International Journal of Research in Business Studies and Management
Volume 7, Issue 5, 2020, PP 01-09
ISSN 2394-5931

Geometric Analysis the Development of Child's Mind Map through Lego Educational Factors Based on Strategic Approach

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ABSTRACT

Objective: *Participating in Lego education courses, whether the mind map geometry's dimensions of children and adolescents changes; if yes, to what extent? What is the impact of Lego's six technical factors quality and quantity (number and variety of parts combined) on mind map quality and quantity of Lego learners? However, this study aims to answers these two important questions from the perspective of strategic management.*

Methodology: *This was descriptive applied cross-sectional survey study. The population consisted of three groups including Lego educators, school principals, and students' parents. Two researcher-made questionnaires were used for collecting the data. The descriptive and inferential (t-test, ANOVA, two-sample independent t-test) statistics were used for analyzing the data.*

Findings: *The Lego educational courses impact on all dimensions of Lego learners' mind map geometry; however, they develop left brain mind map more than right brain mind map (63% vs. 36%). They develop the mind map dimensions in different extents; this is due to Lego parts' different technical characteristics. Therefore, the learners' mind map geometry should be drawn, the development dimensions should be determined, and finally, the Lego parts' technical features should be selected and educated. This will result in higher productivity and more and quick qualitative and quantitative development of learners' mind map.*

Keywords: *Mind Map Dimensions, Educational Lego, Left Hemisphere of Brain, Right Hemisphere of Brain, Strategic Approach.*

PROBLEM STATEMENT

The six studied dimensions include: first, the thinking of people is less analyzed by a geometric method (mind map); second, the strategic approach is less used to analyze people thinking; third, it is not exactly explained that how the Lego tools or techniques impact on mind map; fourth, it is not exactly determined that whether the techniques such as Lego impact on employees and managers' mind map development; fifth, it is not compared to determine that which of the thinking components or dimensions develop less or more by using mind map; sixth, this is less analyzed that the development of employees and managers is based on the development of their thinking template. However, the main research question is: Especially very low-analyzed. The main question is: What is the impact of Lego's six technical factors quality and quantity (number and variety of parts combined) on mind map quality and quantity of Lego learners? To what extent?

THEORETICAL FRAMEWORK

Mind Map

The idea of mind map was first discussed by Edvard Talman in 1948. He aimed to explain learning-based behavior of rats in Maz. The mind map was a project which was invented by Tony Bouzan in 1970. The mind map was created by Novak research at Cornell University in 1972. This idea was designed based on psychology of David Ausuble (Hatami et al., 2009; p. 20). The mind map is a graphical technique which uses a powerful method to collect words, images, numbers, logic, music, color, and spatial information and allows the people to look and explore a wide range of mind (Daghighi, 2010; p. 61). Tony Bouzan, the developer of mind map idea, once said that: (An ordinary employee has spent between 1,000 and 10,000 hours to learn economics, history, language, literature, mathematics, and political science. But, however, this same employee spends less than 10 hours to learn the using of

creativity) (Asadpour et al., 2015; p. 35). This perspective led him to develop the mind map which is one of the most effective skills in creativity process. The mind map framework is based on David Ausuble's learning theory. The mind map is considered to be a kind of cognitive game (Sherry & Teric, 1996). The mind map is a set of graphic organizers techniques which create common visual language to provide information structure and often occurs when students take notes. The mind map is an internal image of external reality (Janson Layerd, 1983). The mind map is considered to be a psychological representation of real, imagined, or hypothetical situations in mind (Peter Senge , 1992). The mind map is defined to be assumptions which are deposited in mind and generalization of images and imaginations (Norman, 1998; Elson & Fin, 1993). The mind map is described to be the knowledge of user of system performance, its various parts, processes, interactions between components, and their impact on each other.

Lego

The Lego is actually the training of engineering (in particular, Civil, Industrial, Mechanical, Electronics, and Computer Engineering) and physics rules and principles in simple language through creating structures by pre-prepared components. The educational Lego is a teaching aid tool for all age levels from 3 to 16 years which has knowledge, skills, and attitude objectives. In 1980, the Lego Company established its education part to satisfy the demands of teachers and educational authorities to achieve educational goals through Lego tools. Today, the effective usage of educational Lego in kindergartens, schools, and universities for students is the main objective of educational Lego. The educational Lego aims to provide the learning along with fun experience to students. It also enables teachers to teach students the ability to solve various problems, use mental maps, foster creativity, maximize group work, and progress in their knowledge and understanding. The educational Lego has integrated the successful software and standard lesson plans in its packages and has combined the science, technology, engineering, and mathematics to transfer them to students in a class. Using educational Lego packages in classes, the students may play an active and effective role in their learning process. The educational packages are tools which may be used by students and teachers in schools and universities (Source: www.legoeducation.ir, 2016).

Right Brain Mind Map

The right hemisphere of brain controls the left side of body. It is the center of understanding images and regulations. It has the ability to distinguish faces. It has the power of solving mysteries. The understanding of color and tone of voice, imagination and dreams, creativity and discovery, sports and rhythmic movements, musical talents, sense of touch and understanding three-dimensional objects, navigation, painting and drawing, and feelings and love are performed in this hemisphere. It has holistic perceptions. It has not the power of regulation and classification, understanding mathematics and philosophy, and management skills. The painters, designers, writers, and artists use the most from this part of brain. The female features dominate this hemisphere (www.tebyan.net, 2009).

Left Brain Mind Map

The left hemisphere of brain controls the right side of body. It loves mathematics and philosophy, order and classification, and logic and analytical work. It disagrees with diversity in life and likes regular and predetermined life. It afraid of criticism. It deals with details, classification, and information process. It is impatient. It explains everything just by talking, not by example or outlining. It lacks imagination, musical and painting talent, and creativity and discovery. It is the center of memorizing words and numbers. The male features dominate this hemisphere. The linguists, mathematicians, and philosophers use this hemisphere more active (Www.tebyan.net, 2009).

Mind Map as a Strategic Approach

The mind map development has always been emphasized as a strategic approach which facilitates learning in education. Today, the mind map is one of the strategic educational approaches. The development of mind map has a special place as a strategic approach which facilitates and promotes the critical thinking in teaching, learning, and assessment. The students learn new things with an emphasis on their previous learning and link any concept to other concepts through interface words. The development of mind map as a strategic approach increases the awareness of learners and help them to organize a set of concepts

based on cognitive structure in multiple connections network (Mirzaee, 2013, p. 26). The mind map development provides a strategic approach to understand the strategic opportunities, develop mind maps, and create innovative solutions for bottlenecks. In strategic approach, the tools and methodologies are replaced by men (strategists) (Mirzaee, 2013, p. 26). The validity of a strategic approach depends on its effectiveness in practice (mind map development). The mind map development is constantly used as a successful strategy in improving teaching and learning to evaluate and understand the ability of learners to achieve a creative thinking.

Spider Web Technique

The spider web technique is one of the simple and most widely used techniques to teach members of societies like Iran. This technique provides a possibility to compare different aspects of a phenomenon and well explains the geometric development of phenomenon. Therefore, this study used this technique to draw the mind map development of learners.

Eight-Dimensional Methodology for Innovative Thinking

Rovio and Raton (2002) in electrical engineering faculty in Florida Atlantic University conducted a research entitled: (eight-dimensional methodology for innovative thinking) and explained the usage of Lego in thinking engineering. Also, Berne and Rovio explained the eight-dimensional thinking methodology in a telescope technical project. In a research entitled (thinking engineering and rhetoric science), John Robinson in Newfoundland University of Canada found that the thinking engineering is developed by explains which are unique, valid, and best solutions. The thinking design term was first published by Peter Rose in 1987. Robert Makimz also published his book named "Experiences in visual thinking" in 1973 and played a role in development of engineering design.

METHODOLOGY

This was descriptive-explanatory cross-sectional applied survey study. The technical factors of Lego is the independent variable. The technical factors means the quantity and quality of Lego pieces. The quantity is the number of Lego pieces and quality s variation in Lego pieces. The variation components include these six features: 1) number of Lego pieces, 2) similarity of pieces, 3) difference in pieces, 4) easy assembly of Lego pieces, 5) difficulty in assembling parts, and 6) connection and replacement of parts to complete different structures.The mind map of learners is the dependent variable. The mind map of learners means the characteristics of left and right hemispheres of brain of learners. The mind map components include the skills which are processed and learned in each of the two hemispheres of brain.The twenty-two components of right brain hemisphere mind map which are related together include: 1-creativit 2-imagination 3-today & futcher 4-philosophy & religion 5-appreciates 6- believes 7-symbols and images 8- can “get it” (i.e. meaning) 9-spatial perception 10-holistic thinking 11-intuition 12--arts (motor skill) 13-rhythm (beats) 14-non-verbal 15-feelings 16-isualisation 17-tune of songs 18-daydreaming 19-risk taking 20-impetuous 21-knows object function 22-music

The twenty-four components of right brain hemisphere mind map which are related together include: 1-logic 2-details 3-today & past 4-analysis 5-sequencing 6-linear 7-mathematics & sciences 8-Speech and speaking skills 9- language & words 10-facts 11-think in words 12 -can comprehend 13-Knowing 14-Acknowledges 15-knows object name 16-forms strategies 17-practical 18-safe 19-appreciate 20-word of song 21-collect 22-subtract 23-multiply 24-divide

Data Collecting Tools

Two researcher-made questionnaires were used for collecting the data. The first questionnaire measured the mind map dimensions and included 44 multiple-choice questions. The second questionnaire measured Logo’s technical factors and included 5 questions. The Cronbach's alpha in SPSS 22 software was used to evaluate the reliability of questionnaires. For this purpose, 30 pre-test questionnaires were distributed among subjects and their Cronbach's alpha coefficient was calculated. Since all were above 70 percent, the reliability of questionnaires was confirmed. In particular, the mind map had the highest reliability (= 0.922).The perspective of three experts (two university professors and a director of educational Lego in Zanjan) was used to determine the face validity of questionnaires. After reviewing and consultation, the face validity of questionnaires was confirmed. The content validity was confirmed by providing

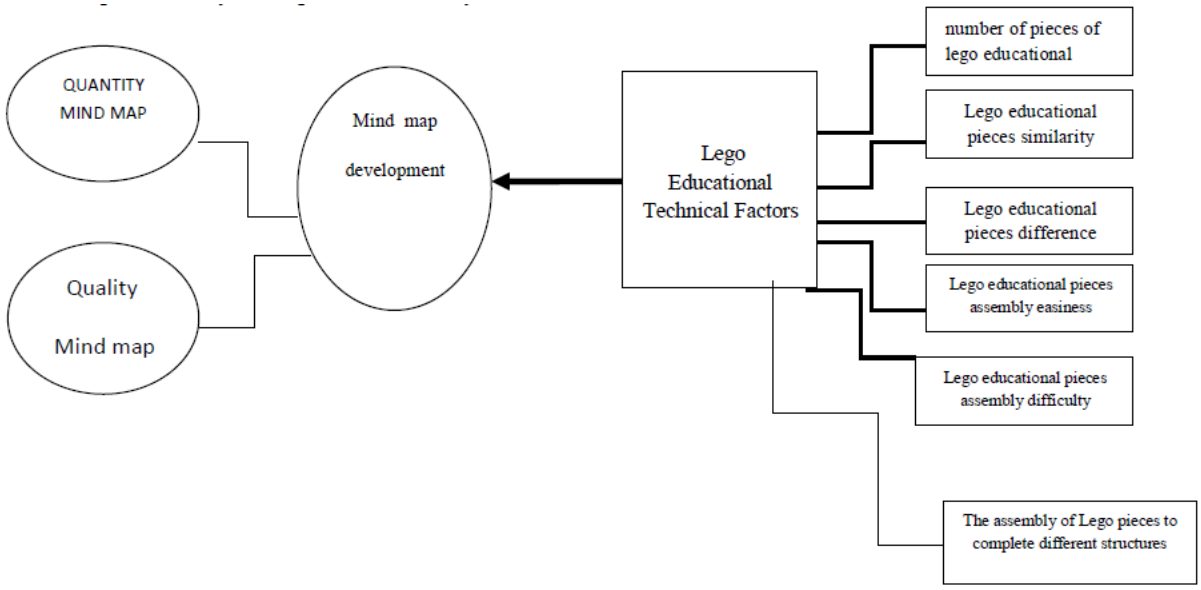
sufficient questions to measure all components of research variables. The population consisted of three groups including Lego educators (=15), Lego director (=1), school principals (=5), and students' parents (=179).Due to limited member of population, all of them were examined and questioned. The characteristics of sample is as follows: Gender: Female: 130, Male: 70; education level: 2 Diploma, 8 associate, 168 undergraduate, 20 graduate, 2 Ph.D.; job: 39 percent Lego educator, 65 percent parents, 1% director of Lego education center, and 5% school principals; age: 20 to 70 years old. The time scope of study was previous 2-10 years. The subject scope is mind map engineering through education by strategic approach.

CONCEPTUAL MODEL

The conceptual model was developed based on issues in two sources: first, Henry Mintzberg's paper entitled: "Planning in left hemisphere and management in right hemisphere"; second, Lego site.

Data Analysis Method

The data were analyzed using descriptive statistics techniques such as average, percentage, and ratio. Also, the main hypothesis and two sub-hypotheses were tested two samples independent t-test and ANOVA test.



Amount development of mind map when number of pieces of educational Lego is low (less than 7)

FINDINGS

The first two findings are resulted from main research hypothesis and the next findings are derived from testing two sub-hypotheses and the answers of open-ended questions.

1. The educational Legos impact largely on students' mind map. The educational Legos impact on mind map of both children and adolescents (under the control of left and right hemispheres of brain), but their impact on quantity and quality of mind map geometry of learners is dominated more in left hemisphere than right hemisphere.
2. From comparative perspective, the educational Legos impact more on problem analysis ability of learners (87 percent). They has the least impact on associating the present and past of students (69.2 percent).
3. Among the abilities of right-brain mind map, the educational Legos has the least impact on increasing of skill and interest in music (51.6 percent), ability of students in religion and philosophy (55 percent), and power of beliefs (57 percent) and has the highest impact on increasing of creativity and discovery (93.6 percent), imagination (93.2 percent), and power of imagery and visualization (92.2 percent).
4. These three dimensions develop more in students' mind map through educational Lego: Creativeness and exploration (93.6 percent), imagination (93.2 percent), and imaging or visualization (92.2 percent).
5. The Friedman test was used to compare the impact of "Lego" on mind map of right brain and left brain of learners. The results showed that the educational Lego impacts more on

left-brain mind map than right brain mind map (79.6 percent vs. 74.2 percent). This means that from total impact of Lego on development of mind map geometry of learners, nearly two-thirds occurs in left hemisphere and about one-third occurs in right hemisphere.

6. Quantity and quality of mind map geometry development of left and right brains through educational Lego

   The left brain and right brain mind map geometry dimensions may be divided into three categories based on effect and development:

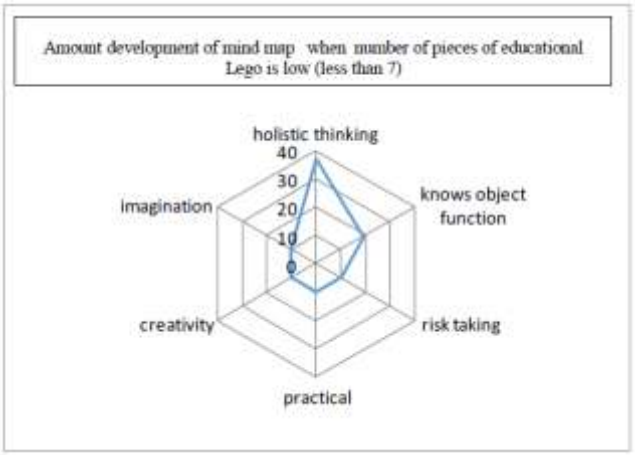
   More highly impacted (develop more than two-thirds or 67%), highly impacted (50% to 66%), and moderately impacted (41 to 49%).

7. The Lego educational courses impact more on these dimensions of learners' mind map geometry and develop them highly (more than 67%):

- creativity % 93.6
- imagination % 93.2
- visualization % 92.2
- daydreaming % 90.2
- knows object function % 88.2
- analysis % 87
- can comprehend % 85
- Knowing % 84.2
- symbols and images % 83.6
- mathematics & sciences %83.6
- Acknowledges %83.2
- practical % 82.6
- spatial perception% 82.6
- facts %82.2
- sequencing %.82
- details %82
- logic % 81
- collect %81
- knows object name % 81
- holistic thinking % 80.6
- Speech and speaking skills (%80.2)
- subtract % 79.2
- multiply %78.6
- think in words %78
- forms strategies %77.6
- non-verbal %77
- today & futcher %77
- intuition %76.6)
- appreciate %76.2
- tune of songs %76
- divide %75.6
- arts (motor skill) %75.2
- risk taking %74
- safe %73.6
- linear %73.6
- can "get it" (i.e. meaning) %73
- appreciates %72
- today & past %69.2

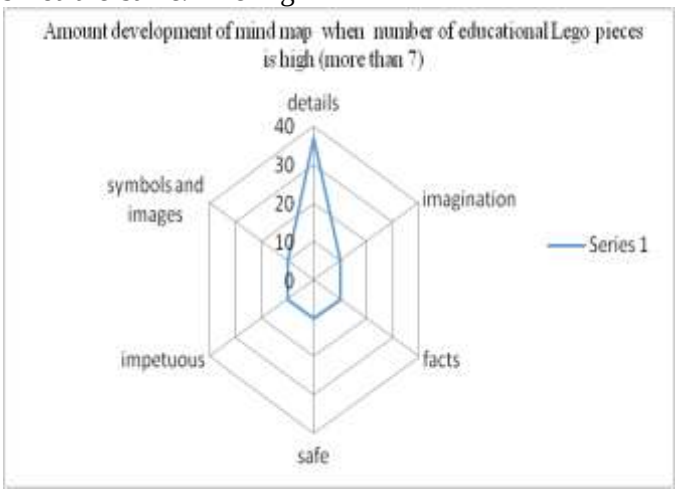
8. The seven dimensions of mind map geometry which are developed highly through Lego educational courses (50 to 66%) include: 1-(music %51.6) 2-(philosophy & religion %55) 3- (believes %57) 4-(rhythm (beats) %57.2) 5-(feelings %58) 6-(impetuous %61) 7-(tune of songs %66.2)
9. The dimensions of mind map which are developed by participation in Lego educational courses Lego (between 41 to 49 percent) include:
10. Among the dimensions of mind map geometry, the music skill and creativity and exploration are impacted less (51.6%) and more (93.6%) than other skills, respectively.
11. Mind map geometry development through Lego education

    If the number of pieces of educational Lego is low (less than 7), six dimensions of students' mind map will develop; however, the extent of development is not the same. The low number of pieces develop most of all the attention to totality and then the object application recognition skill. The other four dimensions are all developed by ten percent.



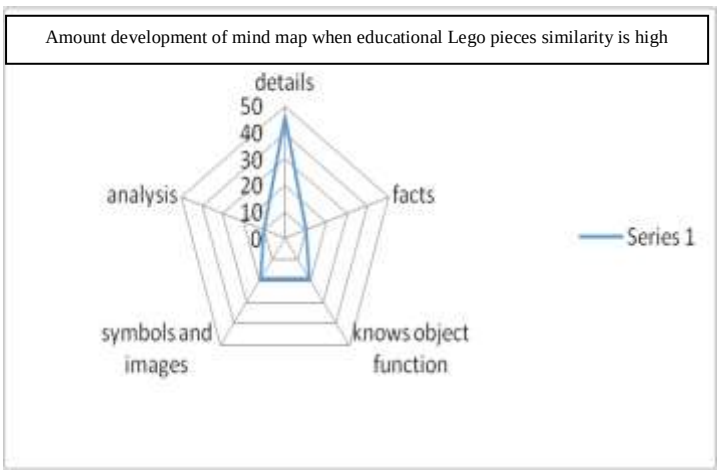
Amount development of mind map when number of educational Lego pieces is high (more than 7)

12. If the number of educational Lego pieces is high (more than 7), six dimensions of learners' mind map will develop; however, the development is not the same. The high number of pieces develop most of all the attention to details (37%). The other seven dimensions are all developed by ten percent.



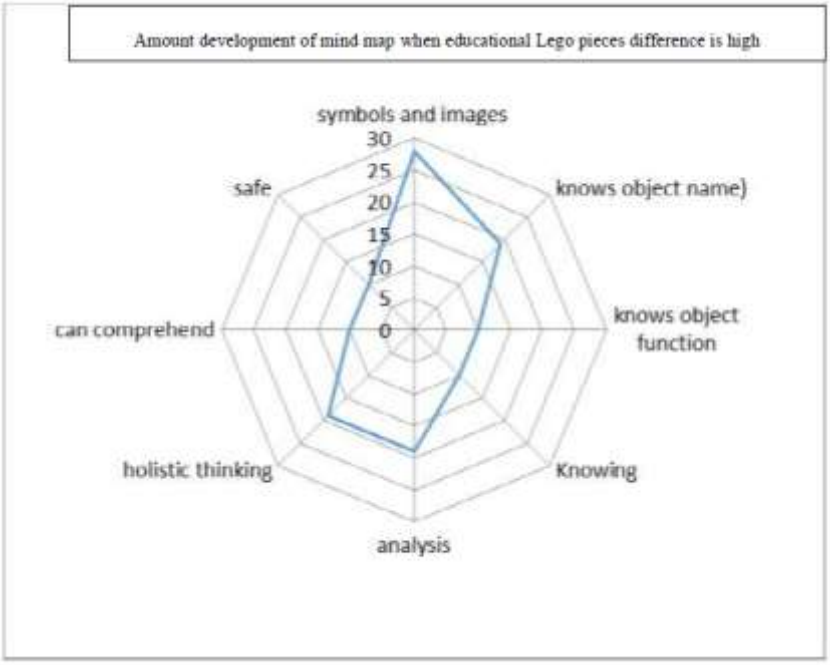
Amount development of mind map when educational Lego pieces similarity is high

13. If educational Lego pieces similarity is high, the five dimensions of learners' mind map will develop; however, the development is not the same. The similarity of pieces develop most of all the attention to details (46%). The recognition of objects usage and attention to signs and figures are developed by (19%) and the other two dimensions are developed by ten percent.



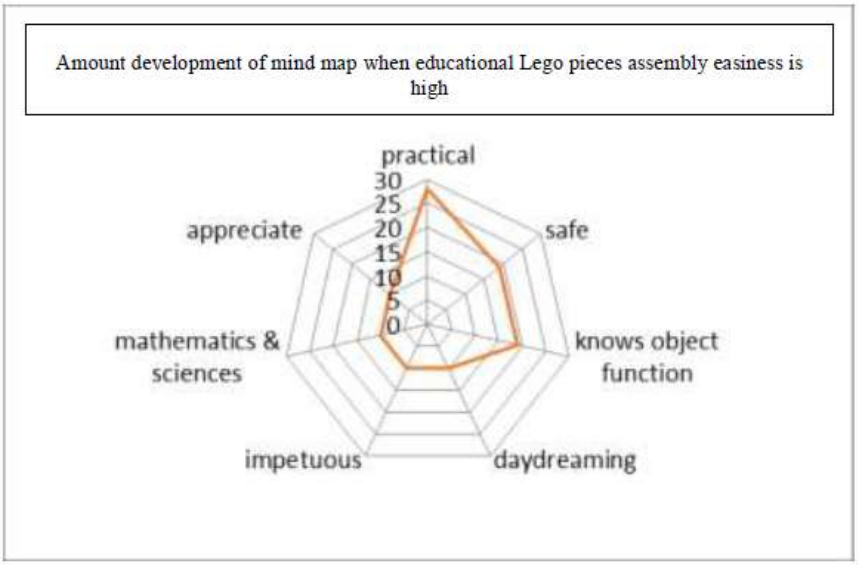
Amount development of mind map when educational Lego pieces difference is high

14. If educational Lego pieces difference is high, the eight dimensions of learners' mind map will develop; however, the development is not the same. The difference of pieces develop most of all the attention to holistic thinking, objects usage, and attention to signs and figures. The other four dimensions are developed by ten percent.



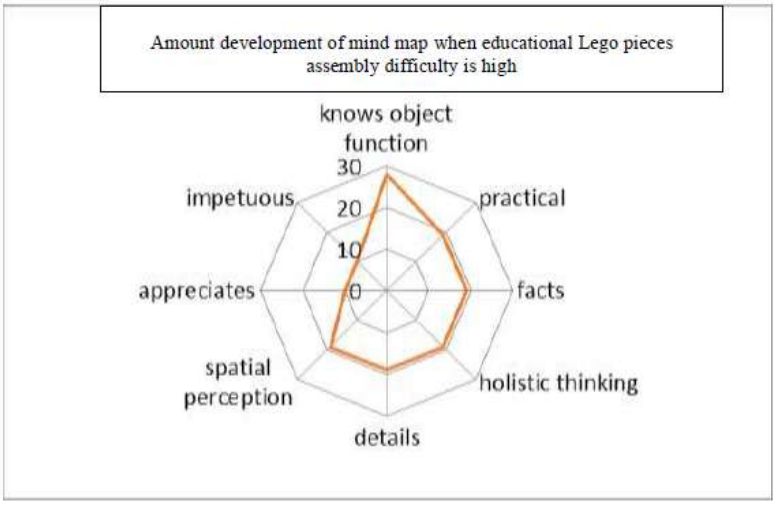
Amount development of mind map when educational Lego pieces assembly easiness is high

15. If educational Lego pieces assembly easiness is high, the seven dimensions of learners' mind map will develop; however, the development is not the same. The educational Lego pieces assembly easiness develop most of all the objects usage, practicality, and be safe. The other four dimensions are developed by ten percent.



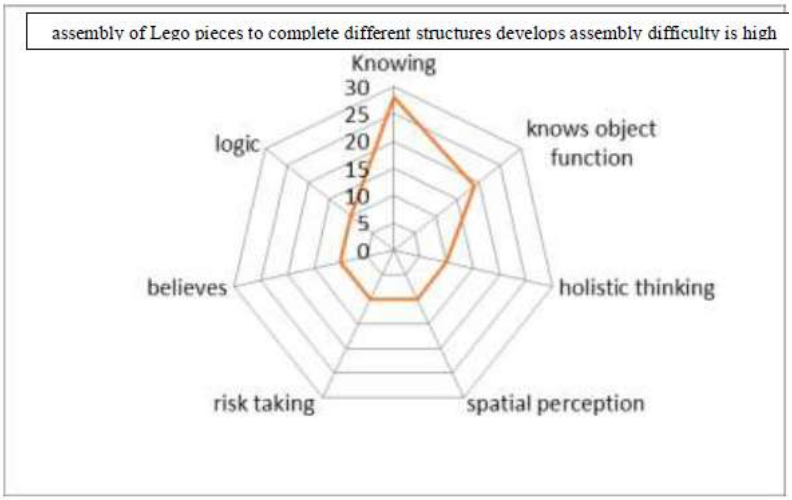
Amount development of mind map when educational Lego pieces assembly difficulty is high

16. If educational Lego pieces assembly difficulty is high, the eight dimensions of learners' mind map will develop; however, the development is not the same. The educational Lego pieces assembly difficulty develop most of all the objects usage, practicality, reality basis, attention to totality, attention to details, and three-dimensional perception. The gratitude and recklessness dimensions are developed by ten percent.



Assembly of Lego pieces to complete different structures develops assembly difficulty is high

17. The assembly of Lego pieces to complete different structures develops eight dimensions of learners' mind map; however, the development is not the same. The assembly of Lego pieces to complete different structures develop most of all the objects usage and intelligence. The other six dimensions are developed by ten percent.



DISCUSSION

The Lego educators and parents should first explain the goal of participation of learners in Lego educational courses and then determine the technical characteristics of Lego based on learners' mind map development dimensions. Therefore, if the goal is increasing of attention to totality, attention to details, attention to signs and figures, practicality, and object application recognition, the education should be performed by low number of Lego pieces (less than 7), high number of Lego pieces, different Lego pieces, easy assembly pieces, and difficult assembly pieces, re4spectively.

CONCLUSION

However, it was concluded that the Lego educational courses impact on all dimensions of learners' mental map geometry in terms of technical features. However, this effect is low, medium, and high in different mind maps; this difference is due to technical characteristics of Lego structures pieces. Thus, the geometry of learners' mind map should be drawn, the development dimensions should be determined, and technical characterization of Lego structures should be selected and trained according to them. This will result in higher productivity and more and quick qualitative and quantitative development of learners' mind map.

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Citation: *Mostafa Jafari, Neda Nouzari "Geometric Analysis the Development of Child's Mind Map through Lego Educational Factors Based on Strategic Approach" International Journal of Research in Business and Management, 7(5), 2020, pp. 01-09.*