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Predicting the Geometry Knowledge of Pre-Service Elementary Teachers

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Abstract
In this study, the aim was to examine the factors that predict the geometry knowledge of pre-service elementary teachers. Data was collected on 387 pre-service elementary teachers from four universities by using a geometry knowledge test, the van Hiele geometric thinking level test, a geometry self efficacy scale and a geometry attitude scale. Correlation analyses which were carried out between the geometry knowledge score and all predictor variables revealed that the relationships between all predictors and geometry knowledge were statistically significant. Furthermore, the findings from the regression analyses showed that a combination of the variables of van Hiele geometric thinking level, geometry self efficacy and attitude towards geometry was able to predicts geometry knowledge significantly.
Keywords: Geometry Knowledge, Van Hiele Geometric Thinking Level, Geometry Self Efficacy, Attitude toward Geometry

Özet
Bu çalışmanın amacı sınıf öğretmeni adaylarının geometri bilgilerini yordayan faktörleri belirlemektir. Araştırmanın verileri dört farklı üniversitede son sınıfta okumakta olan 387 sınıf öğretmeni adayından, geometri bilgisi testi, van Hiele Geometrik düşünme testi, geometriye yönelik öz yeterlik ölçeği ve geometriye yönelik tutum ölçeği kullanılarak toplanmıştır. Veri analizleri öğretmen adaylarının geometri bilgisi ve öngörülen her bir yordayıcı faktör arasında hesaplanan korelasyon değerlerinin istatistiksel olarak anlamlı olduğunu ortaya koymaktadır. Bununla birlikte gerçekleştirilen regresyon analizi geometrik düşünme düzeyleri, geometriye yönelik özyeterlik ve geometri tutum puanlarının öğretmen adaylarının geometri bilgisi puanlarını istatistiksel olarak anlamlı bir şekilde yordayabildiğini göstermiştir.
Anahtar Kelimeler: Geometri Bilgisi, Van Hiele Geometric Düşünme Düzeyleri, Geometriye Yönelik Öz Yeterlik, Geometriye Yönelik Tutum

INTRODUCTION

Understanding geometry has special importance compared to understanding of any other areas of the mathematics since geometry is useful in order to develop visualization, reasoning abilities, and appreciation of the nature (NCTM, 2000). To understand and interpret the world every one- from farmer to geometrician- needs some geometry knowledge. Atiyah (2001, p658) indicated that "*geometry is actually such a powerful part of mathematics – not only for things that are obviously geometrical, but even for things that are not*". To sketch a draft of a building into 2-dimensional form in a profession or to interpret floor plan of an shopping mall, to organize a desktop in daily life one need some geometrical understanding. In reality however, it is widely known that students' performance in geometry is lower than in any other areas of the mathematics. For example, in TIMMS 1999 (In the Third International Mathematics and Science Study) Turkish students got the lowest mean scores from the geometry part of the test comparing to other four content areas of fractions and number sense; measurement; data representation, analysis and probability; and algebra (Mullis, Martin, Gonzalez, Gregory, Garden, O'Connor, Chrostowski, & Smith, 2000). This point can lead one to think about teacher geometry knowledge since the commonly-held view is that a teacher's mathematical content knowledge influences in turn what a student understands in mathematics.

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Teachers' mathematical content knowledge has been an area of research interest for some time. According to Shulman (1987:8-9) "an effective teacher should have different kinds of knowledge including content knowledge (the knowledge about the subject matter they are teaching), pedagogical content knowledge (knowledge of specific strategies for teaching a particular subject matter), and curricular knowledge (knowledge of the materials and media with which instruction and assessment are carried out). Among these, content knowledge is the base upon which the other two are built.

In the case of geometry, the teaching and learning of the content has been the subject of considerable interest worldwide. Previous studies have shown that pre-service teachers do not have the necessary geometry knowledge required of them (Cunningham & Roberts; 2010; Fuys, et al., 1988; Gutierrez & Jaime, 1999; Mayberry, 1983; Saads & Davis, 1997; Van der Sandt & Nieuwoudt, 2003). Hence there is an urgent need for a change in this area since ''many younger teachers these days have had a poor training in geometry both at school and at the teacher training colleges'' (Lundsgaard, 1998, p. 236).

As mentioned earlier mathematical knowledge is an absolute must in order to offer effective teaching of the subject. However, it is distinguished that effective mathematics teaching is a more complex issue than a mere understanding of mathematical knowledge (Ball, 2000). It also can be affected some other characteristics such as efficacy, attitude or thinking skills.

CONCEPTUAL FRAMEWORK

Self-efficacy:

Although predicting geometry knowledge requires emphasizing the cognitive domain, some affective characteristics like attitude, motivation, confidence, self efficacy etc., which are all highly correlated to knowledge, should also be taken into consideration. One of these affective characteristics is self-efficacy which is defined by Bandura (1986, p.391) as "people's judgments' of their capabilities to organize and execute courses of action required in attaining designated types of performances". It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses.

Bandura (1986) proposed that self-efficacy has affects on choice of activity, effort, and persistence. For example a student having a low self efficacy for accomplishing a task may avoid it. On the other hand, the student who believes s/he is capable of doing a task probably works harder persists longer and participates more eagerly in the task. Schunk (1991) claimed that as students gain cognitive and intellectual skills, their self-efficacy towards the subject increases. Increased self-efficacy belief has also been seen to produce higher levels of cognitive performance of children on various tasks. Furthermore a large body of research has shown that a teachers or teacher candidate's self efficacy is related to many factors, like achievement (Chen, 2003; Hackett & Betz, 1989; Kloosterman, 1991), and attitude (Hackett & Betz, 1989).

Attitude

Attitudes can be considered as learned predispositions that consequently affect action. They shape our responses to an objects, or actions, in favorable or unfavorable ways. In this sense, attitudes are linked to both the affective and cognitive domain*. As Shrigley (1983) claimed attitudes are learned, thus, cognition is involved. In other words an attitude is a feeling that results from thought.

Ma and Kishor (1997) offered a definition of attitudes toward mathematics as "an aggregated measure of liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (p. 27). Attitudes toward mathematics are related to the learning of mathematics and to the learning environment in a classroom (Reyes, 1984). If students develop positive attitudes toward mathematics, seeing mathematics as useful and interesting, they in turn, develop positive self-efficacy towards geometry. Likewise, if students develop negative attitudes toward mathematics when they do not do so well or view mathematics as uninteresting they may develop negative self-efficacy towards geometry. The pervasive view is that students learn more effectively when they are interested in what they learn and that do well in mathematics if they like mathematics. However, numerous studies conducted previously concerning the relationship between attitude toward mathematics and mathematics achievement (eg. Aiken, 1976; Davis, 2002; Haladyna, Shaughnessy, & Shaughnessy, 1983; Kulm, 1980; Ma, 1997; Ma & Kishor, 1997; White, 2001) have not produced consistent findings.

Van Hiele Geometric Thinking Levels

Van Hiele (1986) proposed a model that all human beings progresses through five sequential levels namely the visual level, descriptive level, theoretical level, formal logic and the nature of logical laws. Within the first level geometric shapes are identified on the basis of their visual appearance as a whole. At Level 2, one can recognize properties, but properties are not yet logically ordered. At Level 3, properties and relationships previously identified can be related in an informal way. However, at this level, people do not yet understand the intrinsic meaning of deduction (i.e, the role of axioms, definitions, theorems, and their converses). At Level 4, people can understand deduction and the construction of proofs. At the final level, people understand different axiomatic systems. According to this model, progress from one level to the next level depends more on the content and methods of instruction rather than on age or biological maturation. A teaching-learning process is necessary to move students from one level to the next.

Research has documented that preservice elementary teachers are at low levels of geometrical thinking levels (Duatepe, 2000, Fuys, et al., 1988; Mason & Schell, 1988; Mayberry, 1981, Roberts, 1995, Swafford, Jones & Thorton, 1997). Although these researches found that preservice teachers are not high on geometric thinking, no study has yet investigated the predictive value of van Hiele geometric thinking levels on geometry knowledge of pre-service teachers.

Aim and Significance of the Study

In evaluating geometry knowledge; it is worthwhile to examine geometry self efficacy, geometry attitude and geometric thinking levels. A literature review did not reveal any research relating to pre-service teachers' geometry knowledge, geometry self efficacy, geometry attitude and geometric thinking levels. In particular the factors relating to geometry knowledge have not yet been researched. In order to fill this gap, this study aimed to examine those factors which contribute to the geometry knowledge of pre-service elementary teachers. Van Hiele geometric thinking level, geometry attitude and geometry self efficacy were taken as predictor since they were considered as related to geometric knowledge.

This research is important for both practical and empirical reasons. From a practical perspective, a better understanding of teacher candidates' geometry knowledge is critical for the classroom since the teaching of geometry has long been noted for its weaknesses. Identifying both cognitive and affective factors that contribute to geometry knowledge is an important step in efforts to increase their geometry knowledge. Empirically, the factors which comprise geometry knowledge are unknown, since, as yet, there has been no research carried out in this particular area. Results of this study will hopefully contribute to efforts to reform in teacher preparation in this area. In order to improve elementary teachers' geometry knowledge, the first thing we can do is to determine which factors are related to their geometry knowledge.

METHOD

Procedure

Instruments were administered by the researcher to pre-service elementary teachers during one of their courses. The study employed a regression design in order to establish any relationship between the predictor variables of the Van Hiele geometric thinking level test, geometry self-efficacy and the geometry attitude scale test score and the geometry knowledge test score.

Sample

Data for the study was collected from 387 (175 female, 212 male) senior pre-service elementary school teachers from four universities. They are trained to teach courses from grade 1 to 5. Since their last year in teacher preparation curriculum, participants had already taken all required mathematics and teaching mathematics courses. In elementary teacher preparation curriculum they have to take basic mathematics course for two semesters (2 hours a week). Related with geometry, this basic mathematics courses involves basic plane geometry (cube, prism, cylinder, pyramid, cone, etc.), and basic measurement units (length, area, volume weight, time, angle). They also have to take mathematics teaching course for two semesters (3 hours a week) which involve basic geometric concepts; definitions, characteristics and their teaching; basic geometric shapes, constructing of measure and its development.

Instruments

Four instruments used in the study were: the geometry knowledge test, the self efficacy scale toward geometry, the geometry attitude scale and the Van Hiele geometric thinking level test.

Geometry knowledge test (KNW):

The geometry knowledge test comprising 39 multiple choice questions was developed to measure the pre-service teachers' basic geometry knowledge. Items were devised by considering the elementary school curriculum, particularly on the fifth grade geometry curriculum. In other words the questions were at fifth grade-level that means it involves the knowledge that participants were expected to possess. In test construction process questions 45 pilot items were developed by considering the objectives in the National Mathematics Curriculum (MEB, 2005) for the fifth grade geometry. A group of mathematics educators, mathematics and elementary teachers checked these items for the face and content validity by comparing the content of the tests with the objectives. They were also checked the appropriateness, relevance, and conciseness of the questions. Then the test were piloted on 70 preservice elementary teachers to test out the clarity of the questions, to make sure the adequacy of the test duration, to determine the difficulty of the questions, to decide the most suitable questions among the overlapping questions, and to establish the scoring criteria for the responses given to each questions. According to items analyses results and expert suggestions, some revision was made. Finally 39 items were selected. In the final form 12 of items related to quadrilaterals, 14 of them to solids, 4 of them to circle, 4 to polygons, 3 to symmetry, and the remaining 2 to planes. Possible scores for the KNW ranged from 0 to 39. The Cronbach Alpha reliability coefficient was calculated as .98. Specimen items of the geometry knowledge test are displayed in Appendix.

Self-efficacy scale toward geometry (EFF)

The self-efficacy scale toward geometry developed by Cantürk-Günhan and Başer (2007) was used to determine pre-service teachers' geometry self efficacy. This scale consists of 25 items all of which have five response categories as never (1), seldom (2), sometimes (3), frequently (4), always (5). There are three subscales namely Positive Self-efficacy Beliefs (comprising 12 items), Using of Geometrical Knowledge (6 items) and Negative Self-efficacy Beliefs (7 items). Examples of items positive self-efficacy beliefs, using of geometrical knowledge and negative self-efficacy beliefs included, respectively; I can easily understand geometric concepts, I can use my geometry knowledge in the other subjects, I do not have necessary knowledge on geometry. Possible scores on the instrument ranged from 25 to 125. The Cronbach Alpha reliability coefficient was calculated as .76.

Geometry attitude scale (ATT)

To determine pre-service teachers' attitudes toward geometry, an attitude scale developed by Duatepe and Ubuz (2007) was utilized. This scale consisted of 12 Likert-type items with five possible options (strongly disagree, disagree, uncertain, agree, and strongly agree). Motivation and self-confidence components are comprised the scale. Items representing motivation reflected students' pleasure when dealing with geometry and their eagerness to continue thinking about puzzling ideas outside of class. Items representing self-confidence related to any nervousness or tension felt regarding geometry topics and the pre-service teachers' confidence in their ability to learn and perform well on geometry examinations. Negative statements were scored on a 5-point Likert-type scale ranging from 1 (least negative) to 5 (most negative) while positive statements were scored on a 5-point Likert-type scale ranging from 1 (least positive) to 5 (most positive). Examples of items related to motivation components as "I do not like solving geometry problems" and "I do not realize how the time past when I am studying geometry.". Sample items related to self-confidence components are "I feel anxiety in geometry lessons." and "Geometry topics are my most frightened topics in mathematics." The possible scores on this scale ranged from 12 to 60. The scale yielded Cronbach's alpha reliability coefficients of .76 in this study.

Van Hiele geometric thinking level test (VHL)

In order to determine the pre-service teachers' Van Hiele geometric thinking level, a 25-item test developed by Usiskin (1982) was utilized. This test was translated into Turkish during a master thesis study (Duatepe, 2000). In On this test, the first five items, related to identifying polygons, and represent Level 1; the second five items related to the properties of squares, rectangles, diamonds, rhombi, isosceles triangles, and radius and tangents of circles. The next five items represented Level 3 and these items are on ordering the properties of triangles; simple deduction; comprehending hierarchy among squares, rectangles, and parallelograms; and comparing rectangles and parallelograms. The next five items represented Level 4, and the last five items represented Level 5 and are on deduction and the construction of proofs; and different axiomatic, respectively. In scoring, an answer was assigned either 1 (correct) or 0 (incorrect). The possible scores of the VHL ranged from 0 to 25. The Cronbach Alpha reliability coefficient was calculated as .69.

FINDINGS

Descriptive Statistics

Means and standard deviations for each variable are presented in Table 1. As seen in the table mean of the EFF score is 94.08 out of a possible 125 which can be interpreted as high. Similarly the mean of the ATT score is 45.14 out of 60 which is also high. Conversely the VHL and KNW scores were low, which are 11.53(out of 25) and 21.70 (out of 39), respectively.

Table 1: Means and standard deviations of the variables

	Mean	Std. Deviation
KNW	21.70	4.5
VHL	11.53	3.38
EFF	94.17	17.12
ATT	46.07	9.47

Regression Model

To determine whether geometry knowledge accounted for a significant portion of the variation on scores of the Van Hiele geometric thinking level test, geometry self efficacy and geometry attitude scale scores, a sequential regression analysis was performed. Before employing regression analysis, to see relationship between geometry self efficacy and other variables of the study, a correlation analysis was carried out to identify any relationship between geometry self-efficacy and other variables of the study. The result of this analysis is displayed in Table 2.

Table 2: Correlation coefficient between variables

	KNW	VHL	EFF	ATT
KNW	1	.47 (**)	.12(*)	.27(**)
VHL		1	.03	.23(**)
EFF			1	.34(**)
ATT				1

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis revealed that significant relationships existed between geometry knowledge and each of the variables of Van Hiele test and the geometry self-efficacy and the geometry attitude score. Although all values were statistically significant, none of them were above .80. Hence we can say that correlation values indicated no difficulties with multicollinearity (Alpar, 2003). Another way to determine whether the regression model is satisfied multicolliniearity assumption is checking the Variance Inflation Factors (VIF) values. The VIF values from analysis of the scores (see Table IV) were in the acceptable range (lower than 5) as suggested by Tabachnick and Fidell (2001).
By considering the correlation values displayed in Table II, van Hiele geometric thinking levels was entered first into the equation, followed by the geometry attitude scale scores and geometry self efficacy since their correlation coefficient with geometry knowledge were sequenced from greatest to lowest.

Regression Results

Table 3 and Table 4 present the regression analysis result. As the model summary displayed in Table 3 indicates that while van Hiele geometric thinking levels explained 22 % of the variance in geometry self efficacy, the inclusion of geometry attitude in the equation significantly explained 24 % of the variance in geometry self efficacy. Furthermore taking into account all three variables of van Hiele geometric thinking level, geometry self efficacy and geometry attitude, it significantly explains 28 % of the variance in geometry self efficacy.

Table 3: Model summary of regression analysis

Model	R	R^2	Sig. F. Chance	Durbin Watson
1 (only VHL considered)	.47	.22	.000	
2 (both VHL and ATT considered)	.50	.24	.000	2.013
3 (VHL, ATT and EFF considered)	.53	.28	.000	

As the Table 4 outlines, regression analysis using all three significant bivariate predictors (van Hiele geometric thinking level geometry attitude and geometry self efficacy scores) revealed a significant result, $R^2 = 0.28$, $F(3, 385) = 49.3$, $p < 0.001$. Thus we can say that the findings from the regression analysis showed that the combination of geometric thinking level, geometry attitude, and geometry self-efficacy were able to predict geometry knowledge significantly. According to the findings regression equation can be written as; KNW= 11.61+ .546 VHL + .113 ATT + .020 EFF

Table 4: Regression results

	Unstandardized coefficients		Standardized coefficients	T	Sig	VIF
Variables	B	Std. error	Beta			
Constant	11.61	1.07		10.804	.000	
VHL	.546	.060	.410	9.121	.000	1.072
ATT	.113	.023	.237	4.972	.000	1.211
EFF	.020	.005	.186	3.995	.000	1.148

F= 49.3, p<.001; R= .53, R^2 = .28; D-W= 2.013

DISCUSSIONS AND CONCLUSIONS

The present study focused on examining the affective and cognitive factors contributing to the geometry knowledge of a sample of 387 pre-service elementary teachers. Findings revealed that pre-service teachers achieved higher scores on affective tests but they were not as good as they were on cognitive tests. In spite of this, a correlation analysis showed that the relationship between geometry knowledge and all other variables of van Hiele geometric thinking level test, the geometry attitude scale and the geometry self efficacy are significant. This is expected; for a student who has a positive attitude toward mathematics can accomplish more than a student who feels negative towards mathematics (Reyes, 1984). This finding is similar to that of Parsons (1993) who found a strong relationship between the teachers' content knowledge and belief on geometry.

Furthermore, the findings of the sequential regression analysis showed that a combination of all these variables was able to predict geometry knowledge significantly and in particular 28 % of the variation in geometry knowledge can be explained by the cumulative variance of all the predictor variables. This prediction is significant since it means if we want to increase geometry knowledge of the pre-service teacher, we can do so in part by considering their attitudes, self efficacy and geometric thinking levels. More specifically, we can conclude that a combinations of attitude towards geometry, geometry self efficacy and geometric thinking levels provides a useful framework from which to determine elementary school teachers' knowledge of geometry.

Any teacher preparation program intended to enhance pre-service teachers' geometry knowledge should take into account their geometry self efficacy, geometry attitude and geometric thinking levels. Since these three predictors play an important role in geometry knowledge, attention should be given to these predictors, in order to increase teacher candidate geometry knowledge. For example since self efficacy is directly related to personal beliefs that emerge from the interpretation of experience, teacher preparation programs should facilitate students to experience positive geometry learning environments. Moreover; using different techniques we can provide more enjoyable geometry lessons and thereby improve their attitude toward geometry.

REFERENCES

Aiken, L. R. (1976). Update of attitude towards mathematics. *Journal of Educational Research*, 46 (3) 293-311.

Alpar, R. (2003). *Uygulamalı çok değişkenli istatistiksel yöntemlere giriş 1.* Ankara: Nobel Yayınları.

Atiyah, M. (2001). Mathematics in the 20th Century, *American Mathematical Monthly*, *108*(7), 654-666.

Ball D. L. (2000). Bridging practices: Intertwining content and pedagogy in teaching and learning to teach. *Journal of Teacher Education,* 51, 241-247.

Bandura, A. (1986). *Social Foundations of Thoughts and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Cantürk Günhan, B. and Başer, N. (2007). Geometriye Yönelik Öz-Yeterlik Ölçeğinin Geliştirilmesi. *Hacettepe University Journal of Education* 33: 68-76.

Chen, P. (2003). Exploring the accuracy and predictability of the self-efficacy beliefs of seventh-grade mathematics students. *Learning and individual differences*, 14, 79-92.

Cunningham, R. F. and Roberts, A. (2010). Reducing the Mismatch of Geometry Concept Definitions and Concept Images Held by Pre-Service Teachers *IUMPST The Journal,* 1, 1-17.

Davis, B. (2002). Motivating students. Tools for teaching. Retrieved November 19, 2006, from: *http://teaching.berkeley.edu/bgd/motivate.html*

Duatepe, A. (2000). An Investigation on the Relationship between van Hiele Geometric Levels of Thinking and Demographic Variables for Pre-service Elementary School Teachers. Unpublished Master Thesis, Middle East Technical University, Turkey.

Duatepe, A., and Ubuz, B. (2007). Development of a geometry attitude scale. *Academic Exchange Quarterly,* 11 (2), 205–209.

Fuys, D. Geddes, D. and Tischler, R. (1988). The van Hiele model of thinking in geometry among adolescents. Journal for Research in Mathematics Education. Monograph 3 Reston, VA: National Council of Teachers of Mathematics.

Gutierrez, A. & Jaime, A. (1999). Pre-service Primary Teachers' Understanding of the Concept Of Altitude of a Triangle. *Journal of Mathematics Teacher of Education, 2*(3), 253-275.

Hackett, G. and Betz, N., E. (1989). An exploration of the mathematics self-efficacy / mathematics performance correspondence. *Journal for Research Mathematics Education*, 20, 261-273.

Haladyna, T., Shaughnessy, J. & Shaughnessy, M. J. (1983). A causal analysis of attitude toward mathematics. *Journal for Research in Mathematics Education*, 14(1), 19-29.

Kulm, G. (1980). Research on mathematics attitude. In R. J. Shum Way (Ed.), *Research in Mathematics Education* (pp. 356-387). Reston, Va. NCTM.

Kloosterman, P. (1991). Beliefs and achievement in seventh grade mathematics. Focus on Learning Problems in Mathematics, 13 (3), 3-15.

Lundsgaard, V. (1998). General considerations on curricula designs in geometry. In *Perspectives on the teaching of geometry for the 21st century. An ICMI study* . ed. C. Mammana & V. Villani 235-242. Dordrecht: Kluwer Academic Publishers.

Ma, X. (1997). Reciprocal relationships between attitude toward mathematics and achievement in mathematics. *The Journal of Educational Research,* 90 (4), 221-229.

Ma, X. and Kishor N. (1997). Assessing the relationship between attitude toward mathematics and achievement in mathematics: a meta-analysis. *Journal for Research in Mathematics Education,* 28 (1), 26-47.

Mason, M. M., and Schell, V. (1988). Geometric understanding and misconceptions among pre-service and in-service mathematics teachers. In *Proceedings of the tenth annual meeting of the North American Chapter of the International group for the Psychology of*

Mathematics Education M. J. Behr, B. C. Lacampagne, & M. M. Wheeler (Eds.),.290-296. Northern Illinois University.

Mayberry, J.W. (1981). An investigation of the van Hiele levels of geometric thought in undergraduate pre-service teachers. Unpublished Dissertation, Graduate school of University of Georgia

Mayberry, J. W. (1983). The van Hiele levels of geometric thought in undergraduate preservice teachers. *Journal for Research in Mathematics Education*, 14, 58 – 69

MullisIS I. V.S., Martin M. O., Gonzalez E. J., Gregory K. D, Garden R. A., O'Connor K. M., Chrostowski S. J., ve Smith T. A. *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade*, Chestnut Hill, MA, Boston College (2000).

NCTM (2000). *Principles and Standards for School Mathematics.* Reston, Va. NCTM.

Parsons, R. R. (1993). Teacher beliefs and content knowledge: influences on lesson crafting of pre-service teachers during geometry instruction. Unpublished doctoral dissertation, Washington State University.

Reyes, L. H. (1984). Affective variables and mathematics education. *Elementary School Journal,* 84, 558-581

Roberts, S. K. (1995). A study of the relationship between demographic variables and van Hiele level of thinking for pre-service elementary school teachers Unpublished PhD Dissertation, Graduate schools of Wayne State University

Saads, S. and Davis, G. (1997). Spatial abilities, van Hiele levels & language use in three dimensional geometry. In *Proceedings of the 21th PME Conference* 4, 104-111.

Shrigley, R. L. (1983). The attitude concept and science teaching. *Science Education,* 67 849, 425-442.

Shulman L. S. (1987). Knowledge and teaching: foundations of the new reform. *Harvard Educational Review,* 57:1-22.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist*, 26, 207–231.

Swafford, J. O., Jones, G. A., and Thornton, C. A. (1997). Increased knowledge in geometry and instructional practice. *Journal for Research in Mathematics Education*, 28(4), 467-483.

Tabachnick, B.G. and Fidell, L. S. (2001). *Using multivariate statistics* (4th Ed.). Boston: Allyn & Bacon.

Usiskin, Z. (1982). Van Hiele Levels and Achievement in Secondary School Geometry. Chicago: University of Chicago, 1982. ERIC Document Reproduction Service no. ED 220 288.

Van der Sandt, S. and Nieuwoudt, H. (2003). Grade 7 teachers and prospective teachers' content know ledge of geometry. *South African Journal of Education*, 23:199-206.

Van Hiele, P. M. (1986). *Structure and Insight.* New York: Academic Press.

White, J. N. (2001). *Socioeconomic, Demographic, Attitudinal, and Involvement Factors Associated with Math Achievement in Elementary School.* Unpublished EdD Dissertation, East Tennessee State University, USA.

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APPENDIX

Specimen items from the geometry knowledge test

17) Which one is regular quadrilateral?

A) rhombus B) rectangle C) parallelogram D) square

7) Whose diagonals are perpendicular?

A) rhombus B) rectangle C) trapezoid D) parallelogram

29) Which one gives an example of two parallel planes?

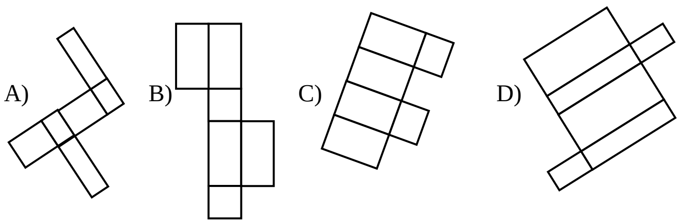
A) door and ceiling of the classroom

B) top of the desk and the wall of the classroom

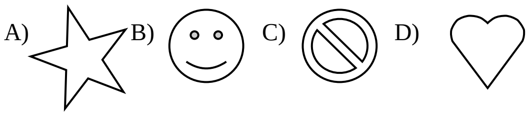
C) blackboard and ceiling of the classroom

D) top of the desk and the floor of the classroom

31) Which one cannot be the open the form of a rectangular prism?



36) Which of the followings has two symmetry axes?



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Sınıf Öğretmeni Adaylarının Geometri Bilgilerinin Yordanması

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Geniş Özet

GİRİŞ

Geometrinin doğru anlaşılması görsel anlamayı, geometrik akıl yürütmeyi ve doğayı anlamamızı sağlaması nedeniyle oldukça önemlidir. Hayatı doğru anlamak ve yorumlayabilmek için herkesin -çiftçiden geometri uzmanına- geometriyi iyi anlaması gereklidir.

Öğretmenlerin matematiksel içerik bilgisi bir süredir araştırmacıların dikkatini çekmektedir. İçerik bilgisi, pedagojik içerik bilgisi ve öğretmenin öğretim programına yönelik bilgisinin temelini oluşturması itibariyle öğretmen bilgisi türleri arasında da oldukça önemli bir yere sahiptir.

Geometri konusundaki içerik bilgisine baktığımızda bu konunun tüm dünyada önemli bir yere sahip olduğu görülebilmektedir. Çalışmalar sınıf öğretmeni adaylarının geometri içerik bilgisine istenen düzeyde sahip olmadıklarını göstermektedir (Cunningham & Roberts; 2010; Fuys, et al., 1988; Gutierrez & Jaime, 1999; Mayberry, 1983; Saads & Davis, 1997; Van der Sandt & Nieuwoudt, 2003).

Çalışmanın Amacı ve Önemi

Geometri içerik bilgisini değerlendirirken geometriye yönelik özyeterliğin, geometriye yönelik tutumun ve geometrik düşünme düzeylerinin incelenmesi önemlidir. Çünkü bu değişkenler içerik bilgisiyle olası ilişkiler taşıyabileceğinden içerik bilgisinin artırılması yönünde kullanılabilirler. Alanyazın taraması tüm bu değişkenleri birlikte ele alan bir araştırmanın eksikliğini ortaya koymaktadır. Dahası öğretmen adaylarının geometri bilgilerini bahsi geçen geometriye yönelik tutum ve özyeterlik ile geometrik düşünme düzeylerini kullanarak yordayan bir çalışmaya rastlanmamıştır. Çalışma bu boşluğu doldurmayı hedeflemiş ve geometri bilgisini tahmin edebilecek faktörleri araştırmayı amaçlamıştır. Bu sebeple yordayıcı değişkenler olarak belirlenen geometriye yönelik tutum ve özyeterlik ile geometrik düşünme düzeylerini kullanarak geometri bilgisini tahmin etmeye yönelik bir regresyon modeli oluşturulmuştur.

YÖNTEM

Araştırmanın verileri dört farklı üniversitede son sınıfta okumakta olan 387 (175 kadın, 212 erkek) sınıf öğretmeni adayından toplanmıştır. Çalışmaya katılan öğretmen adaylarının tümü sınıf öğretmeni yetiştirme programında yer alan matematik ve matematik öğretimi derslerinin tamamını başarıyla tamamlamışlardır. Çalışmada veri toplamak üzere araştırmacı tarafından geliştirilen 39 çoktan seçmeli maddeden oluşan geometri bilgi testi, Usiskin (1982) tarafından geliştirilen 25 maddelik geometrik düşünce testi, Cantürk-Günhan ve Başer (2007) tarafından geliştirilen 25 maddelik geometriye yönelik öz yeterlik ölçeği ve Duatepe ve Ubuz (2007) tarafından geliştirilen 12 maddelik geometriye yönelik tutum ölçeği kullanılmıştır.

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BULGULAR

Veri analizleri sonucunda öğretmen adaylarının geometri bilgisi ve öngörülen her bir yordayıcı faktör arasında hesaplanan korelasyon değerlerinin istatistiksel olarak anlamlı olduğu ortaya konulmuştur. Bununla birlikte gerçekleştirilen regresyon analizi geometrik düşünme düzeyleri, geometriye yönelik özyeterlik ve geometri tutum puanlarının toplamının öğretmen adaylarının geometri bilgisi puanlarını istatistiksel olarak anlamlı bir şekilde yordayabildiğini göstermiştir. Öngörülen yordayıcı değişkenlerin toplamı geometri bilgisi puanlarındaki %28'lik bir varyasyonu açıklayabilmektedir.

TARTIŞMA VE SONUÇ

Bulgular öğretmen adaylarının uygulanan duyuşsal testlerde bilişsel testlere göre daha başarılı olduklarını göstermiştir. Diğer bir değişle öğretmen adaylarının geometriye yönelik özyeterlikleri ve geometriye yönelik tutumları kullanılan bilişsel testler olan geometri bilgisi ve geometrik düşünme düzeylerine göre daha iyi durumdadır. Bununla birlikte yordanması hedeflenen geometri bilgisi testinden aldıkları puanların öngörülen tüm yordayıcı test puanlarıyla pozitif ve istatistiksel olarak anlamlı bir ilişkiye sahip olduğunu bulunmuştur.

Matematiğe karşı olumlu tutumlar içinde olan öğrencilerin olumsuz tutuma sahip olanlara göre daha başarılı olmasından dolayı (Reyes, 1984) bu beklenen bir sonuçtur. Ayrıca bu bulgu öğretmenlerin içerik bilgisiyle geometri konusundaki inançları arasında ilişki bulan Parsons (1993) un çalışmasıyla da uyumludur.