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Designing a Brain-Based Curriculum Model Focusing on Interaction and Motivation in the Secondary School

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Purpose: The purpose of the present research is to present a brain-based curriculum model focusing on interaction and motivation in the secondary school.

Methodology: In order to achieve this goal, qualitative approach, field method and semi-structured in-depth interview techniques were used. The study population included prominent curriculum planning experts, researchers and faculty members and 15 people were interviewed based on the data saturation.

The data collection tools included texts and semi-structured interviews, and the method of data analysis also included inductive thematic analysis (Attride-Stirling thematic networks).

Findings: The results of the research showed that the curriculum design components included four dimensions: goals, content, teaching methods, and assessment methods, which affect students' interaction and motivation. Goals included indices of changing mental images, real learning environment, flexibility of brain-based curriculum, information storage during learning. Content included indices of development of brain ability, mechanism of brain function, cognitive learning, content understanding, triggering body and brain activity, teaching methods including practical learning, learning in the environment, cooperation in class activity, different learning style, getting students to take responsibility for learning, effectiveness of education, purposeful and conscious teaching, continuous information processing. Assessment method included self- assessment, understand the content easily, flexible learning, encouraging activities. The interaction included indices of sharing new experiences in learning; improving the brain ability; and discussing different topics. Stimulation of learning and motivation included the indices cognitive function of the brain, challenging and enjoyable learning.

Conclusion: The results showed that the brain-based curriculum emphasizes on goals, content, teaching and assessment methods, which is designed with an emphasis on interaction and motivation.

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1. Introduction

Curriculum, as the basic subsystem of higher education, is strongly influenced by the policies adopted by higher education and in turn affects higher education and its functions (Jafari et al., 2019). When defining the curriculum as a field of study, theorists consider curriculum as a field that has specific dimensions, topics, conceptual scope or content structure like any other scientific field. Various theoreticians seek to determine the thematic and conceptual limits and gaps in the field of curriculum studies (Rudi et al., 2017). Galin believes that the curriculum should focus on a set of mental skills; activities such as self-exploration, attention, concentration, visualization; mental-physical exercises; art-enhanced visualization activities (Ozizi, 2017).

Knowing the brain mechanism during learning has important effects on education. Considering the brain mechanism, the nature of learning and the way information and skills are stored and retrieved, and then using this knowledge in curriculum design can ensure peak learning for all people with different individual characteristics. (Badiei et al., 2020).

Basically, there are many scientific and practical methods and approaches to teach and improve the quality of students' learning; for example, group learning, learner-based learning, experiential learning; however, there have been few studies on the approach that can be used in all fields of education. The new educational approach called the service learning approach has been used in most scientific fields and at different educational levels (Marandi et al., 2018). Brain-based learning has been proposed since 1980 as a new approach in teaching and understanding the path that the brain naturally designs for learning (Hassani et al., 2015).

Brain-based learning means that as long as the brain can continue to function, its processes are normal and learning can occur (Morgan, 2019). Brain-based learning actually consists of learning based on the methods that the human brain is inherently designed for (Badiei et al., 2020). Therefore, brain-based learning is learning in accordance with the way the brain is naturally designed to learn (Sesmiarni et al., 2020). Brain-based learning (BBL) is one of these theories that has attracted the attention of many education experts. By emphasizing the brain and its mechanism and relating it to learning processes, this theory has brought new topics into the educational field (Shaughnessy, 2016).

Motivation is one of the most important and powerful sources of impulse that affects the behavior of learners and determines the strength and stability of a behavior. Motivation empowers the learner to achieve the goal and acquire the ability to perform necessary activities under certain conditions. Motivation is a complex concept with different dimensions. It is the process by which goal-oriented activities are energized, directed and maintained. The motivation level is different depending on people's thoughts, beliefs and emotions (Nemati et al., 2018). Motivation refers to the internal states of a living being that initiates, guides, and maintains goal-oriented behaviors. In other words, motivation can be defined as a driver and a guiding factor for human activities (Abedi & Rostami, 2017). Academic motivation refers to behaviors that lead to learning and achievement. Academic motivation is an internal process that stimulates activities and continues with the aim of achieving specific academic achievements (Memarian et al., 2015).

Interaction is a kind of action that occurs as two or more objects have an effect upon one another. The idea of a two-way effect, as opposed to a usual one-way effect, is in the heart of the interaction concept. The combination of many simple interactions leads to the emergence of surprising phenomena (Chang & Su, 2020). Based on brain research, collaborative groups can be used in learning environments. These groups make members feel valued in the process of internal interaction, and the brain releases endorphins and dopamine to make people enjoy their work (Sadraei, 2019). Recent results on the brain mechanism in the learning process have led to a new insights on topics such as motivation and interaction. BBL does not function in isolation, but in interaction with others. On the other hand, motivation is the process by which goal-oriented activity is triggered and maintained. In fact, the cognition-motivation interaction is considered as a principle of brain cognitive function (Dadashzadeh et al., 2020).

In a relevant study titled "The relationship between students' awareness of brain-based learning strategies with active memory and creativity", Abassi & Saadipour (2020) showed a positive and significant relationship

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between students' awareness of brain-based learning strategies with active memory and creativity. Saber & Dadashi (2019) conducted a study titled "The effect of brain-based learning on the attention and academic self-regulation of sixth grade female students of Ghaemshahr". The results showed that brain-based learning training has a significant effect on the attention and academic self-regulation of sixth grade female students in Ghaemshahr city. Chavoshan Torghabeh (2019) conducted a research titled " The effects of brain-based learning on motivation to learn and academic progress of female students in Jagharegh village". The results indicated that brain-based learning had a significant and significant effect on students' motivation to learn and also on their academic progress.

Sesmiarni et al. (2020) have conducted a study titled "Brain-based learning from the perspective of students". The results of this study showed that..... Hsu (2020) conducted a study titled "Third-grade elementary teachers' understanding of brain-based learning by gender." They found that the brain learning of the female teacher is effective on the gender of the third-grade elementary teacher.

Many previous BBL studies have paid less attention to the understanding of BBL mechanisms, and basically, the learning processes and the type of student-teacher interaction have received less attention in these studies (Dadashzadeh et al., 2020). Therefore, the current research fills this theoretical gap because, on the one hand, it emphasizes BBL processes, and on the other hand, it is based on better student interaction after BBL or participation. Therefore, the purpose of the present study was to determine the components and present the brain-based curriculum model focusing on interaction and motivation in the secondary school.

2. Methodology

This is a qualitative (mixed-method) study with a thematic approach. The exploratory-sequential strategy and the inductive thematic analysis (attride-stirling thematic networks) have been used. In this method, first, the basic topics (codes and key points of the text) related to the brain-based curriculum with the focus on interaction and motivation were extracted from the relevant texts, and interviews were also conducted. Then the organizing topics (the topics obtained from the combination and summarization of the basic topics) were determined, and then the comprehensive topics (higher topics that include the principles governing the text as a whole) are extracted, the network of topics belonging to the brain-based curriculum components was compiled and the relevant model was presented.

In this research, to conduct related interviews first, a list of experts in based-based curriculum focusing on interaction and motivation was prepared during the August and September of 2021. To perform interviews, first a general description of the interview regarding based-based curriculum focusing on interaction and the motivation was given, and further explanations were avoided due to the possibility of the risk of bias. After the first interview, all the interviewee's statements were re-read and the related topics were first coded, using Atlas Ti software and audio files. Then the second interview was conducted and the topics related to the previous codes were separated and new codes were assigned to the new topics. ...., the primary codes with similar topics in terms of meaning and content were classified.

The participants included curriculum planning experts, prominent researchers and university faculty members. Professors and researchers who have published BBL research projects were selected as the study participants. To determine this group of experts, the purposeful sampling method was used, and 15 people were considered as interviewees. Library and field (interview) methods were used to collect data.

Validity and reliability of the data were confirmed by the supervisor, advisors and three curriculum planning PHD students. For the member-checking, the results of interview analysis and classification were given to five interviewees that were later confirmed by them. Figure 1 shows the types of questions asked during interviews.

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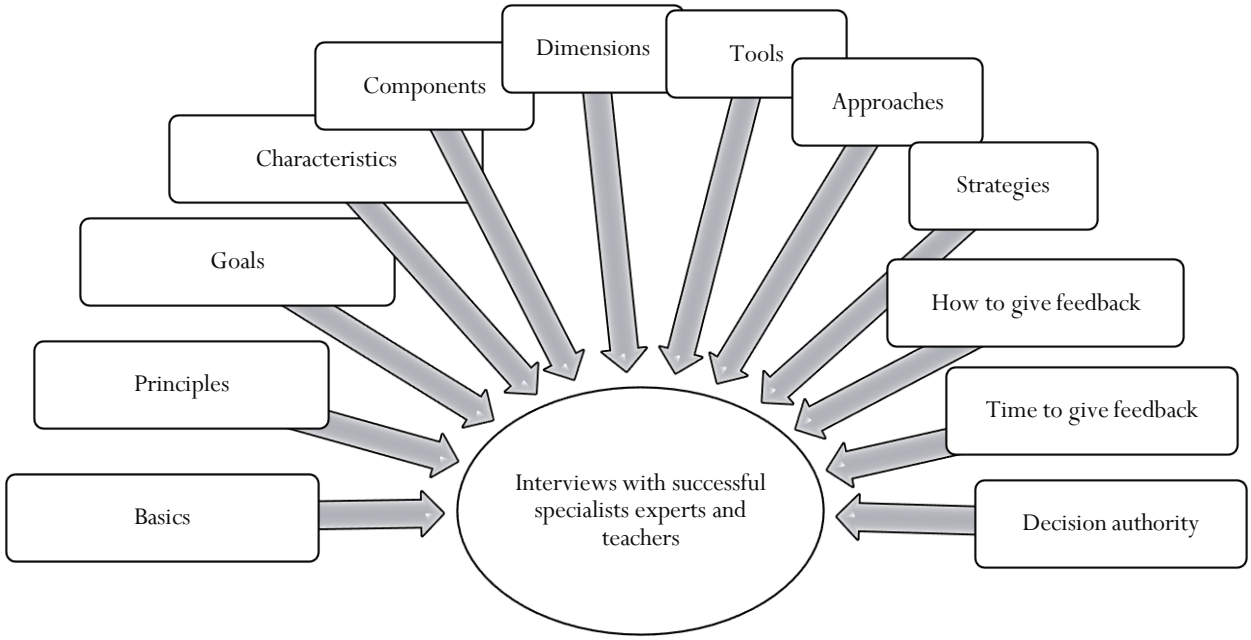

Figure 1: Twelve areas of the qualitative phase interview

The characteristics of the documents are given in Table 1.

Table 1: Characteristics of documents

#	Name	Type	Authors	Year
1	Fundamental Reform Document of Education	Instruction	Secretariat of the Supreme Council of the Cultural Revolution	2011
2	National curriculum of the Islamic Republic of Iran	Instruction	Secretariat of the Supreme Council of the Cultural Revolution	2011
3	The set of approvals of the Supreme Council of Education	Instruction	Riahi et al.	2018
4	Design and validation of brain-based curriculum model in preschool period	Ph.D. Thesis	Nozohouri	2019
5	The effectiveness of brain-compatible learning on the planning and solving executive functioning behaviors of students	Research article	Seifi et al.	2017
6	Designing a comprehensive brain-based curriculum model in organizational education	Research article	Afrakhteh et al.	2019
7	The effect of brain-based electronic courseware on students' problem-solving performance and motivation	Research article	Badiei et al.	2020

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8	Determining and explaining the principles of learning based on brain cognitive processes	Research article	Dadashzadeh et al.	2020
9	Investigating the effect of brain-based learning on comprehension and learning speed of third-grade elementary students	Research article	Seifi et al	2010
10	Brain-based learning approach in the teaching process	Research article	Norouzi et al.	2016

Content analysis was used to analyze the research data. Data analysis was carried out using SPSS and LISREL.

3. Findings

The frequency of interviewees by gender, age, marital status and level of education is shown in Table 2. Participants were male in more than 66.66% of cases. There were also over 40 and under 25 years of age in more than 46.67% and only 20% of cases, respectively. The interviewees were also married in 80% of cases. They also had MA and BA in more than 46.67% and 20% of cases, respectively.

Table 2: Frequency of interviewees by gender, age, marital status and level of education

Variable		Frequency	Percent
Gender	Female	5	33.33
	Male	10	67.66
	Total	15	100
Age	Under 35 years	3	20
	Between 35 and 45 years	5	33.33
	Over 45 years old	7	46.67
	Total	15	100
Marital status	Single	3	20
	Married	12	80
	Total	15	100
Level of education	B.A.	3	20
	M.A.	7	67.46
	P.H.D	5	33.33
	Total	15	100

Qualitative content analysis has been used in order to extract brain-based curriculum components focusing on interaction and motivation. Both manifest and latent content analysis methods were used in the present study; in other words, the latent content was also interpreted in some cases. Overall, the following steps were implemented when using the content analysis method:

1. Implementation of interviews: The recorded interviews were implemented in the format of Word software.

2. Data summarization: The results from each interview were summarized and coded in the form of Atlas TI software tables.

3. Data classification: The results from each interview were inserted in a separate table. Such a general table was completed for codes assigned to concepts. Categories are formed when describing the subcategories. The

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open codes included 56 indices, which were categorized into 56 open codes, 29 axial codes, and 6 selective codes according to their meaning similarity and category (Table 3).

Table 3: Table 3: Identification of brain-based curriculum components deduced from interview coding (authors' design)

Row	Sentence	Open Code	Axial code	Selective code
1	In the brain-based curriculum, learning means changing behavior; there will be a time when students change the images they have about behaviors, that is, all educational activities should be focused on changing mental images.	Changing mental images	Learning in the environment	Goals
2	The learning environment is the real and suitable environment for learning where the learning conditions are provided and the brain works best there.	Real learning environment		
3	This approach should help students to find the application of information in life. For example, learning history will help them understand the events that are happening in the world today.	Application of information in life		
4	The ability to see the whole picture and recognize patterns in learning new information using the brain.	Real learning environment		
5	Stimulation of both left and right brain hemispheres of students during teaching.	Changing mental images		
6	Brain-based compatible learning	Brain-based compatible learning		
7	Cognitive psychology considers humans as information-processing and problem-solving beings.	Brain-based compatible learning		
8	Learning will be more effective if the brain-based learning idea exists.	Real learning environment		
9	The process of storing information to perform learning	Storing information while learning		

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10	Curricula should focus on the right hemisphere of the brain and develop the brain's ability through holistic and spatial assignments as well as artistic skills. Because by doing such activities, students will be able to activate the forgotten hemisphere.	Developing the brain ability		
11	Learning resources and content should be created based on the structure and function of the brain.	Brain-based content		
12	Brain-based learning is a theory that states as long as the brain can continue to function, its processes are normal and learning can occur.	Cognitive learning		
13	Cognitive learning is a general concept that includes all forms of awareness and includes perception, thinking, imagination, reasoning and judgment, etc.	Cognitive learning	Cognitive learning	Content
14	Students are actively involved in the learning process.	Learning engagement		
15	Instead of memorizing content, students should know meaning and develop their comprehension.	Content comprehension		
16	The nature of learning and the way of storing and retrieving information and skills in the mind, followed by the use of a brain-based approach in curriculum design, can bring learning to the maximum possible for all people, with different individual characteristics.	Knowledge-based learning		
17	Classroom environments are very challenging, but not threatening	Involvement of body and brain activity		
18	An important unique feature of brain-based teaching is that a person's thinking is constantly changing.	Learning engagement		

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19	Students are involved in complex learning experiences.	Learning engagement		
20	Training exercises and strategies are based on educational research	Content comprehension		
21	Learning involves both concentration and lateral perception.	Content comprehension		
22	Usually, the information that we receive through visual, auditory and tactile means is stored in the sensory memory unless it is coded and enters the coding stage.	Knowledge-based learning		
23	Learning is an inseparable relationship between the body and the brain, and thinking does not occur independently from the body structure.	Involvement of body and brain activity		
24	Teachers should provide an opportunity for students to test their new knowledge in practice.	Practical learning		
25	According to this approach, learning should take place for students within their environment.	Learning in the environment		
26	The brain can yield better learning outcomes when learning occurs in the environment.	Learning in the environment		
27	In the brain-based curriculum system, students should contribute to their understanding and learning and try to strengthen each other's learning.	Cooperation in class activity	Conscious and purposeful teaching	Teaching methods
28	The teaching method should be planned in a way that engages the whole brain and provides an opportunity for all learners of all age groups with different learning styles	Different learning styles		
29	Whole-brain teaching changes the role of the teacher so that	Responsibility for learning to students		

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	students take responsibility for their own learning.			
30	The whole-brain teaching method helps teachers to gain a deep understanding of the teaching material and thus increase the effectiveness of their teaching.	Effectiveness of training		
31	The brain tends to perform its activities through the neural patterning, therefore, brain-based learning should be based on the patterning of students' educational relationships.	Effectiveness of training		
32	Educators who want more targeted and informed teaching have clear paths in this approach.	Purposeful and conscious teaching		
33	Integrating learning as one of the most important dimensions of human ability, that is, the brain.	Effectiveness of training		
34	Provide the student with an opportunity for continuous and active processing of information to internalize, integrate and relate them.	Continuous information processing		
35	It allows for the reduction of "imprecise learning" (teaching based on guesses rather than real knowledge).	Effectiveness of training		
36	In the brain-based teaching , teachers must acquire high skills in using diverse and multiple teaching methods.	Effectiveness of training		
37	The emphasis of a brain-based curriculum should be based on self-assessment.	Self-assessment		
38	The human brain physically changes when it learns, and once certain skills are practiced, it is increasingly easy to continue learning and improving these skills.	Understand the content easily,	Self-assessment	Assessment method
39	Effective learning improves brain function, flexibility, and intelligence, and has	Flexible learning		

	potentially far-reaching implications for how curricula and teachers design educational experiences in the classroom.			
40	As long as the brain can continue to function, its processes are normal and learning can occur.	Flexible learning		
41	Alertness, calmness, fear of the student may occur while the environment is still challenging.	Understand the content easily		
42	In this teaching method and curriculum, students should be encouraged to do more and be given opportunities to practice and provide more freedom to learn.	Encouraging activities		
43	Emphasis on helping educators and officials to create an effective learning environment	Encouraging class activities		
44	Brain adaptation provides children with the opportunity to change and grow by interacting with new experiences and their environment	Sharing new experiences		
45	Brain abilities are enhanced through interaction and cooperation with others.	Increase brain ability		
46	Brain-based learning does not operate in isolation, but in interaction with others.	Increase brain ability		
47	Teachers should allow synergy to happen and also ensure exchange of information and thus learning by discussing different learning topics and giving them the opportunity to help each other, and we could not include this fact in the curriculum.	Discussing different topics	Sharing learning experiences	Interaction
48	Teachers should use the useful experiences of their students and use this	Sharing new experiences		

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	satisfaction in the learning process.			
49	Usually, the brain-based learning is a combination of common sense or thinking, experience and brain research, which should provide the necessary data to improve the learning of teachers and especially students.	Sharing new experiences		
50	In the group teaching process, internal interaction makes the members feel valued, and the brain releases endorphins to make people enjoy their work.	Stimulate learning		
51	Brain-based learning focuses on the interaction between the teacher and the learner and the use of modern strategies that stimulate learning.	Stimulate learning		
52	The interaction between cognition and motivation is considered as a principle of brain cognitive function.	Cognitive function of the brain		
53	Learning is enhanced by motivation and challenge, discouraged by fear and intimidation.	Challenging learning		
54	If the learning atmosphere is not positive, i.e. happy, calm, the feeling of success is not instilled and we cannot bring them strongly, the negative motivational stimuli will block the hippocampus and the brain fuel will not be used properly.	Enjoyable learning	Enjoyable learning	Motivation
55	Teachers' emotions should be stimulated based on students' emotions.	Challenging learning		
56	Group work increases students' motivation.	Enjoyable learning		

The indices and factors affecting the brain-based curriculum can be categorized as follows (Figure 2). To categorize concepts, higher levels are placed as categories and lower level concepts are placed as subcategories. Categories are formed by the way the subcategories are described. The open codes identified through the interview include 56 indices, which were categorized into 56 open codes, 29 axial codes, and 6 selective codes according to the semantic affinity and their similar category.

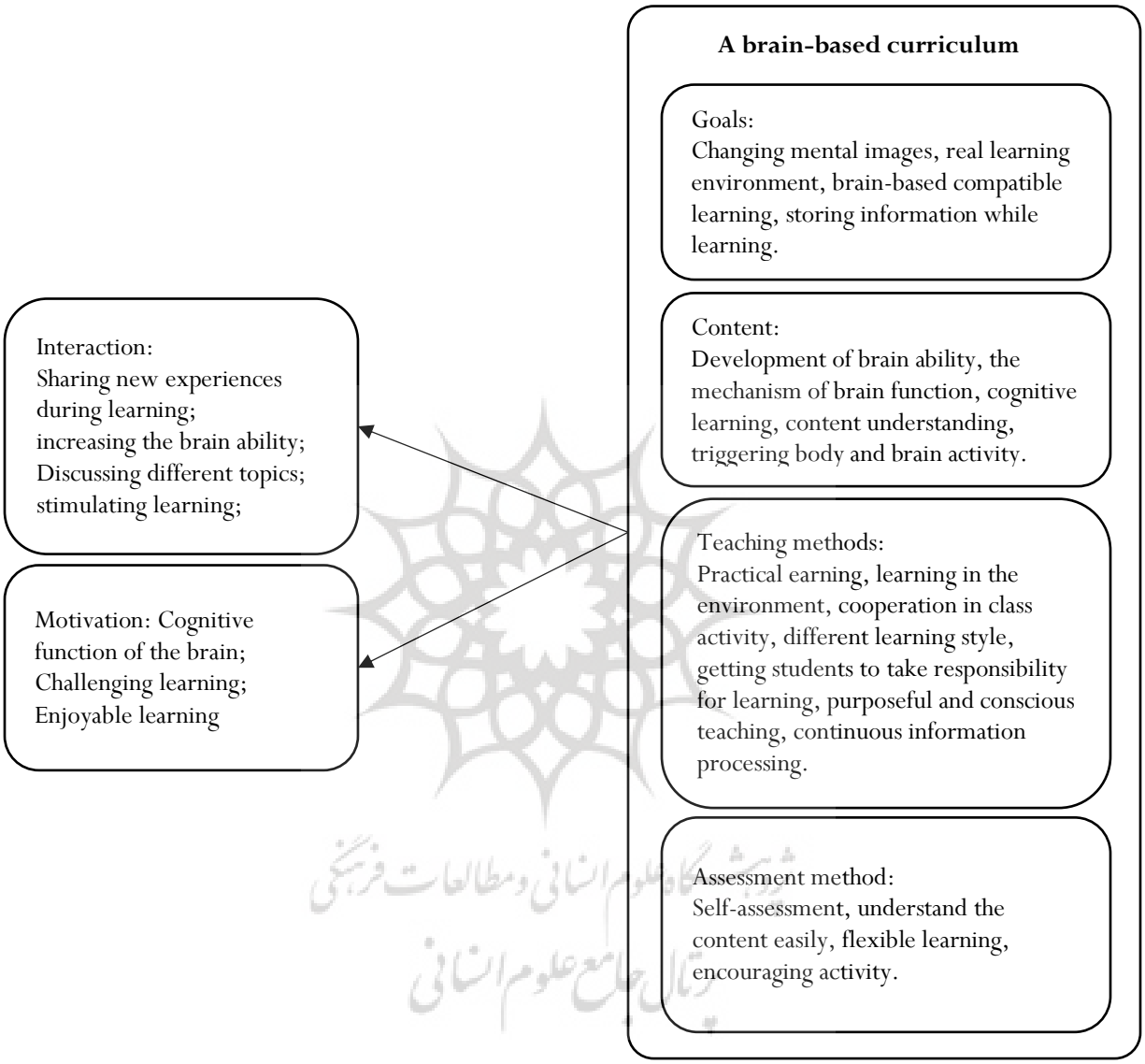

Figure 2: Research analysis model (source: research results)

4. Conclusion

According to the results of the present research, the curriculum design components included four dimensions: goals, content, teaching methods, and assessment methods, which affect students' interaction and motivation. Goals included indices of changing mental images, real learning environment and Brain-based compatible learning and information storage during learning. Content included indices of development of brain ability, mechanism of brain function, cognitive learning Content understanding involvement of body and brain activity. Teaching methods also included indices of practical learning, learning in the environment,

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cooperation in class activity, different learning style, getting students to take responsibility for learning, effectiveness of education, purposeful and conscious teaching, continuous information processing. The assessment method included indices of including self-assessment, understand the content easily, flexible learning, encouraging activity. The interaction also included indices of sharing new experiences in learning; increase the brain ability; discussing different topics. Stimulation of learning and motivation included indices of the cognitive function of the brain, challenging and enjoyable learning. Each of these indices has its own components.

The goals include indices (change of mental images, real learning environment, brain-based compatible learning, storage of information during learning), which are consistent with the studies by Afrakhteh et al. (2019) Nozohouri Pahrabad (2019), Alkateb (2020), Sesmiarni et al. (2020), and Koushar & Badir (2020). The content includes indices (development of brain ability, the basis of brain function, cognitive learning, content understanding, involvement of body and brain activity), which are consistent with the studies by Afrakhteh et al. (2019) Nozohouri Pahrabad (2019), Alkateb (2020), Sesmiarni et al. (2020), and Koushar & Badir (2020). Teaching methods include indices of (practical learning, learning in the environment, cooperation in class activities, different learning styles, getting students to take responsibility for learning, effectiveness of education, purposeful and conscious teaching, continuous information processing), , which are consistent with the studies by Afrakhteh et al. (2019) Nozohouri Pahrabad (2019), Alkateb (2020), Sesmiarni et al. (2020), and Koushar & Badir (2020). The assessment method includes indices of (self-assessment, understand the learning easily, flexible learning, encouraging activities), which are consistent with the studies by Afrakhteh et al. (2019) Nozohouri Pahrabad (2019), Alkateb (2020), Sesmiarni et al. (2020), and Koushar & Badir (2020). Interaction includes indices (sharing new experiences in learning; increasing brain power; discussing different topics; stimulating learning), which are consistent with the studies by Afrakhteh et al. (2019) Nozohouri Pahrabad (2019), Alkateb (2020), Sesmiarni et al. (2020), and Koushar & Badir (2020), which is consistent with the research by Bakhurst (2008).

To understand the role of the brain-based curriculum focusing on interaction and motivation, one of the effective and important strategies is the curriculum-based learning technique. This is the basic assumption that the curriculum-based learning approach and cognitive neuroscience as well as other experimental learning methods help the student to have a better understanding of the course material. Certainly what one experiences through performance is remembered more than what is merely read, heard or taught. Besides, the application of cognitive neuroscience in education increases social responsibility, moral progress, altruism, competence and scientific knowledge of learners in societies. Brain-based learning approach helps students investigate concepts in their real-world settings and apply them to everyday events. Interaction helps the student to achieve a better understanding of the needs of society and this is different from verbal questions that have a specific answer. The brain-based curriculum approach allows investigating and understanding the society, and thus helps the student know the physical and social environment and understand the real needs and demands of the society, the values and beliefs of the society and all kinds of social facilities and provide a suitable solution with the help of his teacher. The conceptual model of the research is shown in Figure 2.

Knowing the brain mechanism during learning has important effects on education. Knowing the brain mechanism, the nature of learning and how to information and skills are stored and retrieved in the mind, and then using this knowledge in curriculum design can ensure maximum learning for all people, with different individual characteristics. Each brain has unique characteristics. This uniqueness implies that each person needs a different educational experience; however, these differences are not recognized in our culture and most students are placed within an educational system and only the needs of people with a dominant left hemisphere are met. Our educational system is basically dedicated to people with a dominant left hemisphere.

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