

# The Effectiveness of Using Costa and Kallick's Habits of Mind in Developing Achievement and Some Visual Thinking Skills of First Year Preparatory School Pupils

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## Abstract

*This research aims at investigating the effectiveness of using Costa and Kallick's Habits of Mind in developing achievement and some visual thinking skills of first-year preparatory school pupils. To achieve that, the researcher designed the following: a list of Habits of Mind in the light of Costa and Kallick and converting it into educational goals which can be achieved after teaching geometry for the first year prep school pupils; Teacher's guide and pupils worksheets for teaching "geometry and measurement" unit of the first year prep school pupils according to Costa and Kallick's Habits of Mind; an achievement test of "geometry and measurement" unit for the second term of the first year prep school pupils and finally, visual thinking skills test. The current research used quasi-experimental research through applying it to a group of female pupils of the first year prep school. The sample consisted of (100) female pupils of Beni Ahmed prep school (1) in Minia Governorate, Egypt. It was divided into two groups: the experimental and control group. The control group consisted of (50) pupils taught with the traditional method, while the experimental group consisted of (50) pupils taught using Costa and Kallick's Habits of Mind. The results have shown that pupils' grades of the experimental group are higher than other group grades on achievement and some visual thinking skills. The researcher introduced some recommendations such as the necessity to set up professional development programs for training mathematics teachers in order to develop pupils' Habits of Mind, the necessity also to train student teachers of mathematics in the faculty of education to develop Habits of Mind. Moreover, Geometric content in the preparatory stage should be enriched with different educational activities that contribute to developing learners' visual thinking.*

**Keywords:** Costa and Kallick's model - Habits of Mind – Achievement- Visual thinking skills.

## Introduction

Habits of Mind according to Costa and Kallick's model should be an integral part of the school's culture. This can be achieved by a type of integration between Habits of Mind and mathematics content. Its use appears in every unit and activity so pupils become aware of it. This helps them to be lifelong independent learners. Teachers should develop pupils' Habits of Mind through using the suitable methods for every topic.

Costa and Kallick defined Habits of Mind from the psychological viewpoint as the intellectual ability in which a person behaves intelligently when confronting a situation or a problem with unknown solution (Costa & Kallick, 2008a, 5).

A number of studies had proved the effectiveness of using Habits of Mind in the field of learning and teaching Mathematics in developing achievement such as: Elmotreb & Elshore's study (2014) , Kamal's study (2014) and Elmofty's et al study (2015).

Developing thinking skills is considered as one of the most important goals in teaching Mathematics. Visual thinking is considered as one of these types of thinking. It is an essential and effective element in the thinking system and mental activity as pupils use their sight to form mental images which enable them to do mathematic processes.

Visual thinking is represented in reading the optical form with converting the visual language into verbal one. The main skills of visual thinking are visual observation, visual comparison and visual imagination. These skills include a number of sub skills (strahy, 2011, 139).

A number of studies such as: Hamada's study (2006) , Mahdy's study(2006) ,Hamada (2009) and Elhana's study(2015) had proved the importance of developing visual thinking .

**Problem of the study:**

The researcher as a mathematics teacher in the preparatory stage observed that there is a difficulty in pupils' learning of geometry. They didn't have perseverance in solving geometric problems to find a solution. They also had no more than one solution. They also could not draw geometric shapes in a right way. It was confirmed by their low scores of the results at the end of year (2016-2017) as indicated in table (1)

**Table (1)**

**Results of Geometric Test at the End of the Second Term (Academic Year, 2016-2017) for the First Year Beni Ahmed Prep School (1)**

| Stage                                | Number of students | Number of successful students | percentage | Number of students who failed | percentage |
|--------------------------------------|--------------------|-------------------------------|------------|-------------------------------|------------|
| First Year Preparatory School Pupils | 323                | 180                           | 55.7%      | 143                           | 44.2%      |

The researcher conducted a survey for teachers' opinions in Minia (20 teachers) to identify the current position of teaching geometry in the preparatory stages and determine pupils' knowledge of some Habits of Mind. The results had shown that:

-75% of teachers use the traditional methods of teaching depending on lecturing and using board to deliver the information.

-85% of teachers do not know anything about Habits of Mind and how to use and develop them in geometry in the preparatory stage.

-80% of teachers attribute the weakness in learning geometry to the content and its massiveness, the relation between subjects of geometry and their ordering with the primary stage and the following stages is not found, the curriculum does not reflect life situations and special goals for teaching geometry are not found.

-70% of teachers do not use geometric shapes or means to achieve geometric goals and indicate that geometry is interesting in its nature and requires perseverance and more effort to get better results.

In view of the foregoing, problem of the study is identified in answering the following main question:

What is the effectiveness of using Costa and Kallick's Habits of Mind in developing achievement and some visual thinking skills of first year preparatory school pupils? and the following two questions are branched from it:

1- What is the effectiveness of using Costa and Kallick's Habits of Mind in developing achievement of first year preparatory school pupils?

2- What is the effectiveness of using Costa and Kallick's Habits of Mind in developing some visual thinking skills of first year preparatory school pupils?

**Research Objectives:** The current research aimed to identify

1- The effect of using Costa and Kallick's Habits of Mind in developing achievement of first year preparatory school pupils.

2- The effect of using Costa and Kallick's Habits of Mind in developing some visual thinking skills of first year preparatory school pupils.

**Research significance:** The significance of the current research lies in the following:

1- This research identified a list of Habits of Mind in the light of Costa and Kallick converting it into educational goals which can be achieved after teaching geometry for the first year prep school pupils.

2- The current research provides Teacher's guide and pupils worksheets for teaching "geometry and measurement" unit of the first year prep school pupils according to Costa and Kallick's Habits of Mind.

3- The current research provides (An achievement test of "geometry and measurement" unit - Visual thinking skills test) may benefit teachers of teaching mathematics for this purpose.

**Research delimitations:** The current research was limited to:

1-Mind habits according to the "Costa and Kallick's " model, of which thirteen habits were chosen: (Perseverance - Thinking flexibly - Thinking about thinking - Striving for accuracy - Questioning and posing problems - Applying previous knowledge in new situations - Thinking and communicating with clarity and precision - Gathering data through all senses - Creating, imagining and innovating - Taking responsible risks - Finding sense of humor – Thinking interdependently – Remaining open to continuous).

2- CAPS achievement levels (knowledge - understanding and application - critical thinking and problem solving).

3- Visual thinking skills (visual discrimination, visual closure and connecting relationships in the shape).

**Research Terms:**

**1- Effectiveness:** It is defined as the extent of success of a particular way or method in achieving an impact on students which can be measured by tests and scales (Allekani & Algaml, 2003, 67)

It is also defined as desirable results or the power of achieving desirable results (Ibrahim, 2006, 86).

**The operational definition of effectiveness:**

The change that is undergone on first year prep school pupils' performance after studying "geometry and measurement" unit in the light of Costa and Kallick's Habits of Mind in increasing achievement and some visual thinking skills which is indicated by the difference between mean scores of pupils in the post test of achievement of the experimental and control groups and the visual thinking skills test using the effect size equation.

**2- Costa and Kallick's Habits of Mind:** Costa and Kallick abstracted a list of sixteen Habits of Mind contributing in thinking which describes how people behave intelligently and is considered as characteristics of intelligent people when coming across problems with no obvious or immediate solutions. These habits are (Perseverance - Thinking flexibly - Thinking about thinking - Striving for accuracy - Questioning and posing problems - Applying previous knowledge in new situations - Thinking and communicating with clarity and precision - Gathering data through all senses - Creating, imagining and innovating - Taking responsible risks - Finding sense of humor – Thinking interdependently – Remaining open to continuous)(Costa & Kallick,2005,12-84) (Costa & Kallick,2008b,44-49) and converting it into educational goals to be achieved within the content of "geometry and measurement" unit..

**3- Achievement:** The learner's acquisition of knowledge, mathematics skills and educational experience after studying the specified unit which can be inferred from the pupil score in an achievement test of geometry of first year prep grade.

**4- Visual thinking:** It is defined as one of the thinking patterns which arouses learner's mind with visual stimuli aiming to realize the relationship between mathematical information, its understanding, its representation and organization then integrating it into his knowledge with aligning between it and his past experience to correct acquirable meaningful experience (Amer & Elmasry, 2016, 49).

It is also defined as one of the thinking patterns that arouses mind using visual stimuli to realize the relationship between concepts (Mohamed, 2006, 82).

**The operational definition of visual thinking:**

It is emerged as a result of arousing mind with visual stimuli resulting in realizing concepts and relationships of geometric shape which can be achieved by a number of mental processes reflecting pupil's ability to understand the geometric shape and changing the visual language into verbal one, It included some skills such as visual discrimination, visual closure and connecting relationships in the shape and is measured by the pupil score in the prepared visual thinking skills test.

**Theoretical background and related studies:****Firstly: Costa and Kallick's Habits of Mind:**

According to Costa and Kallick's model, Habits of Mind were abstracted from studies conducted on a number of people. These habits are more than gathering physical objects that one learns in a school. They are features which distinguish who are proficient in their performance in all places whether in work, school settings, home or etc. These Habits of Mind represent a force which leads to the right behavior because they are the keystone of integrity and regulated decision-making tools (Costa & Kallick, 2009: 38-65).

This study depended specifically on Costa and Kallick's classification of Habits of Mind because:

- 1- It depended on the researches' results of Feuerstein, Baron, Steinberg and Goleman which made this classification more comprehensive for Habits of Mind (Naofal, 2010, 90)
- 2- Habits could be converted into educational goals which were included in mathematics goals.
- 3- There was a broad agreement between Costa and Kallick's classification of Habits of Mind and the seven dimensions of tendency towards Mathematics determined by NCTM" National Council of Teachers of Mathematics"(Elsayed, 2016, 27)

"Habits of Mind" is considered as one of the effective models in developing achievement and different forms of thinking which is confirmed by a number of studies such as Marshal(2004), Amor(2005), Hu(2005), Kreizel & Lincoln(2006), Rayane(2012), Elbarsan & Abd(2013), Abd elhamid(2014), Elmotreb & El shore (2014), Elmofty et al(2015), Elsayed(2016) in using Habits of Mind to develop achievement. And studies such as Rayane(2012), Kamal(2014) to develop creative thinking; the development of analytical thinking such as the Elbale's study (2013), the development of critical thinking such as Elkarki's study (2007), imaginative thinking such as Yousef's study(2012).

**Secondly: visual thinking**

The importance of using visual thinking lies in providing the opportunity for seeing the geometric shapes and making visual comparisons among the properties of these shapes to be directly learned by students. This leads to stabilize the properties of shapes in learners' minds and the survival of the impact of learning. It helps in the acquisition of mathematical skills through recognizing the steps of acquiring and practicing every skill. Visual thinking also helps learners to be connected with others through discussions (Amer & Elmasry, 2016, 63).

A number of studies had been conducted which aimed to develop visual thinking skills in Mathematics such as: Alkhazindar (2008), Hamada(2009), Shath(2009), Strahy(2011), Haciomeroglu & Chicken(2012), Zaghlol(2015), Mahmoud(2017) and Godat (2017) that proved the effectiveness of using different teaching strategies and samples in developing visual thinking skills.

This current study differs from previous studies as it deals with Costa and Kallick's model in developing visual thinking. Visual thinking is considered one of the most important types of thinking which is used in teaching mathematics generally and geometry in particular. It directs learners to visualize the geometric shapes for identification. This helps learners to realize the spatial relationships in a shape. It also helps to analyze information on the visual shape. Habits of Mind are considered as one of the main models in developing visual thinking as they can express the same concepts and ideas with various ways. When learners outline and visualize their ideas, they can understand the geometric relationships.

**Research hypotheses:** This research tried to test the following hypothesis:

1-There would be a statistical significant difference (favoring the experimental group) between the mean scores obtained by the experimental group(using Costa and Kallick's Habits of Mind in teaching geometry and measurement unit) and the control group(studying the same content with the traditional method) on the post achievement test.

2-There would be a statistical significant difference (favoring the experimental group) between the mean scores obtained by the experimental group(using Costa and Kallick's Habits of Mind in teaching geometry and measurement unit) and the control group(studying the same content with the traditional method) on the post test of visual thinking skills.

## Research Method

It indicates the procedural steps of research including research design, variables, sample and its selection, instruments and their design and statistical constant calculation as following:

### Research design

The current research adopts the quasi-experimental design which is based on the two groups: an experimental group (using Costa and Kallick's Habits of Mind in teaching geometry and measurement unit) and control (studying the same content with the traditional method).

### Research variables:

**1- The independent variable:** Teaching using Costa and Kallick's Habits of Mind in teaching "geometry and measurement" unit.

**2- The dependent variables are:** Developing achievement and some visual thinking skills (visual discrimination, visual closure and connecting relationships in the shape) of first year preparatory school pupils.

### Educational material and measurement tools:

To achieve the research goals, the researcher designed the educational material and measurement tools as following:

#### 1-Educational material:

- The researcher designed a list of mind habits according to Costa and Kallick's model which was translated into educational goals. These educational goals can be achieved after teaching the content of geometry for first year prep school pupils (first term). The researcher developed an initial questionnaire for this list presented to jury members to check its validity and reliability. The researcher obtained the final form of this list after doing the needed modifications.
- designing a teacher's guide and pupils' worksheets for teaching "geometry and measurement" unit of first year prep school pupils according to Costa and Kallick's Habits of Mind including: introduction, the model of Costa and Kallick's Habits of Mind, Geometers Sketch Pad(GKP) program, GeoGebra program, the general aims of "geometry and measurement" unit of first year

prep school pupils(first term) according to Habits of Mind, the unit content, the time distribution of sessions in the unit according to the plan, presenting the unit topics according to Costa and Kallick's Habits of Mind, evaluation methods (formative and summative evaluation).

## 2- Measurement tools:

**A-The researcher designed an achievement test of geometry** and measurement unit for the first year prep school pupils (first term). She obtained a final form of this test through these steps:

- identifying the objective of this test: this test aims to measure achievement of first year prep school female pupils in aspects of learning included in geometry and measurement unit in the first term.
- designing a table of specification of the test in the light of the test length (the test items are 30), the relative weight of every topic, the objectives' levels of every topic(knowledge-comprehension and application-critical thinking and problem solving), the researcher designed a table of specification of the test.
- designing an initial form of the achievement test: according to the table of specification, the researcher designed the initial form of the test which composed of 30 items. Test items were formulated as following: (5) completion items, (5) true and false items, (15) essay items.
- The method of test correction:
  - Objective questions: the researcher puts one point for the correct answer.
  - Essay questions: the researcher puts one point for every correct step. The final grade of questions is calculated according to the number of correct steps. For the items of drawing geometric shapes, the researcher puts one point for every correct drawing. As a result of that the maximum score of the test is (45) points.

### **The test validity:**

The initial form of the test is presented to a number of jury members from teaching staff specialized in mathematics and methodology to make sure of the comprehensiveness of test items that measure aspects of learning included in "geometry and measurement" unit and the validity of every item in the test and its purpose. The researcher did the needed modifications according to jury members' viewpoints.

### **Piloting of the test:**

After doing the required changes referred by jury members, the test was applied on the piloting sample after teaching "geometry and measurement" unit to calculate the statistical treatment of the test. The results were as follows:

Test item validity is calculated by calculating the correlation coefficient between the grade of every item in the test and the overall score of the test (internal consistency). The correlation coefficients ranged (from 0.31 to 0.75) which all are statistically significant. Test reliability is high as reliability coefficient using Alpha Cronbach's equation was (0.87). The test item was suitable in its facility as the facility index of items ranges between (0.17- 0.84). the results also indicated that the discrimination index of items ranges between (0.13- 0.25). This means that the test has the ability to distinguish between pupils. The mean of the test

time was calculated from test items of the piloting sample. It is found that the time needed for the test is (120) minutes. Thus, the researcher designed the final form of the achievement test.

### **B- Designing the visual thinking skills test:**

The researcher designed the final form of visual thinking skills test through identifying the test goal which measured some of the visual thinking skills of first year prep school pupils.

- Preparing the initial form of visual thinking skills test: The researcher designed the initial form of visual thinking skills test which was composed of (20) items. These items were formulated in multiple choice questions.
- Preparing the key answer of the test: the researcher puts one point for the correct answer for each item in the test. Therefore, the overall score of the test was (20) points.

### **The test validity:**

The initial form of the test is presented to a number of jury members from teaching staff specialized in mathematics and methodology to make sure that each item is suitable for the level of goal that it measures, the scientific accuracy of the items, the appropriate language formulation of the items,. The researcher did the needed modifications according to jury members' viewpoints.

### **Piloting of the test:**

After doing the required changes referred by jury members, the test was applied on the piloting sample after teaching "geometry and measurement" unit to calculate the statistical treatment of the test. The results were as follows:

Test item validity is calculated by calculating the correlation coefficient between the grade of every item in the test and the overall score of the test (internal consistency). The correlation coefficients range (from 0.31 to 0.59) which all are statistically significant. Test reliability is high as reliability coefficient using Alpha Cronbach's equation was (0.84). The test item was suitable in its facility as the facility index of items ranges between (0.28- 0.86). the results also indicated that the discrimination index of items ranges between (0.12- 0.25). This means that the test has the ability to distinguish between pupils. The mean of the test time was calculated from test items of the piloting sample. It is found that the time needed for the test is (60) minutes. Thus, the researcher designed the final form of the visual thinking skills test.

### **Conducting the research experiment**

The implementation of the experiment began on (13-10-2019), as "geometry and measurement" unit was applied to the pupils of the research groups (experimental and control). Teaching lasted for (20) session, namely 2 sessions per week. The research experiment ended in (18-11-2019), after that the achievement test and the visual thinking skills test were applied (post- application) to the students of the research groups.

### **Research results and their interpretations:**

1-To verify the first hypothesis "There is a statistical significant difference (favoring the experimental group) between the mean scores obtained by the experimental group(using Costa and Kallick's Habits of



Mind in teaching geometry and measurement unit) and the control group(studying the same content with the traditional method) on the post achievement test", the researcher used "T" test for the independent groups. The following table indicates the application results:

**Table (2)**

**The Statistical Significant Difference between the Mean Scores Obtained by the Experimental Group and the Control Group on the Post Achievement Test of "Geometry and Measurement" Unit.**

| Group        | N  | Mean  | SD   | df | T-Value | Sig. |
|--------------|----|-------|------|----|---------|------|
| Experimental | 50 | 32.32 | 7.55 | 98 | 5.62    | 0.01 |
| Control      | 50 | 22.9  | 9.12 |    |         |      |

Table (2) showed that there is a statistical significant difference (0.01) between the mean scores obtained by the experimental group and the control group on the post achievement test favoring the experimental group. As a result of that, the first hypothesis was achieved  $\eta^2$  has been calculated (0.244). It is a value that exceeds the pedagogic importance value of the statistical results in educational and psychological researches which was (0.14). This means the impact of the independent variable (Costa and Kallick's Habits of Mind) on the dependent variable (the achievement test of the unit of "geometry and measurement") was high as  $\eta^2$  value refers. This indicates the effectiveness of Costa and Kallick's model in increasing achievement of female pupils of the experimental group.

Marshal(2007), Amor(2005) ,Hu(2005),Kreizel & Lincion(2006), Rayane(2012), Aljizani & Ward(2012), Elbarsan& Abd(2013) , Abd elhamid(2014), Elmotreb & Elshore (2014) , Elmofty et al(2015) and Elsayed(2016) agree with the results of using Habits of Mind in developing achievement. Therefore, the research question was answered and the research hypothesis was verified.

The results indicated the excellence of first year prep school female pupils of the experimental group who studied "geometry and measurement" unit in geometry course in the first term using Costa and Kallick's Habits of Mind than those pupils of the control group who studied the same course with the traditional method in developing achievement because of using Costa and Kallick's Habits of Mind in teaching the unit. This development occurred due to:

1. using activities that motivate female pupils on perseverance during problem solving and geometric exercises through giving examples of some mathematicians and their discoveries and applying origami activities(they are manual activities pupils use to design shapes which learn them patience during answering exercises of higher order thinking). This helped them to increase their level of achievement.
2. using the previous knowledge in new situations helped them in recalling and the survival of learning impact through continuously practicing to memorize what they studied and using it in new situations. This achieved coherence in their knowledge which helped them in increasing their level of achievement.
3. using some activities based on cooperative learning provided the chance for pupils to share with themselves in groups. This helped them to develop reciprocal thinking and thinking about

thinking through pupils' rethinking of their peers' answers to improve the group level and avoid mistakes. This leads to rapidly understanding and increasing their achievement.

4. asking questions during doing activities helped to clarify the problem for pupils as it helped to find answers to these questions which helped in understanding and finding solutions through questioning. Therefore, this helped to increase their achievement.
5. using activities helped in thinking flexibly through introducing different methods of solution, introducing problems with different higher order thinking and changing the modes of geometric shapes while doing exercises. This helped pupils to deduce various alternatives for solving geometric problems and was not restricted by only one solution. Therefore, this helped to increase their achievement.
6. using activities helped in creating a sense of humor for pupils by using question bank, mathematical fallacies and caricatures. This stimulates pupils to do the activity and discover the fallacy. Therefore, this helped to increase their achievement.
7. using activities developed pupils' imagination, innovation and creativity through introducing unusual problems, giving untraditional solutions for these problems, using GeoGebra and GSP in drawing the geometric shapes by computer. These programs helped to draw the geometric shape rapidly and more accurately. This helped them in enhancing their performance of solving geometric exercises and increasing their achievement which is confirmed by Costa and Kallick's Habits of Mind.
8. the continuous evaluation before, during and after the lessons of the unit and the continuous feedback of pupils contributed in increasing the effect size and their achievement.

2-To verify the second hypothesis "There is a statistical significant difference (favoring the experimental group) between the mean scores obtained by the experimental group(using Costa and Kallick's Habits of Mind in teaching geometry and measurement unit) and the control group(studying the same content with the traditional method) on the post test of visual thinking skills", the researcher used "T" test for the independent groups. The following table indicates the application results:

**Table (3)**

**The Statistical Significant Difference between the Mean Scores Obtained by the Experimental Group and the Control Group on the Post Test of Visual Thinking Skills of "Geometry and Measurement" Unit.**

| visual thinking skills      | Group        | N  | Mean | SD    | T-Value | Sig. | η <sup>2</sup> Value | Sig. of Effect Size |
|-----------------------------|--------------|----|------|-------|---------|------|----------------------|---------------------|
| visual discrimination skill | Experimental | 50 | 6.34 | 1.398 | 5.18    | 0.01 | 0.215                | High                |
|                             | Control      | 50 | 5.14 | 0.847 |         |      |                      |                     |
| visual closure skill        | Experimental | 50 | 5.04 | 0.83  | 6.62    | 0.01 | 0.309                | High                |
|                             | Control      | 50 | 3.80 | 1.03  |         |      |                      |                     |
|                             | Experimental | 50 | 5.60 | 1.14  | 6.21    | 0.01 | 0.284                | High                |

|  |                     |    |       |      |      |      |       |      |
|--|---------------------|----|-------|------|------|------|-------|------|
| <b>connecting relationships in the shape skill</b> | <b>Control</b>      | 50 | 4.06  | 1.33 |      |      |       |      |
| <b>Total skills</b>                                | <b>Experimental</b> | 50 | 16.98 | 2.17 | 7.92 | 0.01 | 0.390 | High |
|  | <b>Control</b>      | 50 | 13.00 | 2.81 |      |      |       |      |

Table (3) showed that there is a statistical significant difference (0.01) between the mean scores obtained by the experimental group and the control group on the post test of visual thinking skills as a whole and in each major skill separately favoring the experimental group. As a result of that,  $\eta^2$  as calculated for the visual thinking skills as a whole and for each major skill separately, and it became clear that the values of  $\eta^2$  exceed the value indicating the educational importance of the statistical results in educational and psychological research and ranges between (0.215-0.39). This means the impact of the independent variable (Costa and Kallick's Habits of Mind) on the dependent variable (test of visual thinking skills) was high as  $\eta^2$  value refers. This indicates the effectiveness of Costa and Kallick's model in increasing visual thinking skills of female pupils of the experimental group.

This finding is consistent with the findings of Al khazindar (2008), Hamada (2009) ,Shath(2009) , Strahy(2011) ,Haciomeroglu & Chicken(2012) ,Zaghlol (2015), Mahmoud (2017) and Godat (2017), which confirmed the effectiveness of using different teaching strategies and samples in developing visual thinking skills. Therefore, the second research question was answered and the second research hypothesis was verified.

The results indicated the excellence of first year prep school female pupils of the experimental group who studied "geometry and measurement" unit in geometry course in the first term using Costa and Kallick's Habits of Mind than those pupils of the control group who studied the same content with the traditional method in developing visual thinking skills because of using Costa and Kallick's Habits of Mind in teaching the unit. This development occurred due to:

1. converting Habits of Mind into educational goals and striving to achieve them in the unit. This helped pupils to do performances related to developing their visual thinking skills because pupils are required to solve the observed activity, visual sensation, sensory experience and geometrical drawing which leads to develop some of their visual thinking skills.
2. converting Habits of Mind into educational goals and striving to achieve them by implicit activities in geometry course. To do these activities, it is required to prepare some pictures and caricatures and to analyze and synthesize geometric shapes which helped in developing perseverance and sense of humor. This helped to develop their visual thinking skills.
3. converting Habits of Mind into educational goals and striving to achieve them in the unit's content requires some activities based on cooperative learning which developed the habit of reciprocal thinking. This leads to doing some kind of dialogue and discussion between group members, all groups as a whole and the teacher who got clarifications and deductions helped in doing the activity. This helped to develop their visual thinking skills.
4. converting Habits of Mind into educational goals and striving to achieve them in the unit's content served to tie relationships and find the connections between the current lesson, the previous one

and the lesson elements itself. It also helped in doing comparisons between shapes' features which helped in doing the activity through using the previous knowledge application habit in new situations. This developed their visual thinking skills.

5. converting Habits of Mind into educational goals and striving to achieve them in the unit's content required using proper verbal expressions. It also required using primary and secondary sources of information in doing the activity which developed the struggle habit to achieve accuracy. This contributed to develop their visual thinking skills.

## Recommendations

In light of the findings of the present research, the following recommendations were drawn:

- 1- The need to pay attention to preparing professional development programs to train mathematics teachers to develop students' Habits of Mind.
- 2- The need to pay attention to training students of mathematics teachers in colleges of education in developing Habits of Mind.
- 3- Enriching the geometric content in the preparatory stage with the various educational activities, which contribute to developing the visual thinking of learners.

## The suggested studies:

In the light of the results, the researcher suggests some further studies such as:

- 1- Doing studies similar to the current study in other grades in different stages of education.
- 2- Developing the preparatory curriculum of Algebra in the light of Costa and Kallick's Habits of Mind.
- 3- Conducting researches similar to this research using Costa and Kallick's Habits of Mind in teaching different types of learners such as students with learning disabilities and underachievers.

## References

- Abd elhamid, S. (2014). *Effectiveness of a suggested program based on some productive Habits of Mind in developing mathematical power skills and decision-making for primary five pupils*. Ph.D. Thesis, Institute of Educational Studies, Cairo University.
- Al jizani, M & Ward, S. (2012). The impact of a training program based on habits of the mind in developing metacognitive skills for sixth-grade primary students. *Misan Research Journal*, Misan University, 9(17), 46-114.
- Al khazindar, N. (2008). Evaluating the content of mathematics books for the upper basic stage in the light of visual thinking skill. *Education Journal*, Al-Aqsa University, 36(161), 148-166.
- Allekani, A & Algaml, A. (2013). *Dictionary of educational cognitive terms in curricula and teaching methods*. 3<sup>rd</sup> Edition, Cairo: Allam El-Kotab.
- Amer, T & Elmasry. (2016). *Visual thinking (concept-skills-strategy)*. Cairo: The Arab Group for Training and Publishing.

- Amor,O.(2005). *The effect of a training program based on Habits of Mind in real life situations on the development of creative thinking of basic stage grades*. Ph.D. Thesis, Faculty of Higher Education Studies, Amman Arab University
- Costa, A. L& Kallick, B. (2005). *Habits of Mind: A Curriculum for Community High School of Vermont Students* .Vermont Consultants for Language and Learning, Montpelier, Vermont
- Costa,A. L & Kallick,B.(2008a). Changing perspective about intelligence .In (Eds) Costa,A.L and Kallick,B. *Learning and leading with Habits of Mind : 16 essential characteristics for success*. Alexandria, Virginia, USA: Association for Supervision and Curriculum Development ,Pp.(5-14).
- Costa,A. L & Kallick,B.(2008b). Habits of Mind in the curriculum .In (Eds) Costa,A.L and Kallick,B. *Learning and leading with Habits of Mind : 16 essential characteristics for success*. Alexandria, Virginia, USA: Association for Supervision and Curriculum Development ,Pp.(42-58).
- Costa,A. L & Kallick,B. (2009). *Habits of Mind across the curriculum: Practical and creative strategies for teacher*. Alexandria, Virginia, USA: Association for Supervision and Curriculum Development.
- Elbale,I.(2013). The effectiveness of a proposed unit in science according to the Costa and Kallick perspective of mind habits in developing analytical thinking and scientific inclinations among middle class first-graders in the Kingdom of Saudi Arabia, *The Egyptian Journal of Scientific Practical Education*,16(5),93-135.
- Elbarsan,E & Abd,E.(2013) .Habits of Mind for tenth grade students and their participation in mathematical problem solving ability. *Journal of the Arabian Gulf message*,(127),161-192.
- Elhanan,O.(2015).*Enrichment program based on reflective teaching in mathematics to develop some habit of mind and visual thinking skills for primary stage pupils* .Ph.D. Thesis ,Faculty of Education , Assiut Univeristy.
- Elkarki.(2007). *The effectiveness of a training program based on Habits of Mind in developing critical thinking of University Students* .Ph.D. Thesis ,Faculty of Higher Education Studies, Amman Arab University.
- Elmofty,M ., Abd elsamie,A & Hamed,F.(2015).*Effectiveness of program based on the integration between multiple intelligences and Habits of Mind for developing of achievement and creative thinking in mathematics for preparatory stage pupils*. *Journal of the Faculty of Education*, Ain Shams University,(39),461-484.
- Elmotreb & Elshore.(2014). The effect of the use of a program based on the Habits of Mind strategy in the development of logical/mathematical intelligence and on the achievement of the second-grade intermediate school students .*The Educational Journal, Kuwait university*,28(112),423-460.
- Elsayed,I.(2016).*The effectiveness of a program based on the Habits of Mind in learning mathematics for developing the preparatory stage Pupils' achievement and creative solving skills of mathematical problems*. Ph.D. Thesis,Faculty of Education ,Benha University.
- Godat,W.(2017). *The effect of using the graphic organizer strategy on developing visual thinking and solving geometric problem among 9th female graders in Gaza* .Master Thesis, Faculty of Education, The Islamic University–Gaza
- Haciomeroglu , E & Chicken , E. (2012) .Visual thinking and gender differences in high school calculus . *International Journal Of Mathematical Education in Science and Technology* , 43( 3) , 303 -313.

- Hamada,F.(2006). Using educational computer games to develop achievement and visual thinking in mathematics among primary school students. *Educational Journal ,Faculty of education, Sohag University*,(22),221-271.
- Hamada,M.(2009). The effectiveness of visual thinking networks in developing visual thinking skills and the ability to solve and subtract verbal problems in mathematics and the attitude towards solving them for fifth-grade primary students. *Journal of Studies in Curricula and Teaching Methods*, Faculty of Education, Ain Shams University,(146),14-64.
- Hu, H.(2005). *Developing siblings and peer tutors to assist native Taiwanese children in learning Habits of Mind for math success" , Ph.D. Thesis*, University of Massachusetts Amherst, United states.
- Ibrahim,M.(2006). An effective classroom environment for teaching students with learning disabilities in solving a mathematical problem. *The 6th scientific conference of the Egyptian Society for Mathematical Trials (contemporary approaches to developing mathematics education and learning)*, faculty members club at Benha University, from ( 19-20) July, 15-37.
- Kamal,M.(2014). The effectiveness of a training unit in the Habits of Mind in develop mathematical achievement , creative thinking, and attitude toward the training unit and toward the mathematics. *Journal of Arab studies in education and Psychology*,(48),100-162.
- Kreizel , M. & Lincoln , E. (2006) . *Developing Habits of Mind .A report on an action research project submitted in partial fulfillment of the requirements for participation in the Math in the Middle Institute:* University of Nebraska-Lincoln.
- Mahdy,H.(2006).*Effectiveness of using education program on visual thinking and the achievement in technology of the 11th grade female students*. Master Thesis, Faculty of Education , The Islamic University–Gaza.
- Mahmoud,B.(2017).The effect of the use of mind maps in the development of mathematical correlations skills and visual thinking skills. *Journal of Educational and Psychological Sciences*, Qassim Univeristy,10(3),805-849.
- Marshal,R.(2004). *High school mathematics Habits of Mind instruction: Students growth and development . Master of Science in Education*, Education Department, Ivlinnesota State University.
- Mohamed,A.(2006). The effectiveness of using visual thinking networks in science to develop cognitive Janah levels and visual thinking skills among middle school students ." *The 10th scientific conference "practical education challenges the present - and visions of the future"*, the Egyptian Society for Scientific Education, Faculty of Education, Ain Shams University.
- Naofal, M. (2010).*Practical applications in developing thinking using habits of reason.2nd edition*, Amman: Al Massira House for Publishing and Distribution.
- Rayane,A.(2012).*The impact of enrichment program based on some Habits of Mind on the creative thinking and mathematical power of the middle grade students in Makkah almokaramah .Ph.D. Thesis*, Faculty of Education, Umm Al Qura University.
- Shath,N.(2009). *Enriching the content of the 10<sup>th</sup> grade spatial geometry unit in the light of the visual thinking skills*. Master Thesis ,Faculty of Education, The Islamic University–Gaza.
- Strahy, M. (2011).A course in engineering based on integration with the Egyptian artistic and architectural heritage to develop engineering visual thinking and awareness of the identity of Egyptian mathematics and

the national values of middle school students. **Journal of Studies in Curricula and Teaching Methods, Faculty of Education, Ain Shams University,(170),105-155.**

Yousef,E.(2012). Effectiveness of using mind map in developing imaginative thinking and some Habits of Mind for the preparatory stage students. *Scientific Journal, Faculty of Education ,Elwady Elgdid, Assiut University.*

Zaghlol ,M.(2015). *The effectiveness based on the simulation computer program in the development of the skills of visual thinking among students learning disabled mathematics primary school. Master Thesis, Faculty of Education, Port Said University.*