the fulfilment of basic psychological needs. Then, 14.2% (*N* = 23) students were in low category of the fulfilment of basic psychological needs and 13.6% (*N* = 22) students were in low category of the fulfilment of basic psychological needs.

Furthermore, the researcher conducted multiple linear regression to explore the effect of teacher autonomy support and fulfilment of basic psychological needs to student's learning engagement. The results of the multiple linear regression were explained in the Table 4 below.

Table 4. Multiple Linear Regression Results

R	**R^2**	**F**	**P**
0.667	0.445	63.726	0.000

Based on the Table 4, it could be seen that the two independent variables which the teacher autonomy support and fulfilment of basic psychological needs predict the student's learning engagement with a significance value of F = 63.726 (p<0.01), R^2 = 0.445. which means that the effect of the teacher autonomy support and fulfilment of basic psychological needs was 44.5% to the student's learning engagement.

The magnitude and direction of the effect of the celebrity worship and peer interaction on the body images were explained in Table 5 below.

Table 5. Coefficients of Regression

	Unstandardized Coefficients		**Standardized Coefficients**	**t**	**sig.**
	B	**Std. Error**	**Beta**		
(Constant)	13.986	4.115		3.399	.001
Teacher Autonomy Support	.456	.061	.523	7.457	.000
Fulfilment of Basic Psychological Needs	.250	.080	.219	3.127	.002

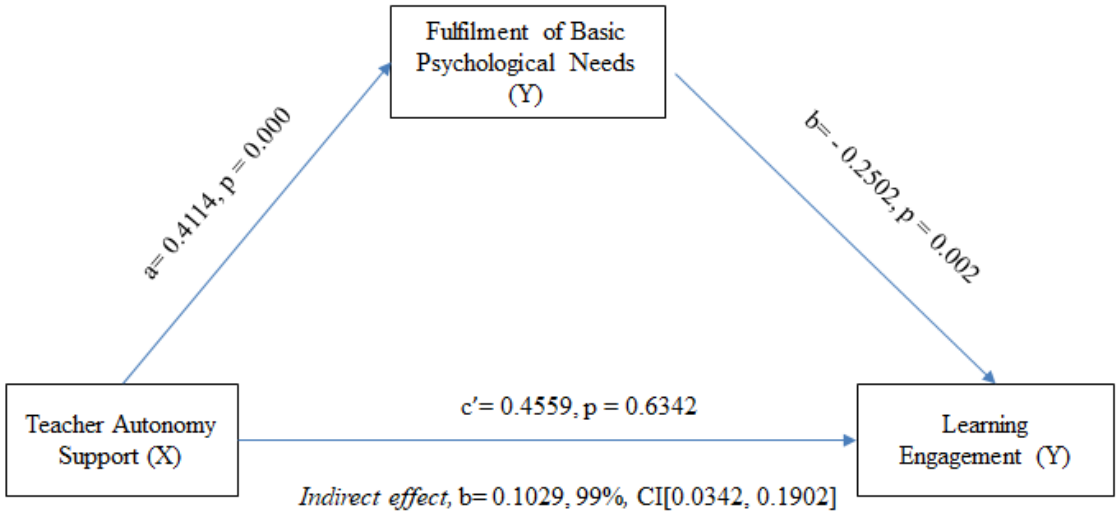
From Table 5, teacher autonomy support affect student's learning engagement positively with $B = 0.456$, $p < 0.01$. The results revealed that the higher autonomy support given by the teacher, the higher learning engagement showed by the students. The results of coefficients of regression also showed that the fulfilment of basic psychological needs affect student's learning engagement positively with $B = 0.250$, $p < 0.01$. The results revealed that the fulfilment of basic psychological needs given by the teacher, the higher learning engagement showed by the students negatively.

In this research, the main technique analysis used in this study is mediation effect with linear regression through PROCESS Hayes (Hayes, 2013). The calculation of the mediation effects with linear regression were explored in total, direct, and indirect effects. Through the calculation with the 162 research subjects, it was found out that the indirect effect of teacher autonomy support on student learning engagement through the fulfilment of basic psychological needs as the mediator existed partially. The results of the linear regression analysis show that the teacher autonomy support served as a significant variable for predicting the fulfilment of basic psychological needs as the mediator(line a) F = 12.284 , P<0.005. With a coefficient value of 0.251 p < 0.007, the teacher autonomy support had a positive effect on the fulfilment of psychological needs, meaning the more the teacher autonomy support, the greater the fulfilment of the students' basic psychological needs. 33.0% of the variants of the fulfilment of basic psychological needs could be explained by the teacher autonomy support.

Then, the fulfilment of basic psychological needs as the mediator could also significantly predict the effect of student learning engagement as a dependent variable (line b) F = 46.470, p < 0.05. The fulfilment of basic

psychological needs correlated to the student learning engagement in a positive direction with a coefficient value of 0.270, p < 0.008. This indicates that the greater the fulfilment of basic psychological needs, the more engaged the students were in learning. 69.5% of the variants of the student learning engagement could be explained by the fulfilment of basic psychological needs.

This research also resulted in a direct effect, the existence of the influence of the teacher autonomy support on the student's learning engagement (line c). The results of linear regression analysis obtained $\beta = 0.4559, R^2 = 0.4449, F = 63.7258, p < 0.01$ which means that the teacher autonomy support positive and significantly predict the student's learning engagement. It means that the greater the teacher autonomy support, the higher the learning engagement which 44.49% the variants of the student's learning engagement could be explained by the teacher autonomy support.



The coefficient of the direct effect (direct effect = c) in this research was higher than the coefficient of the total indirect effect with $\beta = 0.1029, p < 0.01$. It implies that the fulfilment of basic psychological needs had a partial mediator effect on the correlation of the teacher autonomy support with the student's learning engagement. The calculation via "PROCESS" resulted in the significant indirect effect on the correlation between the teacher autonomy support and the student learning engagement partially mediated by the fulfilment with an effect size of 0.1029, CI [0.0342, 0.1902]. So, it is inferable that the fulfilment of basic psychological needs served as a significant mediator in the correlation between the teacher autonomy support and the student's learning engagement. It bears the indication that the greater the teacher autonomy support, the higher the fulfilment of basic psychological needs, which lead to the increase in the student learning engagement.

Table 3. The Results of the Linear Regression Mediated Analysis

Antecedent	Consequent	Coeff	SE	T	Sig
X	M	0.4114 (a)	0.0509	8.0820 R^2 = 0.2899 F = 65.3195	0.000
M	Y	0.2502 (b)	0.0800	3.1272 7.4573	0.002
X	Y	0.4559 (c')	0.0611	 R^2 = 0.4449 F = 63.7258	0.000
M	Y	0.1029	0.0388	7.4573	0.000

Discussion

The objective of this research was to figure out the mediation effects of the fulfilment of basic psychological needs in the correlation of teacher autonomy support and student's learning engagement. This study found a significant positive correlation between teacher autonomy support and student's learning engagement, meaning greater teacher autonomy support results in higher student's engagement in mathematics learning.

According to self-determination theory, a teacher's teaching style in the classroom is in on a continuum from highly controlling learning behavior to supportive student learning autonomy. Teachers who support student's autonomy can facilitate the fulfillment of basic psychological needs, students' interests and provide opportunities in choosing learning activities in in the classroom (Reeve, 2006). On the other hand, teachers who tend to control the behavior of their students can hinder motivation in learning because students are required to follow and obey the instructions of the teacher or lecturer and the lecturer does not pay attention to the motivation that exists within students.

In addition, students who know that their teacher is willing to listen to their ideas and give them a chance to choose and make a decision for themselves, the students feel that they are an active individual, meaning all their actions are performed of their free will (Connell and Wellborn, 1991). This feeling of being an active agent drives a student to be more responsible for their actions (Somad, Malay, Wahyuni, 2022). Moreover, students who understand how important learning activities are for themselves will push them to participate in such activities and use their initiative when dealing with class tasks (Reeve and Jang, 2006).

Deci and Ryan (2000) revealed that individuals can be involved in various behaviors aimed at achieving self-competence and connecting with other people. The behavior displayed by individuals can originate from within oneself autonomously/independently, or there is control from outside oneself individually. For example, between two students, one is diligent and very interested completed his college assignments and wanted to take part in work competitions scientific, while other students are busy organizing to be accepted inside group of friends. The behavior displayed by the two students can be said to be autonomous behavior or behavior controlled by something that originates from outside oneself. The first student feels competent can take part in scientific work competitions because of the motivation that comes from internally and externally, while the second student does everything organizational activities are likely to be based on internal considerations themselves or based on invitation or pressure from their seniors. Therefore, autonomy has a unique meaning and role in its position as one of the three basic psychological needs of humans, autonomy in their roles regulate behavior (as opposed to behavioral control) and autonomy as basic psychological needs. The role of autonomy in regulating behavior can satisfy basic needs for competence and relationships with others. Thus, meeting the need for autonomy is essential for achieving self-determined behavior and to achieve something optimally.

Furthermore, Connell and Wellborn (1991) also reported that students will notice the completion of their basic psychological needs based on the teacher's facilitation in the classroom. If students perceive that their basic psychological need has been fulfilled, they grow the perception that they are competent, autonomous, and related. Similar with Stroet et al., (2013) who revealed that students will perceive their engagement in learning as a self-chosen act that reflects their own authentic needs and values if students satisfied with their teachers' level of autonomy support. Carreira et al., (2013) discovered that students' satisfaction of autonomy needed in the mathematics class correlates positively to their achievement development in future. In addition, study conducted by Laursen and Little (2012) revealed that teachers' autonomy support is time-varying predictive variables of the mathematics achievement and engagement across different assessments over time.

However, this research has limitations. The number of respondents, 162, was still too small for this kind of research, as not every high school in Indonesia was represented. Getting participants from several regions only was far from enough for the inclusion of the whole high schools. It is highly advisable to conduct a more profound study with a vast number of participants that represent every high school in Indonesia for a holistic understanding of the Indonesian educational system.

Conclusion

It can be concluded that students' learning engagement in mathematics is affected by how much their teacher provides them with autonomy support and how the students perceive the fulfilment of their basic psychological needs. Their perceptions determine how engaged they are in mathematics learning.

It is hoped that the outcome of this research will base the evaluation of the educational system, especially the process of teaching mathematics, in Indonesia, shape greater teacher autonomy support, and help teachers to fulfill students' basic psychological needs through an attractive and pleasant learning process so that students get actively involved in it, especially in the process of mathematics learning.

The role of rejection sensitivity in regulating the connection between perceived maternal narcissism and self-disclosure in romantic relationships was explored in this study. It has been determined that rejection sensitivity plays a mediation function between the perceived maternal narcissism and the self-disclosure in a romantic relationship. It has been determined that features of the mother with narcissistic personality traits such as empathy deficiency, grandiosity, criticism-accusation, control-manipulation, and parentification-exploitation can create rejection sensitivity in interaction with the child, and this can negatively affect the self-disclosure towards the romantic partner of the adult. In light of these results, in psychotherapeutic interventions where the self-disclosure in romantic relationships is studied; it is thought that schema therapy methods such as parental restructuring for perceived maternal narcissism and cognitive techniques for the evaluation of negative automatic thoughts, intermediate beliefs, and core beliefs for rejection sensitivity will be beneficial.

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