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Effects of executive functions and academic emotions on pupils' academic performance in mathematics

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Abstract

Purpose: The main aim of the present study was to find out the possible effect of executive functions and academic emotions on pupils' academic performance in mathmatics. **Methodology:** In this study, the structural equation modeling, type of non-experimental method was implemented. Using sampling method based on the structural equation modeling, 400 (100 girls and 100 boys) in fifth and sixth grade elementary school pupils in Education regions of North, Central, and South of Tehran were reandomly selected. The research data were collected by using standard tests and questionnaires. Structural equation modeling findings showed significant relationships among the executive functions of the elementary school pupils, academic emotions and their mathematics performance. **Findings:** Moreover, there was significant relationship between academic emotions of the elementary pupils and their academic performance in math subject. **Discussion:** It is concluded that executive functions and academic emotions can affect pupils' academic performance in mathmatics, requiring more atension to these two influential varaiables while teaching math.

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1. Introduction

Due to its special status and importance, special studies in different areas have been allocated to the field of mathematics. According to the school curriculum, we can notice that since introduction the first academic year (first grade), mathematics is an integral part of the curriculum. The results of the standard and global test of TIMSS showed that regardless of the heavy homework done by the Iranian students at school and home, they did not have acceptable performance in the international test of TIMSS. In fact, education based on the current curriculums has not met the capabilities and abilities of the third millennium students and has not oriented and the capabilities such as choice making, critical thinking, problem solving, creativity and innovation, self-regulation, self-efficacy, emotions of success and failure, and consequently, the independent thinking and has not made them efficient. While in the current curriculum, there are some teachers who have made extensive preparations by their knowledge and attitudes to develop these capabilities and talents. But, the issue we are working on is that how can we have efficient preparations for teaching mathematics with high quality and providing rich educational experiences for all the students (Kiyamanesh and Kheiriyeh, 2000). In the meantime, especially in primary schools, paying attention to the differences and capabilities of the students is very important. Students enter the primary schools with individual differences which affects their mental and practical functions. Of course, paying attention to their practical functions in doing mental works is more important.

Educational psychology experts believe that the individual difference is one of the factors affecting the academic performance of the students, and especially their mathematics performance. Executive functions are the skills that help the individual to decide what kind of activities or goals should be considered, which should be selected and how should the behaviors be organized and planned (Dawson and Guare, 2004; Valera and Seidman, 2006). Budly (1996) discussed about a broader view of performance, and Miyake et al. (2009) published a very influential paper on the synthesis and diversity of the central executive components. They discussed the executive performance in terms of inhibition (ignoring the stronger or dominant responses), change (flexible change between the homework assignments or the mental sets) and update of the executive performance and achievement in mathematics (monitoring and deleting or adding the contents from the working memory).

They focused on a broader concept of executive function to determine whether, despite the significant differences in measurement and analytical points of view, a consistent picture of the relationship between executive function and mathematics achievement are seen or not. Although these two concepts (information processing and recall vs. the optional information replacement) are not identical, it seems that the performance on memory tasks and updating are closely related (St Clair-Thompson and Gathercole, 2006; Wilhelm et al., 2013). Pekrun et al. (2002) believed that emotions are a set of interrelated psychological processes that includes emotions, cognition, motivational and psychological factors, and physiological reactions. For example, at the time of test anxiety, the feelings of uneasiness and discomfort, anxiety, tendency to avoid, facial expressions and physical gestures and some other reactions can be observed. Currently, the main argument of the theory of emotion revolves around the idea of discrete emotions theory and evaluation theory (Hamann, 2012).

Proponents of the theory of discrete emotions argue that these emotions are somewhere between seven and 10 "core" emotions, namely: happiness, sadness, anger, disgust, surprise, fear, and humiliation (Ekman and Friesen, 1971; Lench et al., 2011). Appropriate mathematics education and student achievement are of great importance in the field of education. Appropriate education and mathematics achievement require the identification of the problems that can prevent efficient learning. The learner's beliefs and expectations can affect his practical behavior.

Executive functions are generally defined as "neurological processes" that mediate the problem-solving skills and also the independent and goal-oriented behaviors and are the basis of many emotional and social cognitive skills (Lezak et al., 2004; Willcutt et al., 2005). Among the terms related to executive functions, some functions are so important, which are planning and organization, inhibition and mental flexibility. Planning and organization: planning, or in other words the ability to achieve a major goal through other intermediate steps, is one of the essential components of the high level cognitive process, such as problem solving (Van-den Hevvelet al., 2003). Inhibition: inhibition refers to the ability to consciously suppress the automatic and dominant responses in order to provide more appropriate and targeted responses.

The feature of inhibition is to deter the responses or to control the annoying stimuli or inhibited responses (Huizingaet al., 2006). Inhibition, also involves emotional control and motional control (Best et al., 2009). Mental flexibility is introduced to be a change as the ability to change strategies, assignments, and mental states, such as freedom from the unrelated homework assignments and to begin doing the appropriate and newer ones (Miyake et al., 2000; Huizingaet al., 2006). Working (active) memory: working memory is an essential component of executive functions and has the ability to hold multi-component data (including rules, actions, events, numbers or letters) which are being used, manipulated and combined with other data components.

Theorists believed that working memory can be divided into two different verbal and spatial areas. Verbal working memory depends on phonological loop and includes the left dorsal lateral prefrontal cortex, Broca's area and Wernicke's area (Marverl and Desmond, 2010).H. Clements et al (2015) in a study showed that although much attention has been paid to the development of children in the area of executive functions and elementary school mathematics, few studies have been focused on both two. After the definition of executive functions, they aimed to explore whether the executive functions can be taught in schools or not. They concluded that the development of executive function processes and mathematical problems is essential for children. They suggested that high-quality mathematics education is more important than the development of executive functions.

It is defined as a set of "interrelated mental processes" that includes emotions, cognition, motivational and psychological factors and physiological reactions (Pekrun et al., 2006). Emotions are multidimensional. They exist as mental, biological, purposeful and social phenomena (Reeve, 2005, Trans. Seyyed Mohammadi, 2007). It has been made clear that each of the four dimensions (or elements) of emotion concords with one of the aspects of motivation. The element of feeling (affection), gives the emotion a subjective experience that has a personal meaning and importance. Bodily arousal component (biological and physiological activation) includes autonomous and hormonal systems' activity which regulates the body's reaction to an emotion. Bodily arousal and physiological activation are mixed with emotion in a way that imagination of the feeling of anger or hatred without arousal is impossible.

Senses of purpose (element of motivation), gives motivation a targeted motivational state to take the necessary action in dealing with the stressful situations. The aspect of purposefulness explains why people enjoy their emotions. The one, who has less emotion compared to other people, has an undesirable social and developmental status. Social-expression (cognitive) element is the communicational aspect of the emotion. Our personal experiences appear through the body postures, gestures, phonetic levels, and facial expressions. Emotions activate all the capacities of our existence, that is to say our feelings, bodily arousal, sense of purpose and non-verbal communications (Izard, 1993). Dietz (2014) in a study on 120 college students showed that emotions and motivation are strongly related to each other but in different ways, they depend on students' academic feedback and are closely related. Their academic feedbacks also alter their motivational orientations and emotional feedbacks.

2. Method

The aim of the applied research is to develop the practical knowledge in a particular field. Here the discourse level is abstract and general, but in a particular field. Considering the control of the factors, the present study is a non-experimental study, from thestructural equation modeling type, since it explains the impact of executive functions, academic emotions on math academic performance and considering the data collection method, it uses field study method.

The population of this study include all the female and male fifth and sixth elementary school students in the selected educational regions of north, central and south of Tehran, studying during the academic year 2015-16. Therefore the population is appropriate for the aim of this study. The population included 452 students, comprising 165 female students and 235 male students. After administrating the questionnaires, a total of 400 students were analyzed. It should be noted that in the structural equation modeling approach, determining the sample size is different from the way of common approaches and it is not calculated by the use of formula.

The first instrument that was used is the executive functions test in two main parts of the Stroop Test and the Wechsler test which was designed and developed by Stroop (1935) to measure the selective attention and the cognitive flexibility through visual processing. In the Stroop test, the components of response inhibition and flexibility were examined, and in the Wechsler test, that here its PC translated version was used, the working memory (audiovisual) component was considered. This test was modified, translated and designed in Pc version by Khodadadi (2009). The second instrument was the academic emotion questionnaire. This questionnaire measuredthe emotions ofacademic achievement. This questionnaire was designed and developed by Pekrun et al (2002-2005).

It should be noted that by considering the fundamentals of the theory, Pekrun designed the questions in such a way that each part measured the emotional experiences in three different situations. For instance, about the emotions related tothe test, the three related questions measured the emotions experienced before taking the test, while-taking the test, and after taking the test. This questionnaire included 80 items with four main components, that is, physiological, cognitive, emotional, and motivational components. The items of the sub-components of the four above-mentioned components included: the pleasure of the classroom, the hopefulness of the classroom, the pride of the classroom, the anger of the classroom, anxiety (agitation) in the classroom, the shame of the classroom, discouragement of the classroom, wearinessof the classroom. This questionnaire was designed in five point Likert scale containing "strongly agree, agree, no comment, disagree, and strongly disagree".

The "Mathematical performance" data were colleted by the teachers through recoding the final exam scores in math during the academic year 2015-16. This test contained questions from all contents of the fifth and sixth grades elementary schools textbooks. This test was designed by the staff of exams and was distributedjointly with the supervision of the researcher in the selected and under the study schools . The total score of the test was 20.The teachers were asked to use qualitative scores instead of quantitative scores for this case. Moreover, the results of the validity of the executive functions were reviewed and approved by Stroop (1935) and Khodadadi

(2009); for mathematics self-efficacy, the factors were identified and verified by Lent et al (1991), and the validity results of the academic emotions were certified and proved by Pekrun et al. (2002).

In this study, the test was piloted on 42 pupils before conducting the main study and the reliability of each factor with the components were measured through the use of Cronbach's alpha by the help of the SPSS software. The results showed the high reliability over 0.70 for each of the variables, including executive function, mathematics self-efficacy, mathematics emotions, and math performance (math exam), so their reliability was proved. Moreover, the validity and reliability of the instruments were examined by the researcher through the confirmatory factor analysis in Amos, which results are recorded in findings section.

In general, composite equation modeling method is composed of two parts, measurement model and composite model. The measurement model refers to the reliability and validity of the measurement tools of the hidden variables or in other words, the relationship between the observed variables with the hidden variables. It is evaluated using the confirmatory factor analysis method. The composite model also refers to the relationships between the hidden variables (Kalantari, 2009). The basic models in the modeling of composite equations are those that investigate the fitting of measurement model with the composite model at the same time.

In other words, these models are a combination of a measurement model and a composite model. To investigate the research model, two-step method proposed by Anderson and Gerbing (1988) was used. In this approach, at first the relationships between the observed variables with the hidden variables of the model were investigated using confirmatory factor analysis method. Then, the research model was developed according to the nature of the concepts mentioned in this research. In the last step, this conceptual model was tested using composite equation modeling method.

Table 1. Number of subjects in terms of gender

gender	number	percent
male	335	83.8
female	64	16.3
total	400	100

Among 400 students participating in this study, 335 of them were male (83.8%) and 64 of them (16.3%) were female.

Table 2. Describing subjects in terms of age

Minimum	Maximum	Average	Standard Deviation
11	15	12.23	0.75

The average age of 400 students in this study is 12.23 + 0.75 with minimum age of 11 and a maximum age of 15 years old.

Table 3. Describing subjects in terms of Grade

gender	number	percent
Fifth grade	136	34
Sixth grade	264	66
total	400	100

Among total of 400 students in this study, 136 ones were for fifth grade (34%) and 64 (66%) ones were for sixth grade.

In this section, using Cronbach Alpha Index, we examine the reliability of the conceptual model structures. The results of this analysis are presented in Table 4.

Table 4. Investigation of internal consistency (reliability) of model structures

name of the composite	Number of items	Cronbach Alpha Value
Active memory	14	0.92
Education thrills	50	0.96
Motivational	21	0.93
Emotional	17	0.92
Cognitive	26	0.93
Physiology	16	0.92

With regard to the results presented in Table 4, it can be concluded that each structure has sufficient internal consistency.

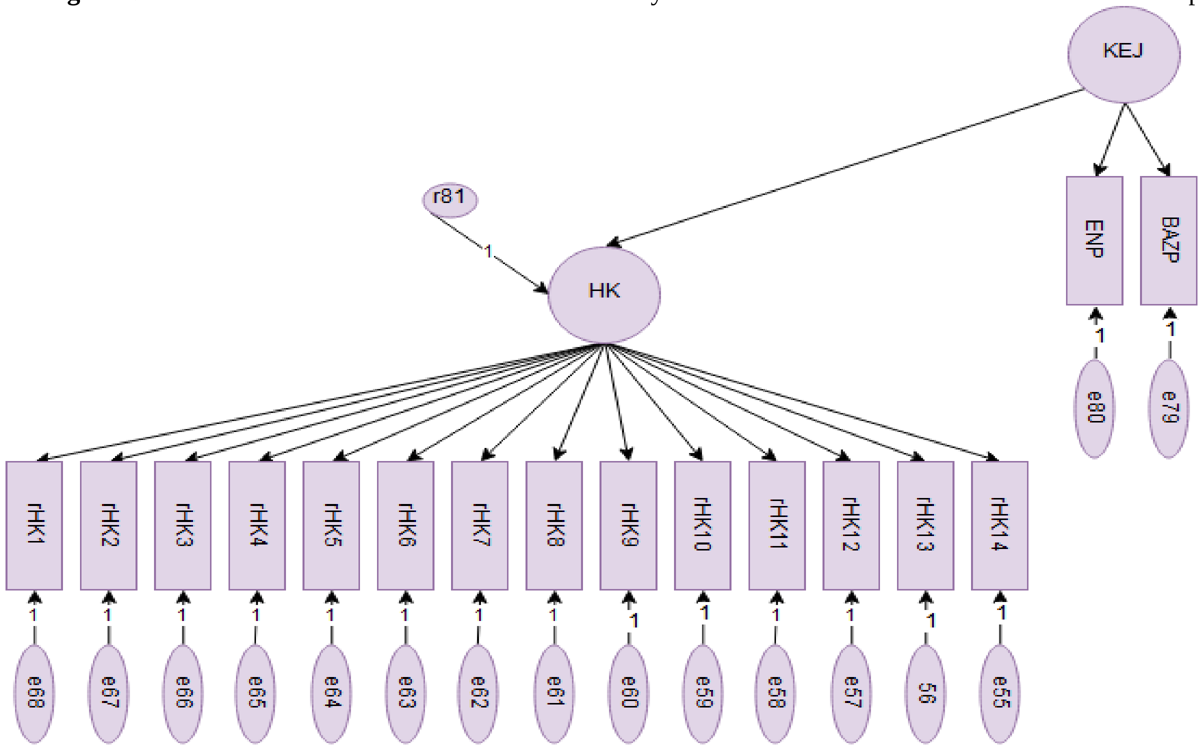
Confirmatory Factor Analysis of each conceptual model structure. To investigate the objectives and the hypotheses of this research we need to confirm the validity of the tools by which we must test these hypotheses. One of the important issues in the validity of questionnaire tools is composite validity. Composite validity consists of two parts: convergence validity and differential divisibility. The statistical method used to verify the validity of the structures is the confirmatory factor analysis. After examining the goodness of fitting the model of confirmatory factor analysis, the convergence validity condition is that: 1) Composite reliability (CR) be greater than 0.7, i.e. CR> 0.7. 2) Factor loads are average, i.e. 0.05> P-value. 3) the standard factor loads be greater than 0.5 and, if possible, greater than 0.7. 4) The composite reliability (CR) be greater than the average variance extracted (AVE), that is CR> AVE. 5) the value of (AVE) be greater than 0.5, i.e. AVE> 0.5.

Also, the divergence validity condition is as follows: 1) AVE be greater than the maximum squared variance (MSV), i.e. AVE> MSV. 2) AVE be greater than the average squared variance (MSV), i.e. AVE> ASV. 3) Convergence validity is analyzed using the confirmatory factor of each composite and divergent validity is done using the model of the confirmatory factor analysis of all composites together.

Therefore, in the first three parts of this section, we first consider the factor analysis of each composite, i.e. second-order confirmation factor analysis (KEJ) of executive function composites (KEJ), the second-order educational thrill composite (HT). Then, in the fourth part, we discuss and assess about the confirmatory factor analysis of the model composites alongside of each other and the divergence validity. Confirmatory Factor for Executive Functional composites (KEJ) (second-order).

The conceptual model related to factor analysis of the second-order social function composites (KEJ) is as the figure of 1. In this form: In this figure: KEJ represents the composite of social functions. HK reflects the active memory composite that rHK1 to rHK7 are related to forward repetition and rHK8 to Rhk14 are related to the backward repetition. Also BAZP and ENP, respectively represent the flexibility score and Inhibition the response of Stroop test.

Figure1. second-order confirmation factor analysis model of executive functions composite



In Fig. 2, we observe the confirmatory analysis model with standard factor loads and in Table 5, we observe the goodness of fit indices. Also in Table 6, the non-standard factor loads have been along with their significance.

Fig. 2: second-order confirmation factor analysis model of executive functions composite with the standard factor loads

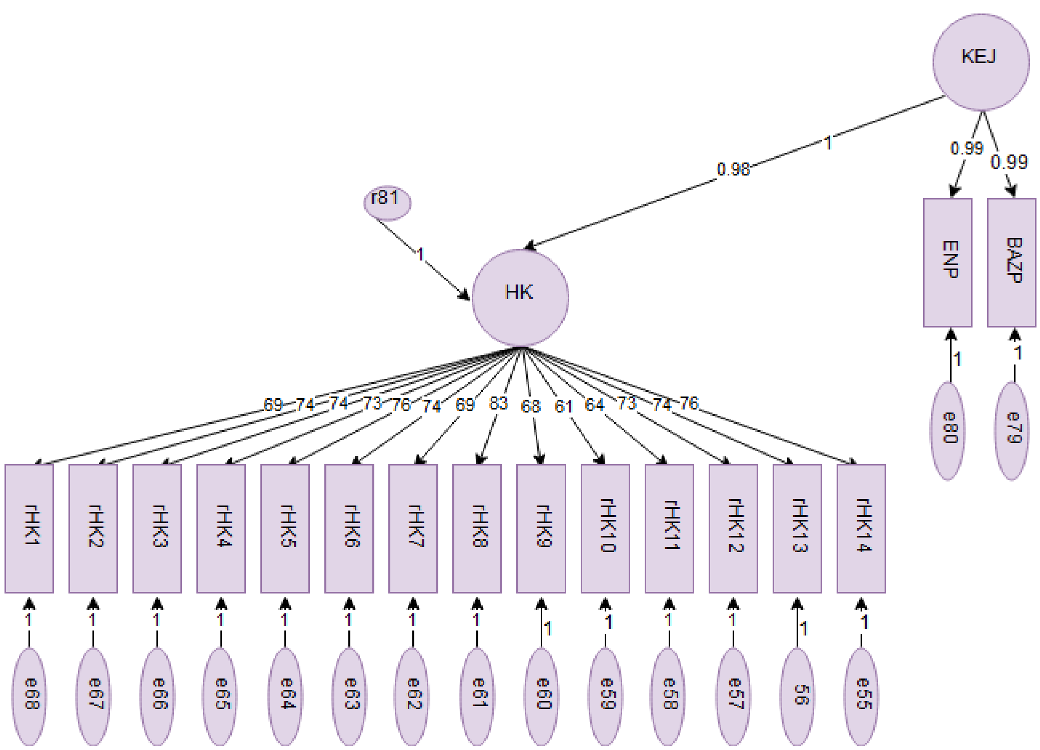


Table 5. goodness index of fitting of confirmatory factor analysis model of second-order of social function composites

Type of goodness fitting index	Range of Index for Approval fitting	Range of Index for good fitting	goodness index of observed fitting	conclusion
The value of x^2 statistic (df)	X2 statistic ratio to freedom degree less than 5	X2 statistic ratio to freedom degree 3	80.95 (103)	good fitting
P-value of x^2 test			0.68	good fitting
X^2 statistic ratio to freedom degree			0.93	good fitting
RMSEA	Less than 0.08	Less than 0.05	0.001	good fitting
P(RMSEA<0/05)	More than 0.05	More than 0.1	1.00	good fitting
CFI	More than 0.90	More than 0.95	1.00	good fitting
NNFI	More than 0.90	More than 0.95	1.00	good fitting
GFI	More than 0.85	More than 0.90	0.97	good fitting
AG	More than 0.85	More than 0.90	0.96	good fitting

According to the values of fitness indices, this model is well-matched in terms of all goodness fitting indices.

Table6. investigating the significance of factor loads (non-standard)

path		Estimate nonstandard factor load	Estimate standard load factor	Estimated Standard error	t Statistic Value	P-value
HK	KEJ	0.05	0.98	0.00	16.91	0.01

After assuring good fitting of model, according to the results of table (6) it can be observed that:

1- The composite reliability value (CR) for this composite is 0.98 which is more than 0.7. Therefore, the existence of the reliability of the second-order composite confirms the social function composite.

2- All factor loadings have meaning and P-VALUE <0.05.

3- All factor loads are greater than 0/5, so the existence of each item in this composite is confirmed.

4- AVE value for this composite is 0.90, so CR value is greater than AVE.

5- Also, AVE value is greater than 0.5.

According to the four cases mentioned above, after considering the goodness of second-order composite fitting, the social functions have convergence validity.

Confirmation Factor Analysis of Educational Thrill s Composites (HT) (Second-Order)

The conceptual model related to the second-order factor analysis of the thrill composite (HT) is presented in Fig. 3.

HT: Represents the composite of educational thrills

M: Represents motivational composites.

C: Represents the emotional composite.

P: Represents the cognitive composite.

A: Represents the physiological composite.

Fig. 3: Confirmatory factor analysis model of the second-order composite of educational thrill

In Figure 4, we see Confirmatory factor analysis model with standard factor loads and in Table _7, we observe the fitting goodness indices. Also, in Table 8, it is also presented the non-standard factor loads with their significance.

Fig. 4: Confirmatory factor analysis model of the second-order composite of educational thrill along with standard factor loads

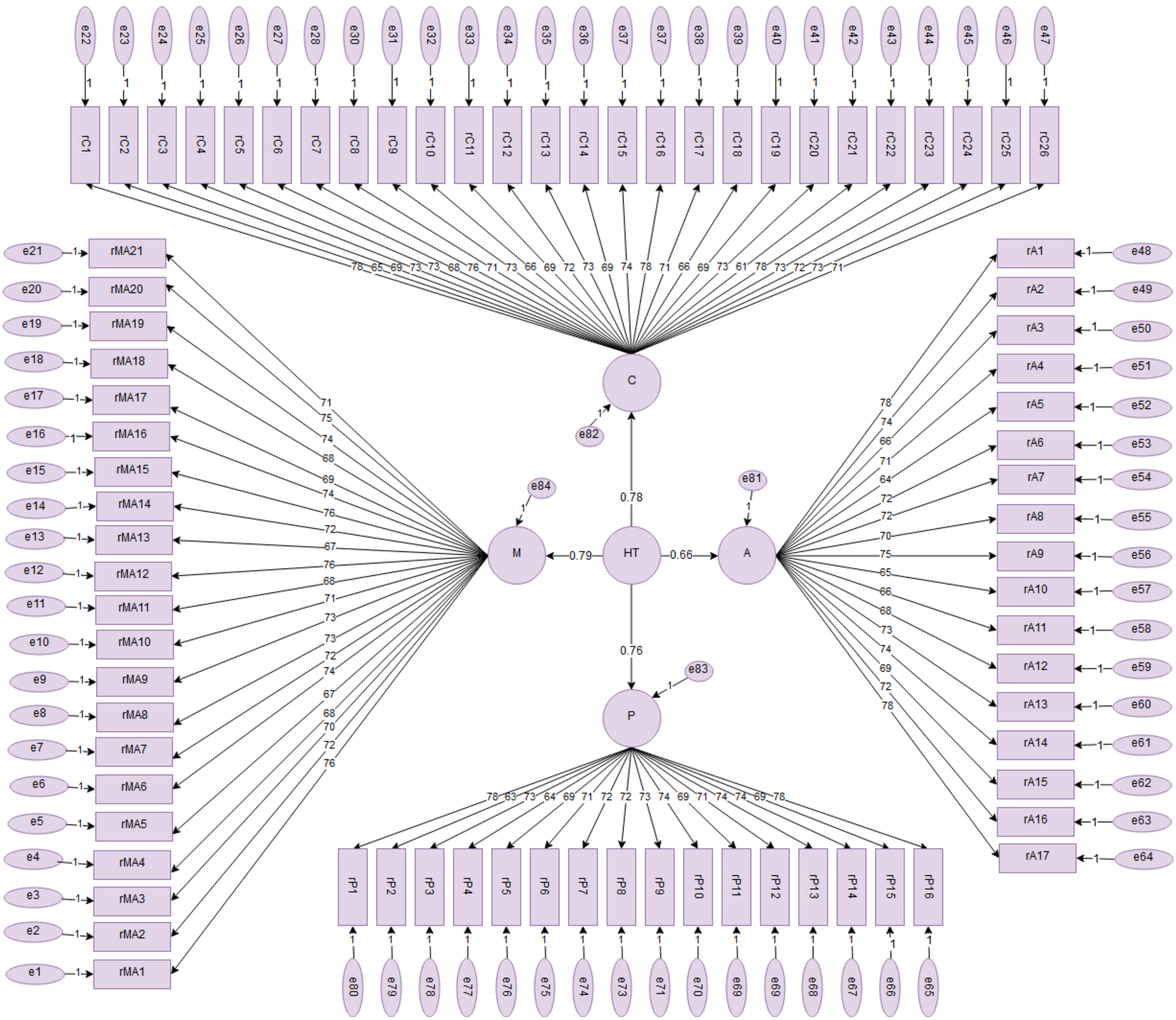


Table 7. goodness fitting indices for confirmatory factor analysis model of second-order composite educational thrill

Type of fitting goodness index	The value of approval fitting Index	The value of good fitting Index	The value of observed fitting Index	conclusion
Amount of x^2 (df) statistic	X^2 ratio to freedom degree 3	X^2 ratio to freedom degree 5	6801194 (1171)	good fitting
p-value of x^2 test			0.31	good fitting
X^2 ratio to freedom degree			1.02	good fitting
RMSEA	Less than 0.08	Less than 0.05	0.007	good fitting
P(RMSEA<0.05)	More than 0.05	More than 0.1	1.00	good fitting
CFI	More than 0.90	More than 0.95	0.99	good fitting
NNFI	More than 0.90	More than 0.95	0.99	
GFI	More than 0.85	More than 0.90	0.91	
AGFI	More than 0.85	More than 0.90	0.91	

Regarding the values related to goodness fitting indices and according to the data of this research this model is well suited for the most goodness fitting indices.

Table 8. The significance of factor loads (non-standard)

path		Estimate the non-standard factor load	Estimate the standard factor load	Estimated Standard error	Amount of statistic t	p-value
C	HT	1.19	0.78	0.12	9.58	<0.01
M	HT	1.28	0.79	0.13	9.56	<0.01
A	HT	1.00	0.66			<0.01
P	HT	1.21	0.76	0.13	9.54	<0.01

After assuring the good fitting of the model, according to the results of table (8), it can be seen that:

1- Value of composite reliability (CR) for this composite is 0.83. Therefore, the existence of the second-order composite reliability confirms the educational thrill s composite.

2- All factor loads are significant and P-value <0.05

3- All factor loads are greater than 0.5 and therefore, each question (item) is confirmed in this composite.

4- AVE value for this composite is 0.90. Therefore, CR value is greater than AVE.

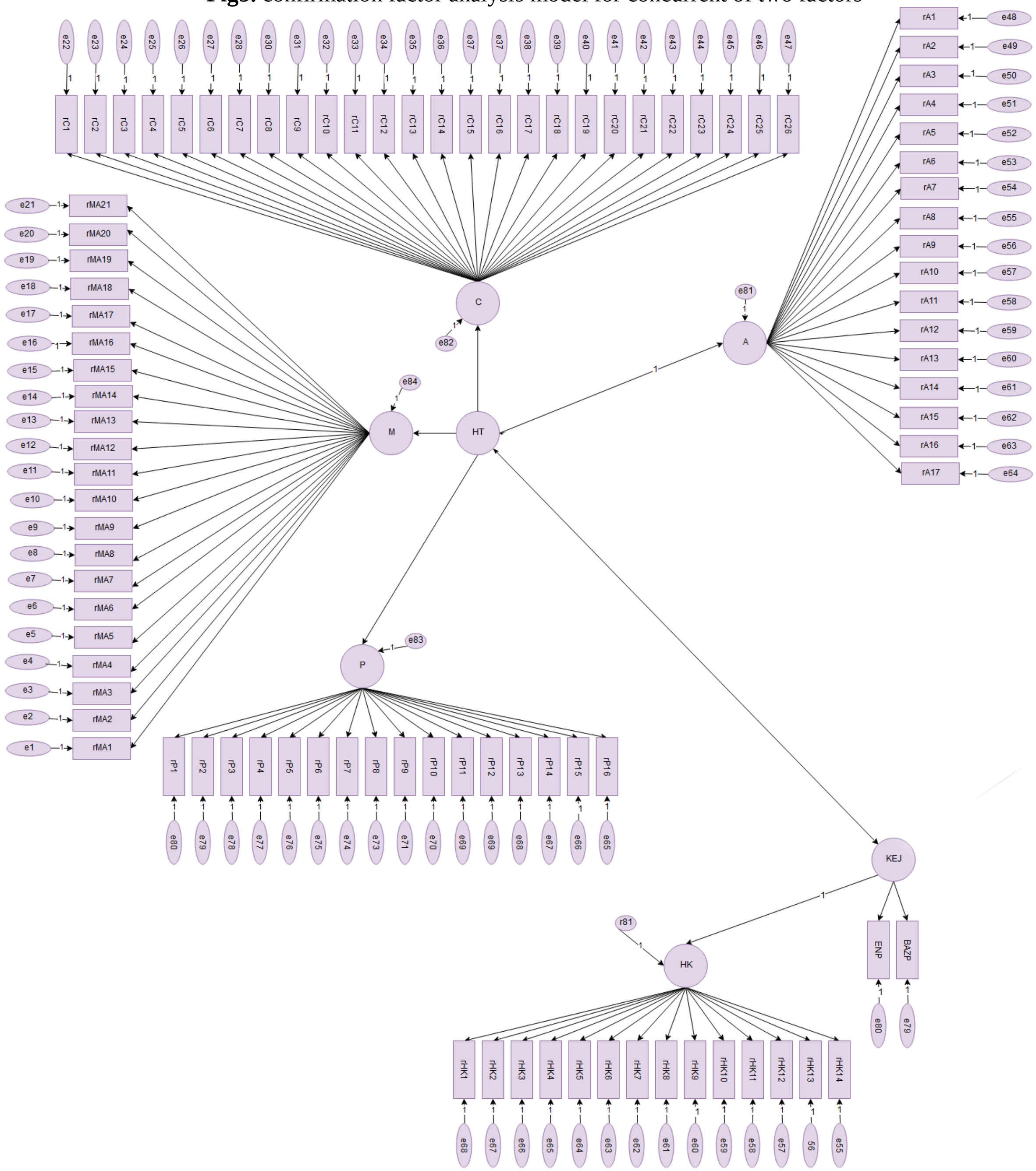
5- Also, AVE value is greater than 0.5.

Considering the four cases mentioned above, after considering the goodness fitting of second-order composite, the composite thrill s have convergence validity.

Confirmatory factor analysis of research model composites together

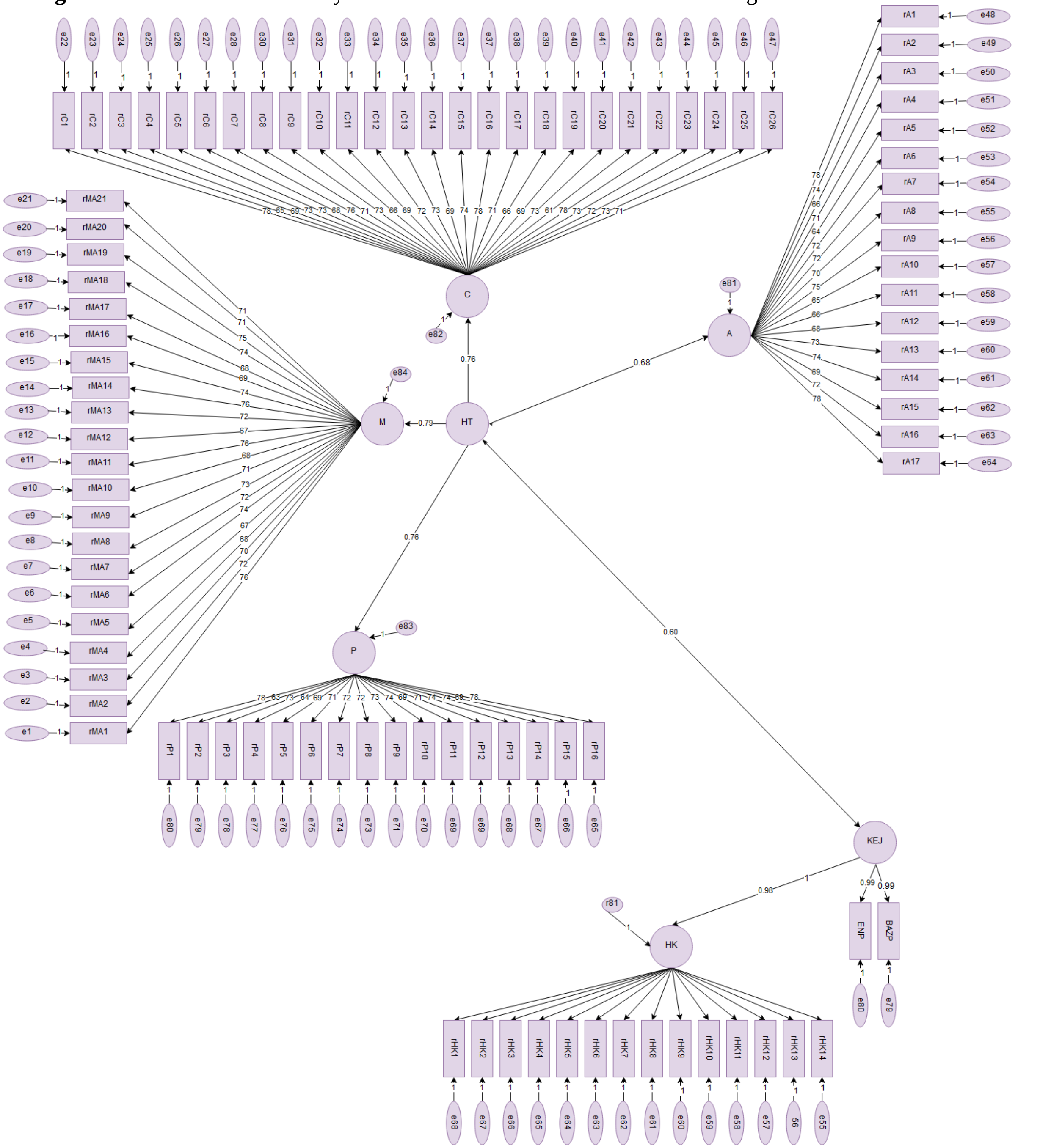
Since the main conceptual model of this research consists of three variables of educational thrill (HT), social function (KEJ) and the existence of composites together is necessary in order to examine the divergence validity, therefore, we should surely observe these composites together in order to verify the overall confirmatory factor analysis. The conceptual model related to the second-order factor analysis of the system is as figure 5. In this figure, in this figure, signs are the same as before.

Fig5. confirmation factor analysis model for concurrent of two factors



In Fig8, we see a confirmation analysis model with standard factor loads, and in Table 11, we observe fitting goodness indices. Also, Table 12 shows non-standard factor loads with their significance values.

Fig 6. confirmation Factor analysis model for concurrent of tow factors together with standard factor loads



After assuring the good fitting of the model, according to the results of Table (12), the required indices can be summarized in Table 13 to investigate the divergence validity of the research composites:

Table 12. investigating the significance value of factor loads (non-standard)

-	-	-	0.98	1.00	KEJ	--->	HK
<0.01	9.83	0.12	0.76	1.18	HT	--->	P
<0.01	9.91	0.12	0.79	1.23	HT	--->	M
-	-	-	0.68	1.00	HT	--->	A
<0.01	9.85	0.11	0.76	1.12	HT	--->	C
-	-	-	0.77	1.00	M	--->	rM1
<0.01	15.00	0.06	0.72	0.89	M	--->	rM2
<0.01	14.66	0.06	0.70	0.84	M	--->	rM3
<0.01	14.14	0.06	0.68	0.80	M	--->	rM4
<0.01	13.94	0.05	0.67	0.73	M	--->	rM5
<0.01	13.88	0.06	0.67	0.77	M	--->	rM6
<0.01	15.51	0.06	0.74	0.88	M	--->	rM7
<0.01	14.90	0.06	0.71	0.83	M	--->	rM8

<0.01	15.21	0.06	0.73	0.89	M	--->	rM9
<0.01	15.32	0.06	0.73	0.94	M	--->	rM10
<0.01	14.73	0.06	0.71	0.91	M	--->	rM11
<0.01	14.08	0.06	0.68	0.89	M	--->	rM12
<0.01	15.97	0.06	0.76	1.02	M	--->	rM13
<0.01	13.92	0.06	0.67	0.89	M	--->	rM14
–	–	–	0.78	1.00	A	--->	rA1
<0.01	15.64	0.06	0.74	0.94	A	--->	rA2
<0.01	14.38	0.06	0.69	0.83	A	--->	rA3
<0.01	14.71	0.06	0.71	0.95	A	--->	rA4
<0.01	13.15	0.07	0.64	0.90	A	--->	rA5
<0.01	14.98	0.06	0.72	0.90	A	--->	rA6
<0.01	15.02	0.06	0.72	0.90	A	--->	rA7
<0.01	14.64	0.06	0.70	0.81	A	--->	rA8
<0.01	13.09	0.06	0.64	0.78	A	--->	rA9
<0.01	15.73	0.06	0.75	0.96	A	--->	rA10
<0.01	13.30	0.07	0.65	0.88	A	--->	rA11
<0.01	12.97	0.07	0.63	0.86	A	--->	rA12
–	–	–	0.78	1.00	C	--->	rC1
<0.01	13.63	0.06	0.65	0.77	C	--->	rC2
<0.01	12.44	0.05	0.60	0.66	C	--->	rC3
<0.01	15.72	0.06	0.74	0.91	C	--->	rC4
<0.01	15.53	0.06	0.73	0.95	C	--->	rC5
<0.01	14.37	0.06	0.68	0.84	C	--->	rC6
<0.01	16.32	0.06	0.76	1.02	C	--->	rC7
<0.01	15.17	0.06	0.71	0.89	C	--->	rC8
<0.01	15.66	0.06	0.73	0.90	C	--->	rC9
<0.01	13.81	0.05	0.66	0.73	C	--->	rC10
<0.01	14.58	0.06	0.69	0.90	C	--->	rC11
<0.01	15.42	0.06	0.72	0.87	C	--->	rC12
<0.01	15.49	0.07	0.73	1.07	C	--->	rC13
<0.01	14.65	0.06	0.69	0.90	C	--->	rC14
–	–	–	0.79	1.00	P	--->	rP1
<0.01	14.37	0.06	0.69	0.81	P	--->	rP2
<0.01	14.92	0.05	0.71	0.73	P	--->	rP3
<0.01	15.83	0.06	0.74	0.89	P	--->	rP4
<0.01	15.04	0.06	0.71	0.84	P	--->	rP5
<0.01	14.43	0.06	0.69	0.81	P	--->	rP6

indices	composite reliability	Average variance extraction (AVE)	Maximum square Variance (MSV)	Average squared variance (ASV)
Executive functions	0.993	0.979	0.692	0.529
Educational trills	0.837	0.562	0.366	0.304

As it can be observed:

1- For all tow composites, AVE is greater than the maximum square variance (MSV). In other words AVE> MSV.

2- For each of the tow composites, the average variance extraction (AVE) is greater than the average square variance (ASV). In other words AVE> ASV.

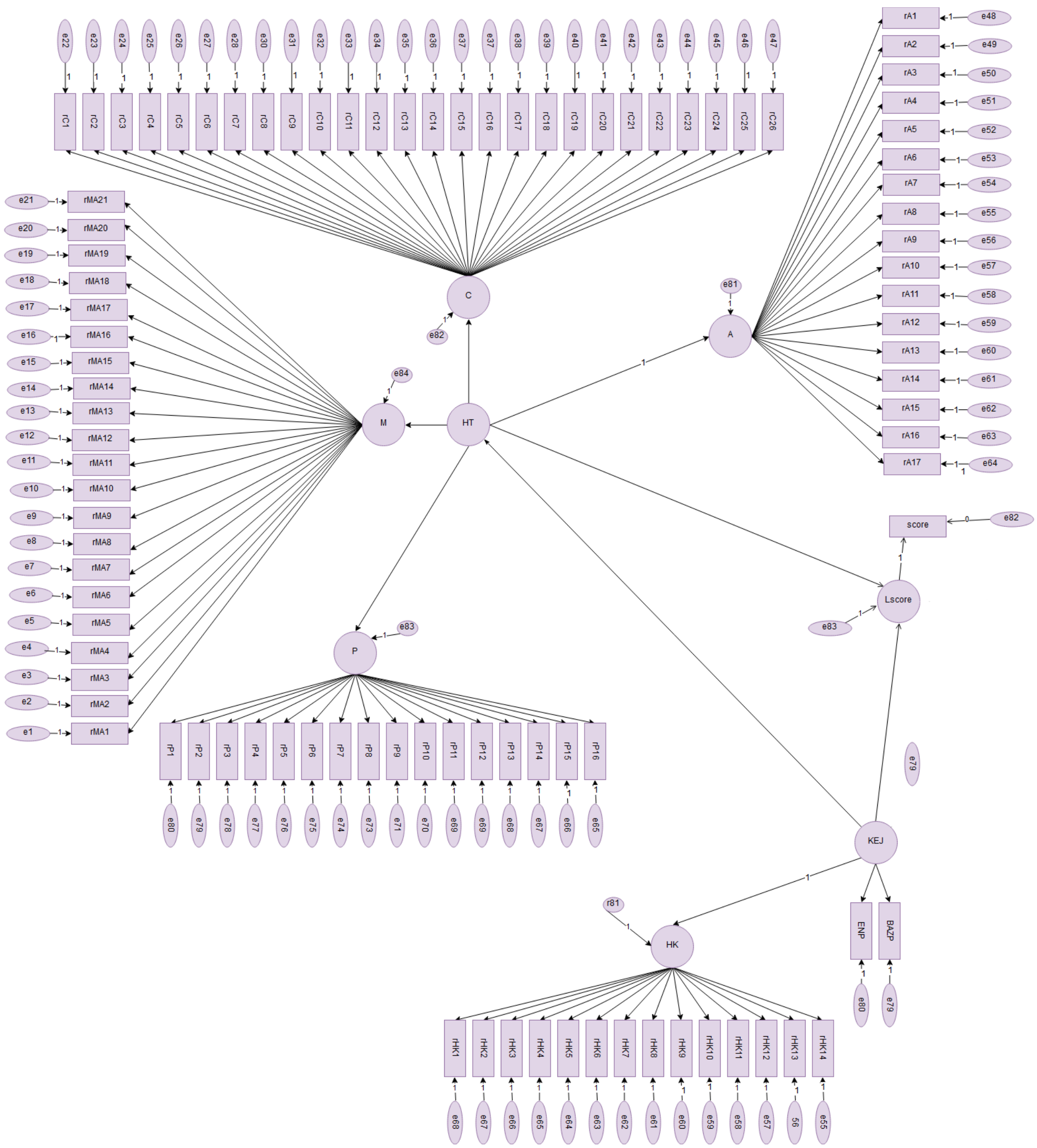
Regarding two mentioned above cases, after considering the goodness of fitting the confirmation factor analysis model of the three factors, it can be concluded that divergence validity exists for each of three composites against other composites.

3: Composite Equation Modeling (CEM)

In this section, we examine the accuracy of the conceptual model of the research with respect to available data using composite equation modeling.

The conceptual model of the research is presented in Fig. (-9). in the conceptual model, the signs related to the previous sections have been used. Also, the score mark represents the student's math score.

Fig7. The conceptual model of the research



In Fig8, we see conceptual model with standard factor loads, and in Table 14, we observe fitting goodness indices. Also, Table 12 shows non-standard factor loads with their significance values.

Fig8. The conceptual model of the research executed along with the factor loads

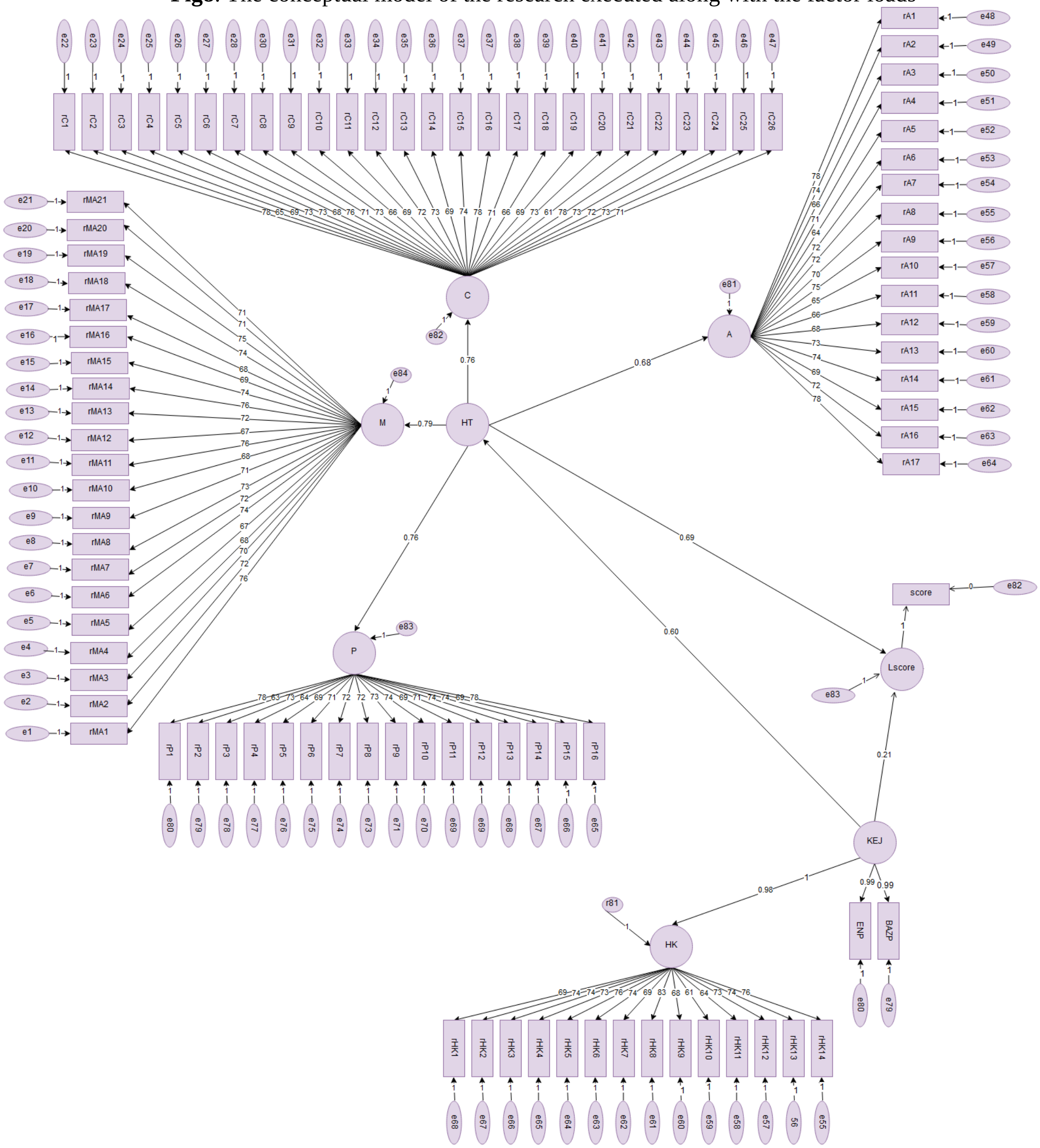


Table 14. fitting goodness indices of the research conceptual model

Type of fitting goodness index	The value of approval fitting Index	The value of good fitting Index	The value of observed fitting Index	conclusion
Amount of x^2 (df) statistic	X^2 ratio to freedom degree 3	X^2 ratio to freedom degree 5	2961.07 (2818)	good fitting
p-value of x^2 test			0.01	good fitting
X^2 ratio to freedom degree			1.13	good fitting
RMSEA	Less than 0.08	Less than 0.05	0.02	good fitting
P(RMSEA<0.05)	More than 0.05	More than 0.1	1.00	good fitting
CFI	More than 0.90	More than 0.95	0.98	good fitting
NNFI	More than 0.90	More than 0.95	0.98	
GFI	More than 0.85	More than 0.90	0.85	
AGFI	More than 0.85	More than 0.90	0.85	

Regarding the values related to goodness fitting indices and according to the data of this research this model is well suited for the most goodness fitting indices.

In table(15), their direct and significant effects on each of the direct paths of the research conceptual model are examined.

In table (15), the indirect and significant effects were implemented using the Bootstrap method with a replication of 5000 samples.

Table15. The significance of path coefficient related to indirect effects according to conceptual model

Indirect path			Path coefficient	Standard path coefficient	Estimated Standard error of Bootstrap method	P-value
L score	HT	KEJ	6.08	0.58	0.034	<0.01

According to the results presented in the table above, we can conclude that the indirect effect of students on their mathematical performance is significant and equals to 0.58.

In table (_16), the total effect of three composites and significance value of conceptual model were implemented using the Bootstrap method with a replication of 5000 samples.

Table 16. investigating the significance of total effect according to the conceptual model

P-value	The standard error of estimating the Bootstrap method	Totalstandard effect	Total effect	direction	
<۰.۰۱	۰.۰۲	۰.۶۲	۶.۳۵	HT	Lscore
<۰.۰۱	۰.۰۲	۰.۸۰	۸.۲۸	KEJ	Lscore

According to the results of the above table, we can say that the total effect of achieved bootstrap related to all three variables was significant. also with regard to the standard total effect, it can be concluded that the effect of the executive function variable on the student's mathematical performance has been more than all. Therefore, it can be said that it has a higher significance in influencing students’ math performance.

Hypothesis 1: the students' executive performance has a significant effect on their educational trills. According to the results of the modeling presented in Table 4-15, the students' executive function has a significant effect on their educational trills (<0.01).

Hypothesis 2: the students' executive performance has a significant effect on their math performance.

According to the results of the modeling presented in Table -17, this effect was significant (<0.01) and also this variable has the greatest effect on students' mathematical performance.

Hypothesis 3: the students' educational trills have a significant effect on their math performance.

According to the results of the modeling presented in Table-15, the students' educational trills have a significant effect on their math performance (<0.01).

3. Discussion

The results of the analysis based on structural equation modeling showed a relationshipbetween executive functions of the elementary school students and their academic emotions. It seems thatemotion plays an important rolein the everyday life. For example, emotions provide appropriate behavioral responses to, regulate decision-making and facilitate the interpersonal interactions. Cognitive problems which are associated with emotional problems, play a major role in the continuation and intensification of these symptoms. What is important in this regard,is the role of executive functions, which doubles the problems of these people along with the emotional problems. Many studies have related the expressive components of emotional processing to the brain's frontal lobe structures which play important rolesin thehumans' executive functions.The brain can adjust theemotions;there is an interaction between the emotionreappraisal and the lateralization of the frontal lobe. The relationship between the function and emotion is a mutual and undeniable relationship, and as the functions can be a driving force for the emotions, the emotions can also affect functions. Functions are the skills that help the students to pay attention to the important aspects of mathematic tasks and plan for completing them. If a failure be seen in the executive functions, it will certainly affect the responses and reactions of students considering the learningenvironment of mathematics.Academic emotions are directly tied to the development activities or progress results. This kind of natural reactions is under the conditions of the students' capabilities and executive functions. The teachers, who pay attention to the students' emotional feedbackswhile doing their math homeworks, provide environmental-situational conditions for empowering the students' executive functions. The results of this finding is to some extent consistent with the results of the studies by Roethlisberger et al. (2014), H. Clements et al. (2015), and Narimani and Soleimani (2012).

The results of the analysis based on the structural equation modeling showed a relationship between the elementary school students' executive functions and their mathematics academic performance. The executive functions develop from childhood to adolescence and even to early adulthood. Executive function is the control center of the cognitive process and function is one of its most important skills. Students with the impaired executive functions in math class do not have the necessary skills to solve the mathematical problems and an opportunity should be created to improve their executive functions. Executive functions cannot be separated from the mathematical problem-solving activities. Therefore the study on this process and examining the ways to solve this problem can lead to the reinforcement of the math skills. Knowing that the mathematical knowledge is an activated structure by every learner, we can intervene in this process through creating the manipulated experiences, giving time for exploration, discussing and examining the students' capabilities. The executive functions in children and its relation to mathematics were studied. It was found that there is a significant relationship between the updating and paying attention to the mathematics executive capabilities. Certainly the improve in working memory, response inhibition and flexibility; will lead to the major changes in upgrading the students' mathematical abilities. The findings of this study are consistent with the research results by H. J. Van den Heuvel et al. (2012), Roethlisberger et al. (2013), H. Clements et al.(2015), Kazemi and Seif (2010), and Narimani and Soleimani (2012).The results of the analysis based on structural equation modeling showed a relationship between the elementary school students' academic emotions and their mathematic academic performance. Emotions and feelings affect the environmental reactions; including the environmental – personality dimensions of the students which are present throughout their learning process and also their executive learning. The academic emotion is directly related to the educational activities or the educational outcomes. Therefore the emotions associated with the activities related to education are also considered as the educational emotions. The pleasure and joy of learning, the fatigue caused by teaching math, the frustration and failure due to the difficult mathematical tasks, are the examples of the emotions associated with the mathematics activities. The effects of emotion on learning and the development in mathematical problem solving get created by some emotional, cognitive, motivational, and physiological mechanism, which lead to self-learning and ultimately lead to self-efficacy and progress in the other activities of the mathematical problems. The environments and evaluations stimulate the academic emotions to start doing mathematics activities, and the emotions, in turn, affect learning and achievement in mathematics problem solving. Moreover, the feedbacks and experiences of success and failure, in turn, can affect the students' emotions. Classrooms and learning environments can create emotions in the students and emotions also affect the education and the environment; through the transfer of teachers' enthusiastic emotions, positive emotions will be aroused in the students and the motivated students can arouse enthusiasm in their teacher. Hence there is a direct relationship between this kind of emotion and the students' performance, especially in the field of mathematical activities. The findings of this study are somewhat consistent with research results of; L. Dietz (2014), kalik and kappa Aydin (2015) ,Nikdelet al (2012), and Zahed et al (2012).

Practical suggestions for further research are presented below; Innovative solutions can be presented based on active and situation-based teachings in order to pay attention to the efficient development of each of the components of executive functions, in order to investigate the effects of each of these components on the academic emotions. The raised activities and questions in math classes can be presented again after a longer period of time, and then the amount of executive functions can be examined by relying on working memory, response inhibition and flexibility to get informed of the lifelong (long-term) promotion of the executive functions and finally, its effects on the students' mathematics performance can be determined .Creating new opportunities for teachers and providing opportunities for growing the mathematics teachers' educational capabilities by the school principals, provides opportunities for creating positive educational emotions, especially for mathematics. This happens when the immediate feedback to teachers is provided by the principals. Surely, when the positive emotions are provided in the learning environment of math classes, some opportunities will consequently be provided to develop the students and make them efficient in doing the other math activities.

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