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Modeling of Self-regulation based on Cognitive Flexibility with Mediated Role of Psychological Hardiness in Students

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Abstract

Purpose: The aim of present research was determine the modeling of self-regulation based on cognitive flexibility with mediated role of psychological hardiness in students.

Methodology: The present study was descriptive, correlational type. The research population was all secondary high school students of Tehran city in academic years of 2019-20, which from them 499 students were selected by step cluster sampling method. Data were collected by self-regulation questionnaire (Bouffard & et al, 1995), cognitive flexibility inventory (Dennis & Vander Wal, 2010) and psychological hardiness scale (Lang & Goulet, 2003) and analyzed by structural equation modeling method in SPSS-22 and Amos-21 software.

Findings: The findings showed that the model of self-regulation based on cognitive flexibility with mediated role of psychological hardiness in students had a good fit. Also, cognitive flexibility on psychological hardiness and psychological hardiness on self-regulation had significant direct effect ($P<0.001$), while cognitive flexibility on self-regulation had not significant direct effect ($P>0.05$). In Addition, cognitive flexibility with mediated of psychological hardiness on self-regulation had significant indirect effect ($P=0.009$).

Conclusion: Regarded to the results, school counselors and psychologists can via increasing cognitive flexibility and psychological hardiness directly and indirectly led to improve self-regulation of students.

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1. Introduction

The growth and development of any society depends on the educational system of that society and students have an important role in the growth and development of the society. One of the factors influencing the success of the educational system is self-regulation through which learners facilitate and through which learners adjust their behaviors for learning and recall (Wagner & Holochwost, Danko, Propper, Coffman, 2021). Self-regulation is an active, dynamic and constructive process in which learners choose goals for themselves and then take steps to achieve them by regulating their cognition, motivation and behavior (Zacharious & Whitebread, 2019). This feature is not a fixed feature, but a set of environment-dependent processes that people choose to do homework, learn and recall (g & Rauch, 2018). Self-regulation refers to the ability to monitor performance and respond to feedback that increases the likelihood of optimal performance in the best possible way (Lenes & et al, 2020). Self-regulation is divided into two general parts, cognition and metacognition. Cognition refers to the use of strategies that learners use to learn, understand and remember, and metacognition is a strategy for monitoring, controlling, guiding, correcting and evaluating cognition (Opalinski & Martinez, 2021).

One of the factors affecting self-regulation is cognitive flexibility (Rubio & et al, 2014) which as one of the important factors in social interactions shows the ability to review the program when it fails or encounters obstacles (Fuss & et al, 2021). Cognitive flexibility refers to the degree to which individuals experience internal and external experiences, which determines the type of individual response to new experiences and requires the ability to communicate with the present and the power to differentiate oneself from internal thoughts and experiences (Giller & et al, 2020).). Cognitive flexibility is a dynamic process that results in positive adaptation to the environment or adaptation of thoughts and behaviors in response to environmental changes, and resilient individuals tend to offer different approaches to problems (Ji & et al, 2018). The three parts of this structure include the ability to create multiple solutions to difficult life situations (perception of different options), the desire to understand difficult situations as controllable conditions (control perception) and the ability to provide multiple explanations for human behavior and life events (perception of behavior justification) (Cartwright & et al, 2019). People with high psychological flexibility are very curious about the inner and outer world, looking for new businessmen. Thus, not only do they not avoid encountering new internal and external experiences, but they also seek to acquire them (Stepanyan & et al, 2020).

One of the factors that can mediate between cognitive flexibility and self-regulation is psychological toughness, which means a set of personality traits that acts as a source of resistance or protective shield against stressful life events (Kowalski & Schermer, 2019). Psychological stubbornness has three parts: the sense of control and management of events and happenings around oneself (control), purposefulness and deep commitment to oneself and others, and accepting responsibility for one's actions (commitment) and the ability to change and transform as common life challenges (challenges) (Bartone & Homish, 2020). Thus, stubborn people feel more committed to their work, see stressful situations and events as a potential opportunity for growth, and feel more in control of life events and situations (Sandvik & et al, 2015). People with psychological hardiness are able to effectively solve interpersonal problems and stress, and they are often curious and use adaptive coping strategies to solve challenges (Potard & et al, 2018).

Although research has been done on the relationships between cognitive flexibility, psychological toughness, and self-regulation, this study has done little to examine the causal relationships between them. For example, the results of Narimani, et al (2020) showed a positive and significant relationship between flexibility and psychological toughness. Asghari Ebrahimabad & Mamizade Ojouri (2018) while researching concluded that cognitive flexibility, psychological toughness and psychological well-being had a positive and significant relationship. In another study, Ram, et al (2019) reported that cognitive flexibility was positively correlated with resilience. Also, the results of Alarcon-Rubio, et al (2014) showed that cognitive flexibility and self-regulation were significantly related. In another study, Seif (2012) reported that self-regulatory

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strategies had a positive and significant relationship with flexibility. In addition, the results of Nasiri, et al (2017) showed a significant relationship between cognitive emotion regulation strategies and psychological hardiness. Zabihi, et al (2014) in a study concluded that hard training had a significant effect on learning self-efficacy and self-regulation. In another study, Bagheri & Yousefi (2009) reported that there was a positive correlation between rigidity, self-efficacy beliefs, and emotional self-regulation strategies.

Students are the future makers of society and can play an effective role in the growth and development of society. One of the effective variables in this field is self-regulation that helps students to regulate thoughts, emotions, cognition, beliefs, behaviors and activities and can play an effective role in the success and performance of students in various academic and non-academic fields. Although much research has been done on self-regulation, it has paid less attention to the role of cognitive flexibility and psychological toughness, and no research has been found that examines the causal relationships between them. As a result, this study can reveal other aspects of students 'self-regulation for education professionals and planners and play an effective role in improving students' self-regulation through cognitive flexibility and psychological toughness. Therefore, given the role and importance of self-regulation in high school students preparing for a major competition called the national entrance examination, there is little research background on the relationship between cognitive flexibility, psychological stiffness and self-regulation, and failure to find research that examines their causal relationships. The aim of this study was to determine the model of self-regulation based on cognitive flexibility with the mediating role of psychological hardiness in students.

2. Methodology

The research method of the present study was applied in terms of purpose and descriptive-correlational in terms of implementation. The study population was all second year high school students in Tehran in the academic year 2019-20. The sample size was considered to be 500 people due to structural equation analysis and relatively high sample size, which was selected by cluster sampling method, but one of the students, was removed from the samples due to improper completion and finally the analysis was performed for 499 people. For this purpose, first, out of 20 districts of Tehran, 5 districts were randomly selected (districts 1, 3, 7, 11 and 16) and then from each district, 2 schools (one for boys and one for girls) and from each school, Three classes in different grades were randomly selected and all students in the classes were selected as a sample. In order to conduct this research, after coordination with the officials of Tehran Education Department and the officials of selected departments, schools were sampled and then for the executive staff of selected schools and students, the purpose, importance and necessity of the research were expressed and students' consent to participate in the research was obtained. They were reassured to follow the ethical guidelines and eventually responded to the following tools.

Self-regulatory questionnaire: This questionnaire was designed by Bouffard, et al (1995). This tool has 14 items and two sections of cognition (7 items) and metacognition (7 items) which are scored using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The instrument score is calculated with the total score of the items, so the range of self-regulatory scores is 14 to 70, cognitive 7 to 35 and metacognitive scores 7 to 35, and a higher score indicates that it has more features. Bouffard, et al (1995) confirmed the validity of the instrument construct by factor analysis method and its reliability by Cronbach's alpha method for total 0.86, cognition 0.78 and metacognition 0.72. In Iran, Rahpeima et al. (2020) reported reliability using Cronbach's alpha method for cognition of 0.67 and metacognition 0.71 and Atarodi & Kareshki (2013) reported reliability using Cronbach's alpha method for total 0.72. In the present study, reliability was calculated by Cronbach's alpha method for total 0.84, cognition 0.82 and metacognition 0.79.

Cognitive Flexibility Inventory: This inventory was designed by Dennis & Vander Wal, et al (2010). This tool has 20 items and three parts of different options perception (10 items), control perception (8 items) and behavior justification perception (2 items), which is used using the seven-point Likert scale (1

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= strongly disagree to 7 = strongly agree) is scored. The tool score is calculated with the total score of the items, so the range of cognitive flexibility scores is 20 to 140, different options perception is 10 to 70, control perception is 8 to 56 and behavior justification perception is 2 to 14, and a higher score indicates that it has more features. Dennis & Vander Wal (2010) confirmed the divergent validity of the instrument with Beck & Clarck Depression Inventory equal to -0.39 and the construct validity of the instrument with factor analysis method and its reliability with Cronbach's alpha method for the whole 0.91, perception of different options Reported 0.84, control perception 0.91 and behavior justification perception 0.88. In Iran, Taghizadeh & Farmani (2014) reported its reliability by Cronbach's alpha method for the whole 0.90, perception of different options 0.89, control perception 0.87 and behavior justification perception 0.55. In the present study, reliability was calculated by Cronbach's alpha method for the whole 0.87, perception of different options 0.85, control perception 0.90 and behavior justification perception 0.73.

Psychological Hardness Scale: This scale was designed by Lang & Goulet (2003). This tool has 42 items and three sections of control (16 items), commitment (15 items) and challenge (11 items), which are scored using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The tool score is calculated with the total score of the items, so the range of psychological toughness scores is 42 to 210, control 16 to 80, commitment 15 to 75 and challenge 11 to 55, and a higher score indicates that it has more features. Lang & Goulet (2003) confirmed the validity of the instrument construct by factor analysis method and its reliability by Cronbach's alpha method for total 0.73, control 0.78, commitment 0.71 and challenge 0.69. In Iran, Zarei (2019) reported its reliability by Cronbach's alpha method for the whole scale of 0.86. In the present study, reliability was calculated by Cronbach's alpha method for the whole 0.76, control 0.81, commitment 0.87 and challenge 0.70. Data were collected by the above tools and analyzed by structural equation modeling in SPSS-22 and Amos-21 software.

3. Findings

499 students participated in this study. Table 1 presents the frequency and percentage of frequency of students' demographic variables.

Table1. Frequency and frequency of demographic variables in students

Variables	Levels	Abundance	Frequency
Gender	Girl	270	54/11
	Boy	229	45/89
Age	16 years	163	32/66
	17 years	169	33/87
	18 years	167	33/47
Grade	tenth	163	32/66
	Eleventh	169	33/87
	twelfth	167	33/47

As can be seen in Table 1, most of the female students (270, ie 54.11%) were 17 years old (169, ie 33.87%) and were studying in the 11th grade (169, ie 33.87%). Table 2 presents the mean, standard deviation, minimum and maximum of research variables in students.

Table2. Mean, standard deviation, minimum and maximum of research variables in students

Variables	Average	The standard deviation	Minimum	Maximum
Perception of different options	50/15	10/23	15	70
Perception of control	37/47	8/59	8	56
Perception of behavior justification	9/08	2/80	2	14
Total cognitive flexibility	96/70	16/69	47	139
Control	54/60	9/31	16	80
obligation	47/30	5/03	33	67

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Challenge	38/73	6/51	19	55
Total psychological stubbornness	140/63	17/46	81	189
cognition	23/62	4/59	7	35
Metacognition	22/78	4/95	8	35
Total self-regulation	46/41	8/51	18	69

Before analyzing the data by structural equation modeling method, the assumptions of normality and non-alignment were investigated. Value of 10 multiple linear hypotheses not confirmed. Table 3 presents the correlation coefficients of research variables in students.

Table3. Correlation coefficient of research variables in students

Variables	Cognitive flexibility	Psychological stubbornness	Self-regulatory
Cognitive flexibility	1		
Psychological stubbornness	0/628**	1	
Self-regulatory	0/481**	0/608**	1

**P<01/0

As can be seen in Table 3, there was a positive and significant correlation between cognitive flexibility, psychological toughness and self-regulation in students (P <0.01). According to the assumptions of normality and non-alignment, the structural equation modeling method can be used. Table 4 presents the fitness indicators of the self-regulatory model based on cognitive flexibility with the mediating role of psychological hardiness in students.

Table4. Fitness indicators of research model in students

Indicators	χ2/df	RMSEA	SRMR	CFI	GFI	TLI
the amount of	2/031	0/053	0/035	0/990	0/987	0/979
Acceptable	<3	<0/08	<0/08	>0/90	>0/90	>0/90

As can be seen in Table 4, all indicators indicated a good fit of the self-regulatory model based on cognitive flexibility with the mediating role of psychological toughness in students. Figure 1 shows a fitted model of self-regulation based on cognitive flexibility with the mediating role of psychological toughness along with path coefficients and in Table 5 the results of direct and indirect effects on students are presented.

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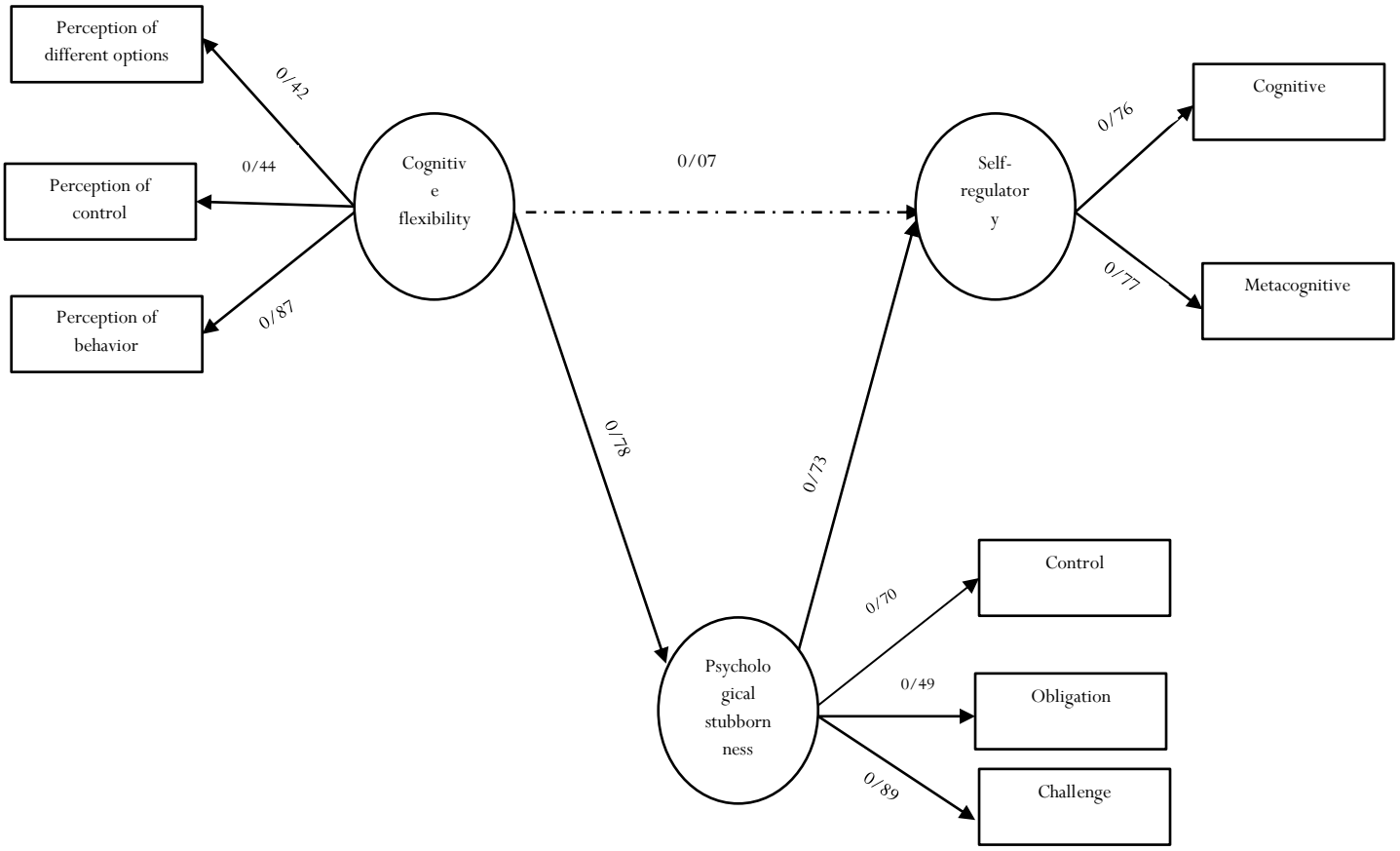

Figure1. Fitted research model with path coefficients in students

Table5. Results of direct and indirect effects on students

Research hypotheses	Beta	B	SE	T	P-value
The direct effect of cognitive flexibility on psychological toughness	0/780	0/570	0/060	9/512	0/001
Direct effect of cognitive flexibility on self-regulation	0/073	0/029	0/040	0/723	0/470
Direct effect of psychological hardiness on self-regulation	0/729	0/392	0/058	6/784	0/001
Indirect effect of cognitive flexibility on self-regulation mediated by psychological toughness	0/568	0/224	0/067	3/343	0/009

As shown in Figure 1 and Table 5, cognitive flexibility had a direct effect on psychological hardiness and psychological hardiness on self-regulation (P <0.001), while cognitive flexibility had no significant direct effect on self-regulation (P = 0.470). In addition, cognitive flexibility mediated by psychological hardiness had a significant indirect effect on self-regulation (P = 0.001).

4. Discussion

Self-regulation has an important role in the success and performance of students as future makers of society, so this study was conducted to determine the model of self-regulation based on cognitive flexibility with the mediating role of psychological toughness in students. Findings showed that cognitive flexibility had a direct and significant effect on psychological toughness, which was in line with the findings of Narimani, et al (2020), Asghari Ebrahimabad & Mamizade Ojouri (2018) and Ram, et al (2019). In explaining and interpreting these findings, it can be said that resilient people are aware of the existence of stress in their lives and do not avoid them, instead, they consider stressful situations as an opportunity for growth and development (Stepanyan & et al, 2020).

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Flexibility means returning to its original state, so that when an object resists or bends, it has the ability to return to its original state. Thus, the term flexibility refers to invulnerability to a large extent, and the more flexible a person is, the more difficult and stressful situations can be considered as a controllable situation, and in the face of life events and behaviors, the ability to have several alternative justifications. In difficult situations, he can think of alternative solutions, and as a result, his capacity to cope, adapt and improve in the face of difficult and stressful life situations increases. Also, these people use alternative justifications, positively reconstruct their frame of mind, accept challenging situations or stressful events, and are psychologically healthier and have a better quality of life than people who are not flexible (Asghaade Ebouri, 2018).

As a result, cognitive flexibility through the described processes can increase students' psychological toughness. Other findings showed that cognitive flexibility did not have a direct and significant effect on self-regulation, which was inconsistent with the findings of Alarcon-Rubio et al. (2014) and Seif (2012). In explaining and interpreting this difference in the findings of the present study with previous research, we can point to the difference in analysis methods. In the present study, the structural equation modeling method has been used, but in both studies mentioned above, the correlation method has been used. In studies that use the structural equation method and in which standard coefficients are reported, a significant value is often confirmed if there is a very high correlation. In confirmation of this explanation, we can point to the degree of correlation in the present study that between cognitive flexibility and self-regulation, the degree of correlation with the value (0.481) is significant at a level less than 0.01, but the standard coefficients of these two variables are not significant. Other findings showed that psychological toughness had a direct and significant effect on self-regulation, which was consistent with the findings of Nasiri, et al (2017), Zabihi, et al (2014) and Bagheri & Yousefi (2009). Explaining and interpreting these findings, it can be said that psychological stubbornness reduces stress and depression by equipping a person with a shield to deal with stressful situations, and by activating adaptive coping strategies in stressful situations, it makes a person more optimistic about events. Comment (Nasiri & et al, 2017).

Also, people with psychological hardiness usually consider life activities as controllable, interesting, important and meaningful and commit themselves to improving their living conditions and society. Such conditions reduce the severity of stress in situations and lead to regular and accurate planning by individuals (Bartone & Homish, 2020). According to the explanations, it can be expected that psychological toughness has an effective role in increasing students' self-regulation. In addition, the findings showed that cognitive flexibility mediated by psychological toughness had an indirect and significant effect on self-regulation. Although no research has been found in this field, but in explaining it can be said that the effect of cognitive flexibility on self-regulation is mediated by cognitive and motivational mediating processes. The most important cognitive mediating processes affecting self-regulation are self-efficacy, self-confidence, commitment and commitment. Weakness, self-esteem, responsibility and planning, and the most important motivational processes affecting self-regulation can be named as low anxiety, high motivation for success, fear of failure, interest in education and learning, source of internal control and vitality. Considering that psychological stubbornness has three parts: feeling of control and management of events and happenings around oneself (control), purposefulness and deep commitment to oneself and others and accepting responsibility for one's activities (commitment) and ability to change and transform as common life challenges (Challenge) (Bartone & Homish, 2020).

Therefore, psychological stubbornness has both cognitive and motivational dimensions, so it can be expected that it can be a good mediator between cognitive flexibility and self-regulation in students. As a result, it can be expected that cognitive flexibility mediated by psychological hardiness will increase students' self-regulation. No research is conducted without restrictions and one of the important limitations of this research is the use of cross-sectional research method and the use of self-report questionnaires to collect data, failure to review the results by gender and the limitation of the research community to high

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school students in Tehran. Therefore, longitudinal research, if possible using interviews, reviewing the results by gender, conducting this research on students in other cities and even other courses is recommended. Another research proposal is based on the results of an intervention study aimed at teaching psychological toughness and examining its effectiveness on self-regulation in students or teaching cognitive flexibility and examining its effectiveness on psychological toughness in students. According to the results of the present study, education specialists and planners can design programs to promote self-regulation by increasing cognitive flexibility and psychological toughness and train them by skilled and experienced people in a workshop manner. Another practical suggestion is to hold self-regulatory training workshops for students or even their teachers. The last practical suggestion is that school counselors and psychologists identify students with problems with self-regulation and refer them to reputable psychological centers to improve self-regulation through psychological hardiness or even psychological flexibility and follow up on the results. If necessary, school counselors and psychologists themselves can directly and indirectly improve students' self-regulation by increasing cognitive flexibility and psychological toughness.

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