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developing a curriculum model based on executive brain functions in elementary schools

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Abstract

The aim of the present study was to present a curriculum model based on executive functions of the brain. The approach of the present study was qualitative and its method was synthesis research. The research population was all articles (211 articles) that have been presented from 1385 to 1403 AH and 2010 to 2024 AD on curriculum and education and executive functions of the brain. The research sample was 30 articles, which were selected purposefully based on thematic monitoring, theoretical saturation of data, and research data were collected from qualitative analysis of the articles studied. By analyzing the data, the dimensions of the curriculum based on the executive functions of the brain were classified into 4 dimensions, 14 factors, and 105 categories, including individual factors (behavioral dimension, psychological dimension, cognitive dimension); scientific factors (knowledge factors and content factors); school factors (school management indicators, physical indicators, school context) and educational factors (teaching and learning approach, interactions, teacher characteristics, classroom management style, and program characteristics). The results showed that to create a curriculum based on the executive functions of the brain, paying attention to only one factor is not effective and there is a need to pay attention to different dimensions and aspects.

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Introduction

The need to make changes to the existing curriculum is one of the issues that has always been of concern to curriculum planners. Mehrmohammadi (2019) believes that different curriculum models should be used by planners based on the changing needs of the time. Older curriculum models should be revised and modified, and newer models should be created based on changes in science, society, interests, and needs of students. The models used by curriculum planners should not be considered as fixed and unchanging factors of the education system; on the contrary, creativity and the ability to adapt to environmental needs and conditions should be among the most fundamental characteristics of existing curriculum plans and new models. Changing and updating curriculum patterns and adapting them to the needs of society and learners is very important in the education system. The education system is the most important place to implement curricula by educating the next generations of society. In this context, evidence suggests that the current language of the curriculum is very limited in addressing and resolving issues and complexities related to classroom language and meanings (Alum and Menim, 2023). An effective solution in this regard is to pay attention to current science in learning areas, which can prevent curricula from becoming ineffective (Sadeghi, 2013).

Among the current sciences, we can mention neuroscience and its findings, the most important of which is the identification and introduction of executive function skills of the brain. Executive functioning of the brain helps children get along better with others because they can see things from other people's points of view and control their emotions and behavior. Executive functioning of the brain has a huge impact on health, happiness, and success throughout life. As executive functioning of the brain develops, the chances of having a successful career increase (Taziki et al., 2015). The brain's executive function is essential for goal-directed activities, including the ability to initiate and end activities, monitor and change behavior as needed, and plan future behavior when faced with new tasks and situations. Executive functions help us anticipate consequences and adapt to changing situations. The ability to form concepts and abstract thinking are often considered components of the brain's executive function (Diporta et al., 2023). Executive functioning is of paramount importance in education. Today, teachers require students to complete lengthy writing and reading assignments along with long-term projects, both of which rely heavily on executive functioning processes. Students are also expected to be adept at note-taking, studying, and testing, all of which require simultaneous organization and integration of multiple sub processes. Academic success thus depends on the ability to plan, manage time, organize and prioritize tools and knowledge, identify the main idea from many details, flexibly transfer approaches, monitor one's own progress, and influence it in work (Baratelli & Zardiani, 2023). In fact, as Leslie Hart (2022) suggests, designing educational experiences without understanding the executive functions of the brain is like designing gloves without understanding the human hand. In education based on executive functions of the brain, all students construct their own knowledge in various learning situations and contexts, because the brain learns best when learning materials and experiences are designed to suit their needs, abilities, and interests (Mehrmohammadi, 2016).

The executive brain function-based learning approach is a student-centered approach that is considered to help teachers strengthen learners' cognitive structures and facilitate their learning (Thomas and Swami, 2022). This approach, due to its comprehensive view of human mental capabilities and rejection of a linear, single-dimensional, and one-dimensional approach to learning, can have many practical implications in designing and implementing curricula, while expanding the perspectives of curriculum planners and educational interns on students' learning methods. By relying on learning based on executive brain functions, in the stage of developing and designing content and learning experiences, as the main tool for achieving curriculum goals, teaching teachers' professional roles, and designing assessment methods, curriculum planners can provide students with a diverse and numerous set of choices that are designed and used in accordance with the diversity and plurality of students' brain capacities and capabilities for the growth and flourishing of individuals with full brain capabilities (Jensen, 2019).

Therefore, it can be said that any decision regarding curricula should be made based on the learner's desires, needs, interests, and capabilities (Kane et al., 2022). In this regard, designing a curriculum based on executive brain functions means making decisions about curriculum elements based on the nature of

students' executive brain functions. The focus of this curriculum is on learning principles derived from knowledge and research related to executive functions of the brain. Proponents of this curriculum clearly claim that an executive functions curriculum, through the application of these principles and brain-based guidelines, seeks to develop learners' emotional and social competence and their ability to plan, make decisions, and solve problems in real-life situations (Kane et al., 2022).

A curriculum based on executive functions of the brain is, on the one hand, due to shortcomings and deficiencies in educational systems as a result of ignoring the numerous learning capabilities of humans, namely the executive functions of the brain and its characteristics, and the excessive reliance of teachers and trainers on traditional methods of education and teaching. On the other hand, it is derived from the characteristics, benefits, and capabilities of the brain, which increases the efficiency and effectiveness of teaching and learning processes and cultivates educated individuals while maintaining the totality and integrity of the brain. Another necessity arises from the nature of the curriculum based on the executive functions of the brain, which indicates the importance of the biological roots of behavior in learning; because the brain, in addition to being the control center of the hereditary body and organizing behavior and biological functions, is also the seat of emotion and feelings. Therefore, it can be emphasized that designing, developing, and anticipating a set of diverse learning experiences and opportunities consistent with the diversity that exists in brain-based learning, while transforming the learning flow into a natural and engaging process, has an unparalleled impact on creating the effectiveness and efficiency of the curriculum (Herman, 2019).

Numerous studies have been conducted in relation to curriculum, brain, and cognitive sciences. For example, Mohammadi Farsani (2017), Nouri (2011), Nouri and Mehrmohammadi (2010), and Talkhabi (2010) have examined learning based on brain processes and brain-based educational elements in their research and have described its educational results. However, none of the above studies have addressed the design of a curriculum based on executive functions of the brain. Therefore, given the importance of executive functions of the brain in the teaching-learning process and the emphasis placed in various studies, including Pourali (2012), Mirzaei (2016), Saatmand et al. (2019), on the importance of paying attention to executive functions of the brain in education, the present study seeks to design a curriculum based on executive functions of the brain.

Methodology

The method of the present research is the-synthesis research, which involves combining specific features and factors of the research literature. synthesis research is sometimes known as qualitative meta-analysis and attempts to analyze the research it covers, resolve contradictions in it, and, while integrating the results, identify the main issues for future research (Cooper and Hajj, 2009). One of its goals is to create generalizations from the combination of empirical research results (Khorasani, 2015). Content analysis using categorization was used to synthesize the existing scientific documents in the research field. In the present study, Roberts' six-step research synthesis model was used to analyze the findings, including the following steps: 1- Identifying the need, conducting a preliminary search, clarifying the need, 2- Conducting research to retrieve studies, 3- Selecting, refining, and organizing studies, 4- Developing a conceptual framework and making it appropriate to the information obtained from the analysis, 5- Processing, combining, and interpreting it in the form of tangible products, and 6- Presenting the results. To ensure the coding method, four evaluators were used to re-code the findings. Scott's (2012) method was used for confirmation. In this study, the rate of agreement between evaluators was 83.81, indicating 84 percent agreement between evaluators in coding.

$$C.R = \frac{95+87+92+78}{4\times105} \times 100 = 83/81$$

$$C.R = \frac{Number\ of\ agreed\ items}{Total\ number\ of\ items} \times 100$$

In the following, according to this section of the research, the four stages of Roberts' model will be discussed with respect to the research topic:

First stage: Identify the need, conduct preliminary research, clarify the need

One of the fundamental issues in the education system is paying attention to the cognition and mind of students. Many of the mental and cognitive potentials of students are neglected in schools, and the curriculum in this regard does not respond well to the needs of students. This leads to a sense of indifference towards lessons and school among students. But the

fundamental question here is what indicators should be referred to in order to understand a curriculum that takes into account students' cognition? One of the fundamental indicators in this field is paying attention to the executive functions of the brain. A curriculum based on the executive functions of the brain leads to the development of diverse cognitive, emotional, and behavioral talents of students (Niaz Azari, 2013). If we want students to experience the learning process in school, if we want them to find school and learning meaningful, we must rethink the educational materials and educational content and the curriculum in general. The curriculum is no longer for creating work and testing and memorizing material, but for cultivating human insight (Welk, 2008). Understanding the indicators and components of the curriculum based on the executive function of the brain will enable us to achieve this important goal.

Second stage: Conducting Research to Retrieve Studies

This stage is dedicated to searching for resources related to the main research need. The process of searching for sources was as follows: first, all valid scientific articles were identified by searching for keywords such as; executive brain function, curriculum and executive brain function, components related to executive function and education through internal databases including; Sid, Normagas, Magiram, IRANDOC,Elmnet as well as foreign databases including; Scopus, Emerald, Sage, Scientific Information Database, Science Direct, ProQuest, Springlink, Worldscientific, Taylor & Francis, Google Scholar, and Eric, Wiley. According to the research objective, relevant sources were retained and irrelevant sources were deleted. In order to improve the quality of the work, the article search was conducted separately by two people who were fully familiar with the search methods and information sources. On the other hand, an expert in the field of curriculum development and education supervised the entire process of the work. This research was also compiled based on internal and external sources and published articles.

Third stage: Selecting, refining, and organizing studies

This stage is dedicated to the judgment of determining the studies relevant to the knowledge needs. A judgment that requires the development of criteria for selecting and categorizing studies. The inclusion criteria for this study include the following:

1- Published articles in the field of brain, cognitive science and curriculum

2- Research must have reported sufficient data and information in relation to the research objectives, hence the sufficiency of a study to be reviewed in this article was the report of executive brain function indicators in curriculum.

3- Research that goes through the expert review process under the supervision of expert referees, and must be in the form of a full article online or in full print.

According to the searches conducted, 211 studies were found in line with the inclusion criteria of this study. However, a number of these studies were not suitable for inclusion in the final analysis and were excluded from the analysis process of this study based on the exclusion criteria, which include the following:

1- Studies that did not report sufficient information on the objectives of this study.

2- Studies that lacked the necessary scientific quality and were published in unreliable journals and conferences.

3- Studies that quantitatively examined the role of the brain and cognitive sciences in curricula in other educational variables.

In this step, a standard form was used. The sections in the form were: Reference (including the name of the journal, title of the article, and author); Objective (purpose of the study); Methodology, and General Results. To select appropriate sources, the desired keywords were searched in each of the databases. Accordingly, after reviewing the titles of 71 cases, abstracts of 140 articles were reviewed, irrelevant research was eliminated after reviewing the abstracts of 67 studies, full-text related research was eliminated after reviewing the full-text of 73 cases, and the total final research was 30 cases. Therefore, in this study, 30 studies, which were foreign and domestic studies, were selected.

Fourth stage: Determining the conceptual framework and making it fit the information obtained from the analysis

This stage is a connecting framework around which the information obtained is combined (Moffat, 2015). Hence, the conceptual framework formed in this research is around two main concepts:

1- Executive functions of the brain: Executive functions include cognitive processes such as problem solving, attention, reasoning, organization, planning, memory, inhibitory control, and response inhibition (Seligken & Adler, 2019).

2- Curriculum based on executive brain functions: Executive brain functions in a lesson promote the growth and development of all aspects of a student's existence in the psychological, cognitive, emotional, visionary, and behavioral dimensions (Claire, 2012).

3- Curriculum: The curriculum is a set of pre-made decisions and is based on a known path that learners must follow based on the planners' determination (Mehrmohammadi et al., 2018).

Findings

In this section, the fifth and sixth stages are analyzed according to Roberts' six-stage model:

Fifth Stage: Processing, combining, and interpreting into tangible products

According to the findings of the selected studies, first, all the components and indicators of executive brain function in the school curriculum were extracted through the open coding process; therefore, according to the coding process from the first stage, in this section, the key indicators and components of executive brain function in the curriculum were identified in Table 1.

Table 1: Indicators and components of executive brain function in the curriculum

Number	Author	Year	Components and elements of a curriculum based on executive brain function
1	Talkhabi	2008	Inhibitory control and planning, desirable social behaviors, attention variability, attentional shift in the breadth and range of attention and self-regulation, attention to individual differences, cognitive development, rational decision-making
2	Nuzouri and colleagues	2022	Flexibility in time, mastery of decision-making, correct and appropriate response to cognitive and emotional needs, efficient attitudes and beliefs, control of disruptive factors in learning, regular planning of student participation in class activities, diversification of content, considering time for imagination, considering individual differences, paying attention to the needs, interests and abilities of learners, paying attention to students' questions and mental curiosities, improving the level of recognition skills, strengthening the power of discrimination, participation and discipline.
3	Baratali and colleagues	2014	Relationship management in school, ability to organize homework, self-learning, self-direction, lifelong learning, cognitive training, self-monitoring, problem solving, self-regulation, cognitive rehabilitation
4	Noori	2018	Adapting the learning environment to students' needs, managing cognitive resources, time management, categorizing assignments, studying courses in a coordinated manner, cognitive flexibility, manipulating information, improving emotional processes, and creating coordination between different cognitive processes.
5	Nejati	2018	Making the trainee aware of the aspects of cognitive, attitudinal, and ability goals to understand the consequences and believe in the subject, managing interactions, creating harmony between cognitive and emotional dimensions, specifying clear goals, and strengthening perseverance.
6	Larrison	2013	The need to improve social life, optimism, positive thinking and understanding of personal well-being, motivation for individual activities, increasing awareness, strengthening creativity, facilitating social relationships, paying attention to physical, emotional, social, individual and educational factors to create happiness,

			creating a positive attitude, the need to revise learning programs and physical facilities implemented in schools.
7	Clement, & Lovat	2012	Regulating emotional expression and experience, being aware of one's own and others' learning styles, facilitating cognitive processes, using active teaching methods such as scientific rotation, paying attention to aesthetics in the curriculum, internalizing control, completing assignments in full, reviewing one's performance, controlling impulses, coordinating between different activities, mental control, discipline, cognitive and emotional responsibility.
8	Akyurek, & Afacan	2013	Emotion and affect, self-regulation, monitoring behavior, decision-making and social cognition, planning, organizing, reasoning, problem solving, attention to students' cognitive experiences, students' cognitive engagement
9	Busso	2015	Self-control, participation in activities, logical reasoning, problem-solving planning, verbal and non-verbal reasoning, attention, mental flexibility and inhibition, cognitive role-playing, problem-solving-based teamwork
10	Watagodakumbura	2017	Psychological mechanisms, attention to mental potential, attention to the link between emotion and cognition, institutionalization of learning, control over learning, problem solving, verbal and non-verbal reasoning in solving tasks
11	Calero-Martinez	2020	Cultivating mindfulness, giving varied and engaging assignments, behavioral adaptation in the classroom, behavioral regulation, realistic images of educational and classroom goals, starting assignments, flexibility, purposeful persistence in completing assignments.
12	Frank	2021	Social and emotional development, cognitive competence, attitudinal competence, self-regulation, program or community performance evaluation, attention to interpersonal differences, academic optimism and hope to achieve educational goals, desirable academic actions, time management in education.
13	Romero-López et al	2021	Self-regulation of emotions, motivation and arousal, and restructuring in the classroom, the ability to eliminate undesirable behaviors in the classroom, intellectual flexibility, generating diverse ideas and responses, organizing materials and information, and self-monitoring.
14	Oldfield	2021	Ability to manage homework requirements, develop the ability to impose order on work, play and enclosed spaces, control distractions, ability to eliminate unpleasant factors in the learning process, and pay attention to mental frameworks in learning time.
15	Gamino	2022	Managing emotions and staying calm when facing problems and responding with the most appropriate level of emotion, behaving appropriately when facing different situations, coping with different methods of solving problems, having many ideas for doing things, and the ability to solve problems, paying attention to the details of assignments
16	Lam Seiden, D	2020	Improve flexibility, logic and creativity, thinking, consequences before action, maintaining self-control and keeping commitments, multitasking, deep information processing, active engagement in task completion
17	Gunzenhauser & Nückles	2021	Mindfulness, mastery of mental processes, reasoning and understanding complex issues, creating new ideas, critical thinking in the teaching-learning process, active processing of information related to learning, excellent cognitive actions in learning, reasoning and analogy in the educational process, ability to sequentially record, maintain and manipulate information.

18	Spiegel	2021	Attention to attitudes and beliefs, emotional and cognitive regulation and control, self-control, internal monitoring, self-review, appropriate emotional responses in the classroom, control of emotional impulses in the classroom
19	Poowanna et al	2022	Qualitative changes in learners' cognitive performance, ability to ignore distractions, ability to control environmental stimuli, internalization of the learning process, improved teamwork, improved problem-solving skills
20	Lohnes	2022	Increasing the ability to solve problems, increasing the ability to pay attention to the details of assignments, reducing anxiety in the classroom and focusing more on the learning process, the ability to control impulses in the classroom.
21	Gold et al	2022	Improving mental abilities, improving cognitive abilities, creatively solving academic problems, flexible approach to academic issues, social adaptation in the classroom and school environment, appropriate decision-making.
22	Mulcahy et al	2021	Cognitive and knowledge development, improving social behaviors, appropriate social adaptation, understanding one's own strengths and weaknesses, meaningful learning strategies, correcting cognitive errors, reducing distractions.
23	Cuartas et al	2022	Attention to special education and individual differences, respect for differences, responsibility in learning, commitment to learning, striving for meaningful learning, control of impulsive behaviors, deep focus on tasks.
24	Fernandez	2023	Creating cognitive harmony and conscious awareness, participation and learning with respect for differences, paying attention to details in the learning process, striving for networking in learning.
25	Gelb et al	2021	Enrichment programs, cognitive exchange programs, avoiding chaos and distress in learning, persistence and insistence on the goal, time management and proper planning, flexibility and emotional control.
26	Kepple et al	2022	Increasing mindfulness, awareness of internal learning processes, appropriate cognitive support in learning, avoiding emotional abuse, being eco-friendly in the classroom, regulating impulsivity, improving social communication in the classroom.
27	Baratali, & Zardeini	2023	Participating in meaningful learning experiences, creating engaging learning situations, paying attention to others in the learning process, adapting to the learning environment, and regulating various emotional and sentimental behaviors.
28	Dwiputra et al	2023	The importance of cognitive competencies, meeting basic psychological needs, maintaining independence in learning, internal monitoring of learning, the ability to solve problems logically, evaluating different aspects of a task.
29	Brown et al	2023	Using innovative teaching strategies, using case tools for interaction between school practice and motivation orientation such as puzzle solving, coloring, role-playing, conscious learning, self-control in learning
30	Feng & et al	2023	Developing cognitive communication in the classroom, managing behavior in the classroom, and properly organizing the learning process.

Sixth stage: Presenting the results of the combination

In this section, considering the process and outcomes of synthesis research, an overview of curriculum indicators based on executive functions of the brain is examined. First, in the synthesis research process section, components and indicators are extracted. In this way, descriptions of all indicators are first identified through the open coding process, and then, since the goal of synthesis research is to combine all scientific findings in a specific topic and achieve a

single coherence, in the presentation of the results of the combination, the qualitative analysis of the open codes is first placed together and, by recoding, overlapping and semantic affinities are combined together and components (axial codes) are extracted. In the following, in order to categorize all indicators and components of the curriculum based on executive functions of the brain, a common concept was presented through axial coding, which led to the identification of 4 dimensions (selected codes). The results of axial and selected coding are presented in Table 2.

Table 2: Curriculum dimensions based on executive brain functions

Selected code	axial code	Open codes	Article code
Individual factors	Behavioral dimension	Effective attitudes and beliefs, flexibility	[2],[6]
		Mastering decision-making and avoiding impulsivity	[2],[15]
	Psychological dimension	Self-confidence, relationship management at school	[4],[15],[17],[23]
		Responsibility, self-regulation	[4],[25]
		Hope for the future, optimism	[4],[6]
		Managing emotions and desires, paying attention to others in the learning process	[5],[7],[17],[18]
		Attention to aesthetics, learning with respect for differences	[5],[8]
		Managing and controlling emotions, reducing anxiety in the classroom	[6],[18],[31]
		Motivation for personal activity, avoiding chaos and distress in learning	[6],[17]
		Self-awareness, the ability to eliminate undesirable behaviors in the classroom	[7],[9],[12],[17], [18],[26]
		Self-regulation, developing the ability to impose order on work	[12],[26]
		Goal setting, control over distractions	[20],[30]
		Ability to solve problems, ability to eliminate unpleasant factors in the learning process	[1],[9]
		Emotional intelligence, managing emotions and staying calm when facing problems	[12],[2], [21],[8]
	Cognitive dimension	Problem solving, verbal and non-verbal reasoning in solving tasks, cultivating mindfulness, manipulating information, deep processing of information	[9],[7], [11]

		Controlling disruptive factors in learning, improving the level of recognition skills, self-learning, self-direction, lifelong learning, cognitive training, self-monitoring, awareness of one's own and others' learning styles.	[2],[18], [29],[14]
Scientific factors	Knowledge factors	Paying attention to the student's cognitive experiences	[2],[4],[7],[22],[23]
		Paying attention to the student's mental processes	[4],[23]
		Paying attention to the student's cognitive mechanisms	[4],[13],[21]
		Paying attention to the student's cognitive functions	[1],[10],[24]
		Paying attention to the student's insight	[3],[19]
		Student cognitive development	[11]
		Paying attention to cognitive errors	[2],[19],[25]
	Content factors	Dynamic, flexible and meaningful content	[9],[18],[30]
		Content based on learner needs	[7],[11],[23],[5],[17]
		Diversification in content	[6],[4],[1]
		Content based on fostering creativity	[9],[14]
School factors	School management indicators	Dynamic management style based on collective wisdom	[1],[3],[32]
		Participatory approach in schools	[1],[4],[24],[32]
		Delegating the management of some school affairs to students	[4]
		Accountability-based management style	[12]
	Physical indicators	Curiosity-based learning environment	[1],[2]
		An educational environment based on cultivating a sense of aesthetics	[1],[2],[19]
		Educational space based on knowledge sharing	[1],[2],[3]
		The existence of cognitive attractions in schools	[1],[2],[3],[6],[14]
		Appropriate classroom size to meet students' cognitive needs	[1],[4],[19]
		Coloring and designing physical space based on student cognitive stimulation	[2],[4]

		Designing physical space based on facilitating curricular and extracurricular relationships	[2],[19]
		A vibrant physical space	[2],[23]
		Physical space based on the student's cognitive structure	[3],[4]
		Making schools Digitalization	[3],[23]
		Eco-friendly physical space in the classroom	[1],[10]
	School context	Ensuring psychological safety at school	[2],[5]
		School support for students	[2],[4],[6]
		Maintaining fairness in school and non-discrimination	[2],[11],[23]
		Adapting the school environment to the interests of students	[4],[6]
		The dynamism and up-to-datedness of schools	[5]
		Creating creativity and optimism	[5],[6],[16]
		Holding competitions based on developing knowledge in school	[4],[1]
		Holding group games based on developing cognition at school	[3],[8],[19]
		Healthy nutrition based on cognitive development in school	[10],[11]
Educational and programmatic factors	Teaching and training approach	Using active teaching methods	[1],[2],[8],[22],[29],[31]
		Paying attention to individual differences in education (personalization of education)	[2],[11],[12],[23],[24]
		Making the trainee aware of the aspects of cognitive, attitudinal, and competence goals	[5],[7]
		Facilitate the cognitive process	[7],[11]
		A combination of games, stories, and practical work in education	[7],[19],[25]
		Using the problem-solving method	[11],[29]
		Giving varied and interesting assignments	[3],[6]
		Useful activities	[19],[22]
		Positive educational experiences	[4],[3],[8]
		Team and collaborative learning	
		Giving a sense of belonging, self-confidence and creativity by giving responsibility	[1],[9]

		Paying attention to meaningful experiences	[7]
		Education based on critical thinking	[6],[25]
		Using field visits	[5],[1],[6]
	Interactions	Networking in the classroom	[2]
		Attention and sensitivity to classmates' learning	[12],[8],[30]
		Maintaining the dignity of students	[23],[24]
		Positive interactions between learners, teachers, and school staff	[14],[17],[12]
		Friendly relations	[19],[1],[10],[23],[7]
		Teamwork	[9],[1],[2]
	Teacher characteristics	Familiarizing the teacher with the cognitive characteristics of students	[22],[4]
		Having expertise and competence in teaching	[18],[22],[27]
		Reasonable expectations from students	[6]
		Teacher's positive attitude towards students	[17]
		Paying attention to students' psychological mechanisms	[5],[19],[11]
		Paying attention to the mental well-being of learners	[9],[3],[18]
		Facilitating the education process	[8],[1],[22],[21],[19]
		Using creativity in teaching	[6],[26]
		Logic and reasoning in the classroom	[14],[25],[8]
		Mastery of various teaching software and hardware	[16],[9]
		Being up-to-date and having up-to-date knowledge	[3],[7],[6],[26],[30]
		Responsibility for teaching-related errors	[15],[2]
		Creatively solving students' academic problems	[19],[28]
		Insight into teaching	[20],[8]
		Paying attention to the mental vitality of students	[3],[17],[6]
	Classroom management style	Class time flexibility	[16]
		Classroom team management	[24]
		Involving students in classroom activities	[5],[13],[9]

	Program features	Extracurricular activities based on cognitive development	[8],[22],[27]
		Continuous program revision based on feedback	[22],[19]
		Internal performance review	[4],[9]
		Diversity in evaluation approaches	[19],[6]
		Planning based on cultivating imagination	[16]
		Continuous monitoring	[6],[8]
		Problem-solving planning	[7],[9],[6]
		Innovation in educational programs	[11],[2],[4],[24]
		Flexibility of programs	[21],[19],[17]
		Involving stakeholders	[20],[28],[1]
		Restructuring	[20],[10],[6]
		Cognitive enrichment programs	[11],[13]
		Cognitive exchange programs	[2]
		Situation-based planning	[8],[5]

Discussion and Conclusion

In recent decades, attention to the brain and its executive functions has attracted the attention of many educational experts. Many of these experts believe that the responsibility for teaching and learning that takes the brain and its functions into account lies with the education system, which can address this issue through the curriculum. However, it must be said that developing a framework and curriculum model based on executive functions of the brain has faced specific issues that have formed the main focus of the present study. The results of the present study indicated that the dimensions of the curriculum based on executive brain functions included: individual factors (behavioral dimension, psychological dimension, cognitive dimension); scientific factors (knowledge factors and content factors); school factors (school management indicators, physical indicators, school context) and educational factors (teaching and learning approach, interactions, teacher characteristics, classroom management style, and program characteristics).

Individual factors: Individual indicators are among the important dimensions in the curriculum based on the executive functions of the brain (Anbari and Haqqi, 2014). Combining the findings of various studies in this field shows indicators such as cognition, behavior, and the individual's psyche. By analytically examining the findings of this section, it can be concluded that personality-psychological characteristics are important and fundamental factors in education based on the executive functions of the brain. The personality-psychological dimension is the basis for appropriate brain-based education in individuals. Individual factors can facilitate a curriculum based on brain-based executive functions. The findings of this part of the research are in line with the findings of Dehghani et al. (2018), Culp (2020), and Sobel (2020).

Scientific factors: Scientific factors are the foundation of a curriculum based on the executive functions of the brain. Combining the findings of various studies in this dimension shows indicators such as knowledge factors and content factors. Content is the first important aspect in implementing a brain-based curriculum, without having appropriate

content, one cannot expect success in this field. On the other hand, paying attention to current knowledge in this field is also very important. It is very important to revise educational processes according to current knowledge in the field of executive functions of the brain. The findings of this part of the research are in line with the findings of Jafari and Talebzadeh (2010), Baja et al. (2019), and Kupta (2020).

School factors: A school can be considered a house with larger dimensions where children spend part of their lives. Therefore, designing its dimensions according to the special needs of students is of particular importance (Torkeman et al., 2016). In recent years, psychologists have realized the significant effects of school and its environment on improving and increasing children's physical, motor, mental, and social abilities (Torkeman et al., 2016). Integrating the findings of various studies on the impact of school factors on the curriculum based on executive brain functions has led to the identification of items such as school management indicators, physical indicators, and the school's context. The educational environment, along with other factors that affect the education of learners, such as curriculum, teachers, etc., has an important impact on the education and upbringing of students. The management style in schools provides the basis for dynamism in schools, while the physical structure of the school leads to the use of the brain's executive function capacities in it. The culture and psychological indicators present in schools and their hardware and software facilities are other items that have a significant impact on the curriculum based on executive functions of the brain. The findings of this part of the research are in line with the findings of Dehghani et al. (2018), Van Terra (2020), and Alam et al. (2022).

Educational-programmatic factors: The educational and programmatic dimensions are the most important in the curriculum based on the executive functions of the brain and lead to the creation of up-to-date schools in this field (Ahmad Puri, 2017). Curriculum and instruction based on executive functions of the brain not only contribute to student academic success, but also improve other life skills such as healthy communication, lifelong success, and self-actualization (Brid and Markel, 2012). The integration of findings from various studies in this dimension indicates indicators such as educational approach, classroom interactions, teacher characteristics, classroom management style, and curriculum characteristics. In this regard, the role of curricula as a guide for other curriculum elements, including the interaction environment and the teacher, is of particular importance. The flexibility of curricula tailored to the needs and interests of learners and its proper implementation leads to the successful implementation of a curriculum based on the executive functions of the brain. The findings of this part of the research are in line with the findings of Jafari and Talebzadeh (2010) and Alam et al. (2022).

Basically, implementing any curriculum requires attention to micro and macro policies and programs. Ignoring this issue leads to the formation of pressure forces against the curriculum and, as a result, increased costs and challenges for implementing a curriculum based on executive functions of the brain. In general, proper attention to the components and elements of a curriculum based on the executive functions of the brain can bring about enormous achievements for the individual and society, which fall into a range of issues, including scientific advances, increased academic performance, responsibility, and so on.

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