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Effect of the Van Hiele Model in Geometric Concepts Acquisition: The Attitudes towards Geometry and Learning Transfer Effect of the First Three Grades Students in Jordan

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Abstract

This study aimed to investigate the Effect of the van Hiele model in Geometric Concepts Acquisition, and the attitudes towards Geometry and learning transfer of the first three grades students in Jordan. Participants of the study consisted of 60 students from the third grade primary school students from the First Directorate, Amman, in the academic year (2015-2016) and they were divided randomly into a control group and an experimental group. To achieve the objectives of the study, the teacher's guide was prepared for the unit of Engineering and Statistics "taken from the text book of Mathematics of the third grade in accordance with the model of the Hill, and the preparation of test engineering concepts which consisted of 17 questions of multiple choice, in addition to the scale of attitudes towards engineering and test learning transfer effect. Data were analyzed using ANCOVA and results were as follows: there are significant differences between the average performance of each of the two groups of the study on the scale of Geometric Concepts acquisition in favor of the experimental group taught by using the van Hiele model. And there are significant differences between the average performance of the two groups on a scale of attitudes towards geometry in favor of the experimental group taught by the van Hiele model. There are significant differences between the average performance of each of the two groups on the learning transfer test in favor of the group taught by the van Hiele model.

Keywords: Van Hiele model, first three grades, geometric concepts acquisition, attitudes towards geometry, learning transfer

1. Introduction

One of the basic goals of teaching mathematics is to improve the students' geometric thinking levels. Geometric thinking is important in many scientific, technological and professional subjects (Olkun, Sinoplu, & Deryakulu, 2005). Some studies have pointed to the significant role of the teaching method in developing geometric thinking skills (Ghneim, 2012). The criteria of the Math curricula of the different educational levels which stemmed from the National Council of Teachers of Mathematics for the different stages and the National Council of Teachers of Mathematics in the USA emphasized the importance of having students being able to describe the geometric shapes, analyze their characteristics, and make a comparison between the geometric systems (NCTM, 2000).

The scholars paid much attention to the concepts as learning them is considered a very important educational goal in all levels of learning because they provide the learner with organized cognitive structure that could be used to distinguish new examples and interpret new situations related to them. Moreover, some educationists, such as Khalifa (1999), Al-Khateb (2011) and Al-Mashdani (2011), harped on the necessity of taking care of the concepts and focusing on the concept formation process through integration of teaching the Math concept starting from the abstract phase that represents the common characteristics that distinguish the concept's elements, followed by the generalization phase where the new elements are highlighted, till the discrimination phase where the students can distinguish between the concept's elements. Despite the importance of Mathematical geometry, learning it faces many difficulties.

Studies such as Esawi's (2000) showed 15 difficulties in the unit of rectangular geometry, 16 in the unit of circle geometry and 24 in the unit of transformation geometry of the third preparatory grade students. Ismael (1998) pointed out that geometry is one of the difficult branches of Math facing the students and this difficulty refers to

the lack of geometric concepts acquisition.

Learning transfer effect is one of the most important issues in education because learning transfer is one of the goals of the Ministry of Education of Jordan and one of the most important goals of the modern methods of teaching. Learning transfer effect has many definitions such as: the individual's learning in a situation or an activity that affects his capability to behave in other situations or to do any kind of activities.

Developing the right attitudes towards Math, which is one of the emotional goals that hopefully could be achieved in the educational process, is not less important than the skill and cognitive aspects. To achieve the skill and cognitive goals, the students should have positive attitudes towards studying Math. To develop the right attitudes towards geometry, the student has to know that Math as a vital subject develops continuously and he should appreciate the social and civil role of the geometric knowledge and its effect in the nation's progress and the development of the student's appreciation of the beauty in Math, in addition to the opportunities it provides to enjoy Math through studying patterns and different geometric shapes. The teacher has a major role in developing positive attitudes towards the study of Math by presenting it using a method that the students can understand. He needs to be sure of the students' readiness to know more concerning the subjects. Moreover, the needs to use methods that allow the students to discuss, explore and take part in competitions as well as reading and writing articles.

One of the theories that helps greatly and effectively in teaching geometry is van Hiele which attracted scholars and educationists' attention the world over because it helps effectively in teaching geometry to the students through the school stages. The van Hiele model which emerged from this theory includes five phases which are: information, directed orientation, explication, free orientation where students are involved in tasks relying on themselves, and integration when the students summarize materials learned from activities (Mistretta, 2000).

The van Hiele model is considered one of the most important models in teaching geometry and the geometric concepts and thoughts are developed through five phases within an educational program. These phases represent the development of the thinking process in geometry in addition to the geometric knowledge acquisition. The progress in the student's thinking leads him to summarize what he learned and employ it in his daily life activities (Tall & Pegg, 2005). According to van Hiele, the five phases of geometric thinking are Visualization, Analysis, Abstraction, Deduction and Rigor (Groth, 2005).

The model of van Hiele which organized the students' learning phases of geometry subjects in a sequential system are as follows (Abdgadr, 2002; van Hiele, 1999 & Mason, 1995).

Information: The start of the teaching of subjects that help the students to discover specific structures and the teacher can ask the students some questions to know what they knew and attract their attention to the information that should be learnt. For example, the teacher can ask: What is a square? Rectangle? What are the similarities between these forms? The teacher's goal is to help the students to know and identify the whole image of these geometric shapes.

Directed orientation: Structured activities presented to students to help them recognize and verbalize their understanding of the new geometric concepts which were introduced in the information phase.

Explication: The students are engaged in verbalizing their understanding of the geometric concepts that they have observed and they take part in discussions for the purpose of exchanging ideas.

Free orientation: The students end their tasks in different ways and they acquire experience relying on themselves. Whenever they face difficulty, they can ask the teacher for help.

Integration: The students can summarize and make a link between what they have learnt and come up with some new conclusions.

Learning geometry is not easy and many students fail in developing the appropriate understanding of geometric concepts and in acquiring the geometric problem solving skills. Idris (2009) attributed this failure to the students' weakness in geometric thinking and the teachers' failure to use effective and appropriate teaching methods that can help them overcome the difficulty of teaching geometry. Because of the importance of methods of teaching in acquiring and learning concepts, the teacher has to be aware of effective teaching methods that are aimed at increasing the educationists' awareness of the students' learning process and supplying them with ways that help the students to acquire the concepts and to give them the chance to take part in the teaching process as well.

1.1 Problem & Questions of the Studies

Based on her experience, the researcher noticed weaknesses in the students' geometric concepts, their negative attitudes towards the geometric concepts, and their weakness in dealing with these concepts in their daily life.

Teachers of geometric courses face difficulties in teaching Geometry Unit. And based on the field teachers' feedback, it was clear that there was weakness in the geometry subjects.

Some studies, such as those by Todri (2004) and Ghnem (2012), pointed to the students' weakness in geometric thinking in all the school levels because of the teaching practices which are away from the modern trends in teaching geometry which focus on developing thinking skills and the geometric sense and linking the geometric structure with the students' status and their experiences which in turns negatively affects learning transfer. Results of the national exams of quality control which were carried out in Jordan showed that performance of 82% of the students in the geometry field was moderate and that of 60% was lower than moderate (Ministry of Education, 2008). And this was totally clear in the international studies which were conducted in the years 1998, 1999, 2003, 2004, 2006 and 2007 (National Center of Human Resources Development, 2000). The results of the International Trends in Mathematics and Science Study (2011) showed a fall in Jordan's rank in Mathematics internationally and nationally compared with the year 2007.

Additionally, the Program for International Student Assessment (PISA) showed that Jordan was in rank 51 internationally in Mathematics which is an indication of real weakness in Math which geometry is a basic component of (National Center of Human Resources Management, 2012).

After addressing van Hiele's levels of geometric thinking, some geometric difficulties were solved. Van Hiele assured that every level of geometric thinking has its own language which can be understood by the students and the difficulties of learning geometry which cause achievement weakness and understanding difficulty are attributed to the teachers' language of presenting the concepts which is higher than the students' linguistic level. In other words, the language used in teaching geometry is an important factor which van Hiele called "Linguistic barrier" (Fuys, 1985, p. 52).

There are appropriate methods used to explain the lessons through the use of suitable scientific language to overcome the linguistic barrier. Based on this, it is important to use certain teaching methods for the first three grade students. Accordingly, there is a need to adopt modern teaching methods to deal with this weakness and improve the students' levels and so this study aimed to investigate the effect of using the van Hiele model in the first three grades students' geometric concepts acquisition and the attitudes towards geometry and language transfer in Mathematics.

1.2 The Study's Problem Is Represented by the Following Questions

First question: What is the impact of using van Hiele in teaching on the first three grades students' geometric concepts acquisition in Jordan?

Second question: What is the impact of using van Hiele in teaching on the first three grades students' attitudes towards geometry in Jordan?

Third question: What is the impact of using van Hiele in teaching on the first three grades students' learning transfer in Jordan?

Fourth question: Is there a relationship between geometric concepts acquisition and learning transfer?

1.3 Significance of the Study

The theoretical significance of the study stemmed from the following fields:

- The significance of geometry in developing and acquiring the geometric concepts and effectively employing knowledge in all the fields of geometry which students need in all the school stages. Additionally, geometry plays a major role in supplying the student with methods and daily life skills in addition to developing his spatial sense and geometric reasoning (Sellke, 1999) which accordingly helps learning transfer and the development of the right attitudes towards geometry from the early stages.

1.4 Application Significance

The practical significance of the study stemmed from the following:

1) This study may help in improving the first three grade students' acquisition of geometric concepts.
2) It helps the teachers of the first three grades to follow modern teaching methods in teaching geometry based on the van Hiele model and its application in the classroom.
3) It may lead to other similar field studies in the same areas for different school stages.

1.5 Procedural Definitions

- Van Hiele model: It is a model designed by Pierre van Hiele and his wife Dina van Hiele. It consists of

three domains: levels of the model, characteristics of the model and the learning phases of the model. The model consists of five phases arranged hierarchically from the simple to the complex (Visualization, Analysis, Abstraction, Deduction and Rigor).

The student cannot get to the next level unless he got the previous one right. This model is interested in teaching geometry according to educational strategy consisting of five phases started by presenting information and ended by integration when the student summarizes what he has learned and links it with his cognitive structure.

Conventional method: It is a set of common processes and procedures used by Math teachers where the student is a receiver and the teacher is the core of the teaching and learning process. The teacher, according to this method, relies heavily on lecturing, asking questions and writing on the board to clarify major points. The textbook is the source of knowledge and the teacher prepares a daily plan that helps him to transfer information to the students.

Learning Transfer: This is the extent to which the learner retains the concepts which he studied three weeks ago and it is measured by the scientific concepts achievement test (Gasem, 2000).

The researcher defined it: This is the learner's degree of retention of the information, skills and geometric concepts which will be studied using the van Hiele model in geometry unit in the Math textbook of the third grade within four weeks and it is measured by an achievement test.

Geometric concepts acquisition: This is the students' learning of the concepts mentioned in the geometry unit in the Math textbook of the third grade. In this study it refers to the concepts concerning the concepts included in the geometry unit in the textbook of the third grade.

Attitudes towards geometry: This is the students' feeling of enjoyment and relaxation during geometry class, his interest of the activities, his realization of the importance of this subject, and his love towards the teacher. In this study this attitude is measured by total degree that the students achieved in the scale of attitudes towards geometry. Also, it can be defined as the first three grades students' emotional and mental readiness created during the study of geometry units using the van Hiele model which in turn develops their attitudes towards geometry and its nature and their appreciation to the teacher's role in teaching geometry.

The first three grades: It is the stage that includes the first, second and third school grades.

The study is limited to the following:

- Spatial and human resources: The study's results are limited to students of the third grade in Jordan.
- Time: The results of this study are limited to the period of time when this study was conducted which was in the first semester for the academic year 2014-2015.

2. Theoretical Frame and Previous Studies

One of the most important subjects which the Math curricula include is geometry. Geometry is a necessity because it provides us with the basic skills used in practical life and helps us to develop spatial sense and geometric reasoning (Al-Wehbi, 2004). Erdogan (2009) assured of the importance of geometry as it enables the students to acquire the basic skills that help them to deal with their environment and this asserted geometry's role in learning transfer.

Teachers face difficulty in teaching geometry because of the nature of geometry and the nature of the learner and his attitude towards it. Nevertheless, studies concerning this aspect in our society are few and, therefore, more studies should be carried out about it (Al-Hazaima, 2004).

Abo Zeina (2003) believes that Modern Math is not just ordinary operations or separated skills but it is a well-organized structure with strong relations forming an integrated structure and the components of this structure are the Math concepts.

The study of Al-Bayati (2010) aimed to identify the effect of using the Klausmeier Model in fifth grade students' acquisition and retention of Math concepts. The participants in the study consisted of 63 students selected randomly from two sections and assigned into groups: experimental 32 and control (31). The researcher prepared an achievement test. Results showed the experimental group's superiority in achievement test of Math concepts.

Madah's (2009) study was aimed at identifying the effect of active learning on the fifth grade female elementary students' achievement of some geometric concepts and attitudes towards Math in Makha Mokrama. The sample of the study which consisted of 60 female students was selected randomly and assigned into groups: experimental (30), taught by active learning method and control (30), taught conventionally. The researchers prepared geometric concepts test and used a scale to measure the attitudes towards Math. Results showed

statistically significant differences between means of the degrees of the experimental group and the control in the post test of the geometric concepts test in favor of the experimental group. Moreover, there were statistically significant differences in the participants' responses in the post application of the scale of attitudes towards Math between the two groups in favor of the experimental group and there was a statistical correlation between the achievement and attitudes towards Math.

Mousley and Perry (2009) conducted a study aimed at developing Math concepts in preschool children through the use of interactive activities that enhance the development of Math concepts. The sample of the study consisted of children aged 5 to 8. The researchers used interview and video records to collect data. Results revealed that the children had the capability to learn Math concepts through play and to overcome their ignorance in learning math concepts in early stages. Additionally, developing math concepts in early stages (less than 4 years old) is possible.

Bang (1994) conducted a study aimed at examining the use of the van Hiele model in the teaching of non-Euclidean geometry to prospective elementary school teachers in Taiwan. The sample of the study which consisted of the elementary stage students was assigned into groups: experimental, taught by the van Hiele model with the five stages, and control, taught the using lecture method. Results revealed that van Hiele model was more effective than lecturing in developing geometric thinking and achievement.

Alabsi (2006) conducted a study aimed at identifying the impact of training the basic seventh grade's Math teachers on the geometric thinking levels of the students and their achievement in geometry and development in their geometric thinking levels and their attitudes towards geometry. The study was applied on a sample consisting of 64 students from Dobian Basic School in Amman. Results showed statistically significant differences in the geometric thinking levels and the attitudes towards geometry in favor of the experimental group.

Ghnem's (2012) study was aimed at investigating the effect of teaching geometry using the van Hiele model on the ninth grade students' achievement and critical thinking in Jordan. The sample of the study which consisted of ninth basic grade students was assigned to two groups: experimental and control. Results showed statistically significant differences in achievement and critical thinking.

Based on what has been mentioned, the following can be noted.

There are no studies examining the effect of the van Hiele model in learning transfer and all the studies use this model were applied in the schools. To the researcher's knowledge, there are no studies addressing the basic stage levels. Moreover, there are no studies examining the effect of the van Hiele model in developing attitudes towards geometry and learning transfer in any school stage in Jordan or the wider Arab world.

So this study aims to examine the effect of teaching using the van Hiele in the first three grades students' geometric concepts acquisition and the attitudes towards geometry and learning transfer in Math.

3. Methodology

3.1 Population and Sample of the Study

The sample of the study which consisted of 60 male and female students was chosen randomly and assigned into groups: The experimental group (32) taught by the van Hiele model and the control group (28) taught conventionally.

3.2 Groups Equivalence

The geometric thinking skills, the scale of attitudes towards geometry and the learning transfer test were applied before starting the application of the study. The means and standard deviations were calculated and their results showed the absence of statistically significant differences between the groups at level of significance (0.05) between the means of the students' grades in the test as a whole which indicates the two group's equivalence.

3.3 The Study's Instruments

To achieve the study's goals, the researcher prepared the following instruments.

1) Geometric thinking test
2) Attitudes towards geometry scale
3) Learning transfer test

Geometric thinking test:

The test was prepared after the content of the geometry unit in a Math textbook published in 2015 for the third

grade was analyzed. The researcher had the benefit of previous studies, such as those by Jawad (2012) and Waston (2012), to help her build the test. There was a review of the good conditions of the test specifications in terms of validity and reliability, time and transaction difficulty, discrimination, organization and FAQ. There was a determination of the objective of the test, which measured the question of geometric concepts. The researcher had the benefit of previous studies, such as those by Jawad (2012) and Cononiah Waston (2012), to build the test.

Test's validity:

To check the test's validity, it was presented to a group of arbitrators made up of university professors, whose views were taken into account; two questions, the eighteenth and nineteenth, were deleted and some questions, the fifth and sixth, were modified; there was more than one opinion about modifying the engineering drawing in these questions to suit the age group of third grade of primary school; there were some grammatical errors in the first, fourth, fifth and ninth questions, which have been corrected; some other paragraphs have been reformulated. Final test consisted of 17 multiple-choice questions and each question carried one mark.

Time test application:

The researcher determines the amount of time required to answer all the paragraphs of the test by creating the arithmetic average from the period of time that it took fourteen students from the exploratory sample members. The fastest seven students Seven students in terms of duration that Astgrkoha in answer paragraphs of the test and the slowest him select the appropriate time for the test (35 minutes).

Test's reliability:

To check the test's reliability, it was applied on an exploratory sample out of the sample of the study. The internal consistency was calculated using Chronback Alpha and its value was 82.0 which are accepted for the purposes of this study.

Scale of the attitudes towards geometry:

After reviewing related literature and previous studies, the researcher prepared attitudes scale consisting of 23 items distributed as follows:

Table 1. Items number of attitudes towards geometry

Attitude dimensions	Items n
Nature of geometry	5-1
Attitude towards geometry value	9-6
Attitudes towards learning geometry	16-10
Attitudes towards teacher's role in teaching geometry	21-17
Attitudes towards enjoying geometry	27-22

Validity of scale of attitudes towards geometry:

To achieve the scale validity, it was presented to a group of arbitrators whose views concerning the items on the scale were taken into account and therefore some items were deleted and the final number of the items was 20 distributed to the following dimensions: geometry nature, geometry value, learning geometry and enjoying geometry.

Reliability of the attitudes scale towards geometry:

To achieve the reliability of the scale, the researcher applied it on an exploratory sample consisting of 30 students and the Cronbach's alpha coefficient was calculated. The reliability coefficient was 82% which is an indication to the scale's high reliability.

Test of learning transfer effect:

The researcher prepared a test of learning transfer in Math subject in the geometry unit. It consisted of nine questions but after it was presented to a group of arbitrators, they became five questions with two marks for each one.

The test's reliability:

To check the test's reliability, the internal consistency of an exploratory sample consisting of 25 students was

calculated and the test' items were analyzed using Kuder-Richardson-20 and the reliability coefficient value was 86% which showed a high degree of reliability.

4. Results

Based on its questions, the study came up with the following results.

First question: What is the impact of using van Hiele in teaching on the first three grades students' geometric concepts acquisition in Jordan?

To answer this question, the means and the standard deviation of the experimental and control groups' performance in the test of concepts acquisition were calculated as it is illustrated in Table 2.

Table 2. Means and standard deviations of the groups' performance in the geometric concepts acquisition test (method of teaching)

Group	N	Pre		Post	
		M	Std	M	Std
Control	28	8.14	2.51	11.64	2.26
Experimental	31	8.74	2.89	14.58	1.46
Total	59	8.46	2.71	13.19	2.38

It is noted from the previous table that the means of the study's control experimental group's participants' performance in the concepts' test was 14.58 whereas the means of the control group's participants' performance was 11.64.

To find out whether these differences between the means were significant at the level of significance (a = 0.05), ANCOVA analysis was used and the following table illustrates this.

Table 3. ANCOVA of the two groups' performance in the geometry concepts acquisition test (method of teaching)

Source of variance	Sum of seq.	Fd	Means of seq	F	Sig.	$^2\eta$
Pre	8.321	1	8.321	2.406	0.126	
Method of teaching	118.293	1	118.293	34.207	0.000	0.379
Error	193.656	56	3.458			
Adjusted total	328.949	58				

It is noted from Table 3 that the F value is 34.207, indicating statistically significant differences at the level of significance (0.000) between means of the two groups' performance in the geometric concepts acquisition attributed to the teaching method and so the null hypothesis is rejected thus: "There are no statistically significant differences at ($0 \leq 0.05$) in the first three grades students' acquisition of the geometric concepts in Jordan attributable to the method of teaching." To find out the significance of the differences, the adjusted means and standard deviations for the groups' performance in the geometric concepts acquisition test were calculated and the following table illustrates this.

Table 4. The adjusted means and the standard errors of the two groups' performance in the geometric concepts acquisition test (method of teaching)

Group	Adjusted mean	Standard error
Conventional	11.69	0.35
Experimental	14.54	0.34

It is noted that the adjusted mean of the participants' performance in the geometric concepts acquisition test was 14.54 for the experimental group taught by the van Hiele model whereas it was 11.69 for the control group that was taught conventionally. Results showed that the differences were in favor of the experimental group.

Second question: What is the impact of using van Hiele in teaching on the first three grades students' attitudes towards geometry in Jordan?

To answer this question, the means and standard deviation of the students' performance in the scale of attitudes towards geometry (teaching method) were calculated as it is illustrated in Table 5.

Table 5. Means and standard deviation of the students' performance in the scale of attitudes towards geometry

Group	N	Pre		Post	
		M	Std	M	Std
Control	28	45.96	16.41	59.21	8.79
Experimental	31	49.03	12.70	80.55	6.43
Total	59	47.58	14.53	70.42	13.15

It is noted from the previous table that the mean of the participants' performance in the attitudes scale towards geometry was 80.55 for the experimental group taught by van Hiele while it was 59.21 for the control group taught conventionally. And to know whether these differences between the means were significant at the level of significance (a=0.05), ANCOVA was used as it is illustrated in Table 6.

Table 6. ANCOVA analysis of the groups' performance in the scale of attitudes towards geometry

Source of variance	Sum of seq.	Fd	Means of seq	F	Sig.	$^2\eta$
Pre	25.414	1	25.414	0.431	0.514	
Method of teaching	6533.335	1	6533.335	110.836	0.000	0.664
Error	3300.978	56	58.946			
Adjusted total	10022.41	58				

It is noted from Table 6 that the F value is 110.836, indicating statistically significant differences at the level of significance (0.000) between means of the two groups' performance in the scale of students' attitudes towards geometry attributable to the teaching method and so the null hypothesis is rejected thus: "There are no statistically significant differences at $0 \leq 0.05$ in the first three grades students' attitudes towards geometry in Jordan attributable to the method of teaching. To find out the significance of the differences, the adjusted means and standard deviations for the groups' performance in the scale of attitudes towards geometry were calculated and the following table illustrates this.

Table 7. Adjusted means and the standard errors of the groups' performance in the scale of attitudes towards geometry (teaching method)

Group	Adjusted mean	Standard error
Conventional	59.29	1.46
Experimental	80.48	1.38

It is noted from Table 7 that the adjusted mean of the experimental group's participants' performance in the scale of students' attitudes towards geometry who used van Hiele was 80.48 while the mean of the control group's performance was 59.29, indicating that the difference was in favor of the experimental group.

Third question: What is the impact of using van Hiele in teaching on the first three grades students' learning transfer in Jordan?

To answer this question, the means and standard deviation of the students' performance in the learning transfer effect test (teaching method) were calculated as it is illustrated in Table 8.

Table 8. Means and standard deviation of the students' performance in the learning transfer effect test (teaching method)

Group	N	Pre		Post	
		M	Std	M	Std
Control	28	3.29	0.81	4.89	1.37
Experimental	31	4.23	1.33	7.23	1.33
Total	59	3.78	1.20	6.12	1.78

It is noted from the previous table that the mean was 7.23 for the experimental group's participants' performance and 4.89 for the control group's participants' performance in the learning transfer test. To find out if these differences in the means are significant at the level of significance (a=0.05), ANCOVA was used as it is illustrated in the following table.

Table 9. ANCOVA results of the groups' performance in the test of learning transfer effect (method of teaching)

Source of variance	Sum of seq.	Fd	Means of seq	F	Sig.	$^2\eta$
Pre	26.329	1	26.329	18.959	0.000	
Method of teaching	38.573	1	38.573	27.776	0.000	0.332
Error	77.769	56	1.389			
Adjusted total	184.169	58				

It is noted from Table 9 that the F value is 34.207, indicating statistically significant differences at the level of significance (0.000) between means of the two groups' performance in the learning transfer test attributable to the teaching method and so the null hypothesis is rejected thus: "There are no statistically significant differences at $0 \leq 0.05$ in the first three grades students' learning transfer in Jordan attributable to the method of teaching. To find out the significance of the differences, the adjusted means and standard deviations for the groups' performance in the learning transfer test were calculated and the following table illustrates this.

Table 10. Adjusted means and standard errors of the groups' performance in the test of learning transfer effect

Group	Adjusted mean	Standard error
Conventional	5.19	0.23
Experimental	6.95	0.22

It is noted from Table 10 that the adjusted mean of the experimental group's participants' performance in learning transfer test was 6.95 while the mean of the control group's performance was 5.19, indicating that the difference was in favor of the experimental group.

Fourth question: Is there a relationship between geometric concepts acquisition and learning transfer?

To answer this question, the correlation between geometric thinking skills and learning transfer was calculated using Pearson correlation coefficient and the following table illustrates the results.

Table 11. Pearson correlation coefficient between the geometric concepts acquisition and learning transfer effect

Test		Learning transfer
Geometric thinking	Correlation coefficient	0.580**
	Sig.	0.000

**sig(a=0.05).

As the previous table illustrated, there is a positive statistical relationship at the level of significance (a≤580) between geometric concepts acquisition and learning transfer as the correlation coefficient was 0.580 at level of significance (0.000). This value is acceptable for the purpose of this study.

5. Discussion

Concerning the first question, results showed statistically significant differences at the level of significance (a=0.05) between the means of the participants in the geometric concepts acquisition attributable to the method of teaching in favor of the experimental group which was taught by the van Hiele model. It seems that presenting information as the first procedure in the teaching process is the conceptual basis which learning relies on. Additionally, the mathematical ideas are accumulative and depend on each other which in turn enhance the geometric concepts acquisition and the students' ability to strengthen and enhance the geometric concepts using idioms, symbols and drawing geometric shapes through the van Hiele model's components. Learning according to the van Hiele model is meaningful learning based on understanding and linking the ideas and this is compatible with what Ausubel stated and this result agrees with the studies of Mousley and Perry (2009), Ghnem (2012), Madah (2009) and Bayati (2010).

Results concerning the second question revealed statistically significant differences at the level of significance (a=0.05) between the participants' performance in the scientific attitudes scale in favor of the experimental group taught by the van Hiele model. This result indicates that teaching using the van Hiele model improves thinking, giving the students the opportunity to discuss and justify their opinions. So it helps the students to express their views without feeling embarrassed by attracting their attention and enhancing their motivation towards looking for appropriate solutions. As a result, a positive educational environment has been created where the students' self-confidence has increased enough to enable them take part in discussion and to learn and search for information. Consequently, the students' scientific attitudes were improved (Madah, 2009).

Results of the third question showed statistically significant differences at the level of significance (a=0.05) between the participants' performance in learning transfer test in favor of the experimental group taught by the van Hiele model. This result may be due to the effect of the last level of the van Hiele model which allows the student to summarize what he learnt and link it with his cognitive structure which enhances his capability to employ the new knowledge in daily situations which is called learning transfer.

Results of the fourth question showed significant relationship statistically positive at α=0.05 between the geometric concepts acquisition and the learning transfer test, reaching the correlation coefficient (0.580) and the level of significance (0.000) by using the Pearson correlation coefficient. It can be inferred from this result that students' acquisition of the concepts of engineering reflects the positive impact on the students and their ability to use it in other situations in their lives.

6. Recommendations and Suggestions

In light of the results which showed the positive effects of the van Hiele model in the geometric concepts acquisition, the scientific attitudes development, and learning transfer effect, this study recommends the following.

1) It is necessary to follow the methods of teaching Math that help the students to implement the geometric tasks fast and accurately and with a high degree of motivation in addition to employing it in new situations to enhance learning transfer effect.
2) Avoid giving the students the ready answer; rather, the students should be guided to look for these solutions and answers within a secure and educationally sound environment to develop the scientific attitudes and the scientist's behavior.
3) Carry out further studies in the field of geometry on different school stages with higher numbers of participants.

4) Get the benefit of the teacher guide book which the researcher prepared for this goal and generalize it on the teachers of geometry in the colleges in order to prepare school plans according to the van Hiele model.

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