Educational Sciences: Theory & Practice - 12 (2) (Supplementary Special Issue) • Spring • 1667-1672

www.edam.com.tr/estp

Mathematical Modeling Activities as a Useful Tool for Values Education*

Bekir Kürşat DORUK[a]
Ahi Evran Üniversitesi

Abstract

Values education is crucial since it is one of the factors to reach success in education in broader sense and in mathematics education in particular sense. It is also important for educating next generations of societies. However, previous research showed that expected importance for values education was not given in Mathematics courses. In a few studies, it was identified that discussion-based approaches, problem solving strategies and cooperative learning environments made contribution to values education. It can thus be considered that mathematical modeling activities in which school students study cooperatively in small groups, find solutions to daily-life problems using mathematics and share these solutions with their counterparts would be useful. Therefore, in this study, it was aimed to determine the processes in detail which will contribute to the teaching of general educational values, mathematical values and mathematics education values emerging during the experiences which students gain while working with mathematical modeling activities. 58 school students at Grades 6 and 7 constituted the sample of the present study. It was used eight mathematical modeling activities through one semester. The classroom observations, video records and students' written documents were investigated using descriptive analysis. As a result, it was argued that modeling activities include very rich settings that would contribute to the development not only of general educational values but also of mathematical values and mathematical education values.

Key Words

Values, Values Education, Values In Mathematics Education, Mathematical Values, Mathematical Modeling Activities.

Values are significant for societies in order to maintain their existence and togetherness, the establishment of peace and trust within the society, thus the development of the society in every aspect. As Yazıcı (2006) mentions, an understanding which advocates development of only cognitive and psycho-motor skills in students will prevent the members of the society from acquiring values. Therefore, the maintenance of social integrity and the determination of common objectives will become complicated, even impossible. On the same grounds, Kohlberg (1981) postulates that one of the primary functions of the school is to carry on some of the social values.

Values education should not be restricted to certain courses. It is crucial to make use of every opportunity for values education (Arizona Department of Education Institute [ADE], 1993). However, research has demonstrated that (Bishop, Clarkson, FitzSimons, & Seah 2000; Bishop, FitzSimons, Seah, & Clarkson, 1999; Clarkson, FitzSimons, Bishop, & Seah, 2000; Seah & Bishop, 2000) in the field of mathematics education, values do not receive enough attention. As a matter of fact, Matthews (2001) argues that values which are viewed as mediators and precursors of behaviors have a direct effect on the learning behavior. Organization for Economic

* This study was presented at the Values Education Symposium, October 26–28, 2011, Eskisehir Osmangazi University, Eskişehir, Turkey.

a **Bekir Kürşat DORUK, PhD.**, is currently an assistant professor at the Department of Primary Education. His research interests include mathematics education and mathematical modeling in mathematics education. Correspondence: Assist. Prof. Bekir Kürşat DORUK, Ahi Evran Üniversity Faculty of Education Department of Primary Education, Kırşehir/Turkey. E-mail: bkdoruk@gmail.com Phone: +90 386 211 4386 Fax: +90 386 213 4513.

Development and Cooperation / International Student Evaluation Program for International Student Assessment [OECD/PISA] (2003) defines "*mathematical literacy*" as an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a "*constructive, concerned and reflective citizen*".

Education which centers on values promotes optimism in students, helps them realize themselves as an individual and claim social responsibility (Department of Education, Science and Training [DEST], 2003). Hence, it can be argued that values should be given consideration for a successful mathematics education. Nevertheless, traditionally the focus is directed towards academic success in schools whereas the individual's social and personal development is not given enough consideration (Açıkgöz, 2003). In fact, in Turkey, the new curriculum which have been implemented since 2004 host elements related to the affective field, too (Milli Eğitim Bakanlığı [MEB], 2009). However, the current examination system forces the students, families, and teachers to focus on academic success (Türk Eğitim Derneği [TED], 2010). Unfortunately, the state of focusing on academic success in mathematics education is even more observable than other fields. In effect, values are the most important factors in raising the quality of mathematics education (Seah, 2002). Students can understand the precision, beauty, aesthetics, consistency, abstractness and the progressive aspect of mathematics only if the values education dimension is given enough attention (Dede, 2007).

Modern mathematics has a deductive-axiomatic nature and in some aspects it is structured hierarchically (Swadener & Soedjadi, 1988). The idea that mathematics does not host any values is widespread worldwide to a considerable degree due to its axiomatic structure and due to the fact that it does not contain social preferences (Wong, 2005). However, mathematics too carries special values of its own and these values are transmitted during mathematics education, in a hidden way though (Bishop, 2004).

Bishop et al. (1999) have classified values related to mathematics education under three categories: general educational values, mathematical values and mathematics educational values. General educational values comprise ethical values like honesty, philanthropy and responsibility. As for the mathematical values, they are values like openness, mystery, rationalism, objectivism, progress and control which mathematics carries in its nature. Mathematics educational values are values which emerge in environments where mathematics is learnt and determines teachers' and students' tendencies towards mathematics education. Some of the values related to mathematics education are listed as follows: Formalism, activism, instrumental learning, relational learning, relevant, theoretical, accessibility, specialism, evaluating, reasoning and pleasure (Chin & Lin, 2001; Clarkson et al., 2000; Horzum & Kıymaz, 2011; Seah & Bishop, 2000).

A student who has acquired values related to mathematics will have completed the basic and the most important step needed for a good mathematics education. For, Umay (2007) holds that mathematics is a part of life, sometimes a key, sometimes an entertainment and fun for a "learner" who works with problem situations adapted from the real world, sees the patterns and manages to form relations, knows why s/he has found that thing, knows how to act, and makes the decisions himself/herself. On the contrary, the emphasis on making a lot of exercises for exam preparation or the emphasis on certain patterns to be used in disliked practices prevents the acquisition of the aesthetic aspect of mathematics (King, 2004).

In recent years, a good many studies on mathematical modeling activities have shown that these activities are highly practical for mathematics education (Bransford, Brown, & Cocking, 1999; English, 2010; English & Watters, 2004; Lesh & Doerr, 2003b; Lesh & Lehrer, 2003; Lesh & Yoon 2006; Mousoulides, Pittalis, & Christou, 2006; Mousoulides, Christou, & Sriraman, 2008; Swan, Turner, & Yoon, 2006). Modeling activities have the potential to add a new dimension to problem solving and mathematics education (Lesh & Doerr, 2003a).

Mathematical modeling is the expression of real-life situations mathematically (Blum & Niss, 1989). The modeling process begins with a complex real-life situation. A problem statement is formed in relation to this situation. From this point, a mathematical model is obtained through mathematizing. With a mathematical study conducted over the model, a solution can be found. This solution is first interpreted and then its accuracy is validated. If the solution or the process does not comply with the reality, certain steps or the whole modeling process is repeated (Stillman, Galbraith, Brown, & Edwards, 2007).

Mathematical modeling activities refer to the performance of mathematical modeling by students. Students who work in these activities in small groups develop the mathematical interpretation of the problem situation by themselves (Lesh, Hoover,

Hole, Kelly, & Post, 2000). These activities are developed on the basis of the themes children are interested in so as to encourage children to investigate the problem statement. At the end of the modeling activities, children present the models they have developed to their friends through various demonstration tools (Fox, 2006).

Halstead (1996) states that a discussion-based approach, student-centered active learning strategies, project work, applied activities, cooperative learning, group work and student research can be employed in values education. It has been pointed out that problem solving activities (Taplin, 1998b) and cooperative learning (Suharjo, 2007) are practical tools for values education in mathematics classes. In the light of these, it is thought that modeling activities which start with a complex daily life situation related to students' social environment, open-ended and non-routine problems as opposed to traditional problem solving activities, and whereby students work in small groups may highly contribute to values education in mathematics classes. An analysis of the related literature shows that no previous study has scrutinized on mathematical modeling activities in values education. Therefore, the present study aims to determine in detail the opportunities students meet when working in modeling activities that might contribute to values education. To this end, the following questions were investigated: What are the contributions of mathematical modeling activities to *(i)* general educational values; *(ii)* mathematical values; *(iii)* mathematics educational values?

Method

Research Model

The case study approach, which is a qualitative research method, was adopted in the present research. In the case study approach, one or more events, environments, programs, social groups or interrelated systems are analyzed in detail (McMillan, 2000). Case studies may be carried out in order to define and see the details comprising an event, develop potential explanations as to an event, and to evaluate an event (Gall, Borg, & Gall, 1996). It is one of the qualitative research methods which give the researcher the opportunity to make in-depth analysis and interpretation, and through the findings arrive at analytical generalizations rather than realistic estimates for similar situations (Cohen, Manion, & Morrison, 2000). In the present research, complimentary single case study design was adopted.

Participants

The study was carried out in a town of Ankara in a primary school to which low-socio economic status students attend. Students from the area as well as students from the villages nearby received education in the school. The participants were selected from among 6th and 7th graders. Of the 58 students in the sample, 34 students were selected from section 6B and 24 students were selected from 7C. Among these students, 30 were female and 28 were male. The participants were selected on the basis of convenience sampling.

Data Collection Instruments

The research data were collected for another study aiming to investigate the effects of mathematical modeling activities on students' level of transferring mathematics into daily life (Doruk, 2010). As for the present study, these data were analyzed in terms of another aspect. The data used in the study were collected by means of researcher's observation, the worksheets used by the students, the video recordings obtained during the students' mathematical modeling activities, the reports prepared at the end of the activities and the semi-structured interviews.

The Application Process

Mathematical modeling activities were organized for the students as two additional hours weekly (apart from the mathematics course) for a semester. Eight of the activities compiled from the previous literature were adapted to the participants' school environment to be used with the research groups (Cramer, 2003; Henning & Keune, 2005; Johnson & Lesh, 2003; Lesh & Doerr, 2003a; Mousoulides et al., 2006; Swan et al., 2006). The activities were applied in the standard format used by English (2004).

Data Analysis

In the analysis of the collected data, descriptive analysis was utilized. The situations that arose when students were working in modeling activities and included the values related to mathematics education were determined as themes. The collected data were summarized and interpreted in terms of the pre-determined themes.

Results

Through the students' mathematical modeling activities, processes which might contribute to some of the general educational values, mathematical values and mathematics educational values were experienced. These values are presented below:

General Educational Values

Common Values Observed in All of the Mathematical Modeling Activities: Philanthropy- service to humanity, cooperation, helping, respect towards others' opinions, courage, self-confidence, responsibility, perseverance, patience.

Values which Arise Specially according to the Problem Statement in the Activity: Justice, defending the right one (in the long jump problem), prudence (in the travel problem), handing the task to the master (in the summer job problem) and helping without letting others know (in the big feet problem).

Mathematical Values: Openness, mystery, rationalism, objectivism, control, progress.

Mathematics Educational Values: Activism, relevant, accessibility, evaluating, reasoning, pleasure.

Discussion

On the whole, values education is an element which should be taken into consideration in the functioning of the educational system and the individual's education life. As for the mathematics education, general educational values as well as mathematical values (Bishop, 2004; Sam & Ernest, 1997) reflecting the nature of mathematical knowledge are also at work. For a student who can feel the precision, aesthetics and power in the mathematics world, dealing with mathematics is a great source of pleasure and in the same way it paves the way for mathematics education. Otherwise, as the mathematics experiences of the students who love mathematics in the first years of the school increase, their interest in mathematics decreases (Ünlü, 2007); mathematics which is perceived as a set of rules that should be memorized arises feelings of fear and hate in students (Sertöz, 2006; Tepedelenlioğlu, 1983). For this reason, care should be given so that students acquire mathematical values as well as general educational values for a good mathematics education.

In contrast to the traditional problems, in modeling activities the daily life context containing modeling activities is not artificial, which prevents students from ignoring it. In a traditional verbal problem exemplified by Taplin (1998a) for values education "*Nick helps his old neighbor every weekday for ¼ hours, and ½ hours at the weekends. How many hours does he spend helping him?*" students do not have to consider the problem context in order to find a solution. Here it is expected that as Blum (2002) expresses, the artificial cloth over the problem is taken off and the situation is stated in symbols. In effect, the daily life context cannot be disregarded in the solution step of mathematical modeling activities. The findings obtained in the present research lend support to this idea.

Having students encounter problems which distance them from monotony, which require them to do modeling may make them more conscientious about which way to follow (Olkun, Şahin, Akkurt, Dikkartın, & Gülbağcı, 2009). Considering the research findings, it can be argued that modeling activities are more advantageous in terms of giving perseverance and patience values in coping with problems when compared to traditional problems. That is, as English and Waters (2005) state, modeling activities are more effective than traditional problem solving activities in terms of maintaining the social development necessary for today's world which is getting more complicated each day.

In the present day, one of the most significant problems of the education world is the problems in having students acquire responsibility value. In Tepecik's words (2008), depriving the individual of the chance to make decisions of their own, be responsible for the results of these decisions, express and realize their own ideas prevent the development of responsibility feeling. As is seen in the research findings, modeling activities in which students develop their own models, defend the functionality of their models and discuss it freely, are highly effective for helping them acquire the responsibility value. As Lesh and Yoon (2006) state, modeling activities prepare students for their life after school. As reflected in the findings of this study, students have the opportunity to acquire values like "*philanthropy, service to humanity, justice, prudence, respect towards others' ideas, responsibility, patience, perseverance, self-confidence*" which are needed for social life through modeling activities in the study process. The socially strong aspect of modeling activities make these activities more advantageous than other problem solving activities. In the same way, Maaß (2005) states that the integration of modeling activities to mathematics classes will help students become social citizens and improve critical social skills.

Mathematical modeling activities help students see which mathematical knowledge is related and applicable to the real world for a moment (Sriraman, 2005). This will help improve the value of taking pleasure in mathematics. The findings obtained in the student interviews within the scope of the research point to the practicality of the modeling activities in this respect.

In mathematical modeling activities put forward by Zawojewski, Lesh and English (2003), where social dimensions are integrated, which require team work and communication, students discuss within groups, listen to other group's representatives and cooperate with their friends; thus environments highly suitable for developing social and cultural values emerge. As Stipek (1998) points out, in modeling activities, students work interactively in groups, which contributes to development of mathematical skills and trust. The findings of the present research also lend support to these ideas.

The activities used in the present study have not been specially designed for values education but compiled from the previous literature and adapted to students' school environment with small changes. Therefore, elements related to social environment can easily be integrated to modeling activities and thus activities which focus more on values education can be designed and the implementation of these activities might be analyzed.

References/Kaynakça

Açıkgöz, K. Ü. (2003). *Aktif öğrenme.* İzmir: Eğitim Dünyası Yayınları.

Arizona Department of Education Institu [ADE]. (1993). *Report of task force on values in education and ımplementation of teaching values in Arizona schools.* Phoenix: ADE.

Bishop, A. J. (2004, July). Critical Issues in Researching Cultural Aspects of Mathematics Education. *Paper presented in Discussion Group 2 at the 10th International Congress on Mathematical Education,* Copenhagen, Denmark.

Bishop, A., Clarkson, P., FitzSimons, G., & Seah, W. T. (2000). *Why study values in mathematics teaching: Contextualising the VAMP project*. Retrieved February 25, 2012 from http://www.education.monash.edu.au/research/groups/smte/projects/vamp/hpm2000a.pdf .

Bishop, A., FitzSimons,G., Seah, W. T., & Clarkson, P. (1999, December). *Values in mathematics education: Making values teaching explicit in the mathematics classroom*. Paper Presented at the Combined Annual Meeting of the Australian Association for Research in Education and the New Zealand Association for Research in Education, Melbourne, Australia.

Blum, W. (2002). ICMI Study 14: Applications and modelling in mathematics education- discussion document. *Zentralblatt für Didaktik der Mathematik, 34* (5), 229-239.

Blum, W., & Niss, M. (1989). Mathematical problem solving, modelling, applications, and links to other subjects – state, trends and ıssues in mathematics instruction. M. Niss, W. Blum & I. Huntley (Eds.), *Modelling applications and applied problem solving* (pp. 1-19). England: Halsted Pres.

Bransford, J. D., Brown, S. J., & Cocking, R. (1999). *How people learn.* Washington, D.C.: National Academy Press.

Chin, C., & Lin, F. L. (2001). Value-loaded activities in mathematics classroom. In *Proceedings of the 25th Conference of the International Group for the Psychology of Mathematics Education, 2*, 249-256. The Netherlands: Utrecht.

Clarkson, P., FitzSimons, G., Bishop, A., & Seah, W. T. (2000, December). Methodology challenges and constraints in the values and mathematics project. *Paper Presented at the Annual Meeting of the Australian Association for Research in Education,* Sydney, Australia

Cohen, L., Manion, L., & Morrison, K. (2000). *Research methods in education* (5th ed.). London: Routledge.

Cramer, K. (2003). Using a translation model for curriculum development and classroom instruction. R. Lesh & H. M. Doerr (Ed.), *Beyond constructivism: A models and modeling perspective on mathematics problem solving, learning & teaching* (pp. 449-464). Mahwah, NJ: Lawrence Erlbaum Associates.

Dede, Y. (2007). Matematik öğretiminde değerlerin yeri. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *7* (1), 12-25.

Department of Education Science and Training [DEST]. (2003). *Values education study: Final report*. Carlton South, Victoria: Curriculum Corporation.

Doruk, B. K. (2010). *Matematiği günlük yaşama transfer etmede matematiksel modellemenin etkisi.* Yayımlanmamış doktora tezi, Hacettepe Üniversitesi, Ankara.

English, L. (2004). Mathematical modelling in the primary school. I. Putt, R. Faragher & M. McLean (Eds.), *Proceedings of the 27th annual conference of Mathematics Education Research Group of Australasia, Mathematics Education for the Third Millenium: Towards 2010* (pp. 207-214). Townsville: MERGA.

English, L. D. (2010). Young children's early modelling with data. *Mathematics Education Research Journal, 22* (2), 24-47.

English, L. D., & Watters, J. (2004). Mathematical modelling with young children. *28th Conference of the International Group for the Psychology of Mathematics Education, 2,* 335-342.

English, L. D., & Watters, J. (2005). Mathematical modelling in the early school years. *Mathematics Education Research Journal, 16* (3), 58-79.

Fox, J. (2006, July). A justification for mathematical modelling experiences in the preparatory classroom. *29th Annual Conference of Mathematics Education Group of Ausralasia,* Canberra, Ausralia.

Gall, M., Borg, W., & Gall, J. P. (1996). *Educational research an introduction* (6th ed.). White Plains: Longman.

Halstead, M. J. (1996). Values and values education in schools. In J. M. Halstead & M. J. Taylor (Eds.), *Values in Education and Education in Values* (pp. 3-13). London: The Falmer Press.

Henning, H., & Keune, M. (2005). Levels of modelling competencies. *Proceedings of the 4th European Congress of Mathematics Education* (pp. 1666-1675), Feliu de Guixols, Spain.

Horzum, T. ve Kıymaz, Y. (2011, Eylül). *Bir öğretim üyesinin genel matematik dersinde kullandığı matematiksel değerler ve bu değerleri seçme nedenlerinin tespit edilmesi*. 10. Matematik Sempozyumu'nda sunulan bildiri, İstanbul.

Johnson, T., & Lesh, R. (2003). A models and modelling perspective on technology-based representational media. R. Lesh & H. M. Doerr (Eds.), *Beyond constructivism: A models and modeling perspective on mathematics problem solving, learning and teaching* (pp. 265-278). Mahwah, NJ: Lawrence Erlbaum Associates.

King, J. P. (2004) *Matematik sanatı* (çev. N. Arık). Ankara: Gökçe Ofset.

Kohlberg, L. (1981). *Philosophy of moral development: Moral stages and the idea of justice*. San Francisco, CA: Harper & Row.

Lesh, R., & Doer, H. M. (2003a). Foundatations of a models and modelling perspective on mathematics teaching, learning, and problem solving. In R. Lesh & H. M. Doerr (Eds.), *Beyond constructivism: A models and modeling perspective on mathematics problem solving, learning and teaching* (pp. 3-33). Mahwah NJ: Lawrence Erlbaum Associates.

Lesh, R., & Doer, H. M. (2003b). In what ways does a models and modeling perspective move beyond constructivism? In R. Lesh & H. M. Doerr (Eds.), *Beyond constructivism: A models and modeling perspective on mathematics problem solving, learning and teaching* (pp. 519-556). Mahwah NJ: Lawrence Erlbaum Associates.

Lesh, R., & Lehrer, R. (2003). Models and modeling perspectives on the development of students and teachers. *Mathematical Thinking and Learning, 5* (2&3), 109-129.

Lesh, R., & Yoon, C. (2006). What is distinctive in (Our views about) models & modelling perspectives on mathematics problem solving, learning, and teaching? In W. Blum, P. Galbraith, H.-W. Henn, M. Niss (Eds.), *Modelling and applications in mathematics education: The 14. ICMI study* (pp. 161- 170). New York: Springer.

Lesh, R., Hoover, M., Hole, B., Kelly, A., & Post, T. (2000). Principles for developing thought-revealing activities for students and teachers. In R. Lesh & A. E. Kelly (Eds.), *Handbook of research design in mathematics and science education* (pp. 591-645). Mahwah, NY: Lawrence Erlbaum Associates.

Maaß, K. (2005). Barriers and opportunities for the ıntegration of modelling in mathematic classes- results of an empirical study. *Teaching Mathematics and its Applications, 2* (3), 1-16.

Matthews, B. (2001). The relationship between values and learning. *International Education Journal* [Educational Research Conference 2001 Special Issue], 2 (4), 223-232.

McMillan, J. H. (2000). *Educational research: Fundamentals for consumer* (3th ed.). New York: Longman.

Milli Eğitim Bakanlığı [MEB]. (2009). *İlköğretim matematik dersi 6-8. sınıflar öğretim programı ve kılavuzu.* Ankara: Yazar.

Mousoulides, M., Pittalis, M., & Christou, C. (2006). Improving mathematical knowledge through modeling in elementary schools. J. Novotna, H. Moraova, M. Kratka & N. Stehlikova (Eds.), *Proceedings 30th Conference of the International Group for the Psychology of Mathematics Education, 4*, 201- 208.

Mousoulides, N., Christou, C., & Sriraman, B. (2008). *From problem solving to modelling- a meta analysis.* Retrieved September 25, 2008 from http://www.umt.edu/math/reports/srireman/ MousoulidesChristouSriraman.pdf.

Olkun, S., Şahin, Ö., Akkurt, Z., Dikkartın, F. T. ve Gülbağcı, H. (2009). Modelleme yoluyla problem çözme ve genelleme: İlköğretim öğrencileriyle bir çalışma. *Eğitim ve Bilim, 34,* 65-73.

Organisation for the Economic Co-operation and Development (OECD). (2003). *The PISA 2003 assesment framework: mathematics, readings, science and problem solving knowlege and skills.* Paris: Author.

Sam, L., & Ernest, P. (1997). Values in mathematics education: What is planned and what is espoused? In *Brirtish Society for Research into Learning Mathematics. Proceedings of the Day Conference held at University of Nottngham,* 37-44.

Seah, W. T. (2002). Exploring teacher clarification of values relating to mathematics education. In C. Vale & J. Roumeliotis & J. Horwood (Eds.), *Valuing Mathematics in Society* (pp. 93-104). Brunswick, Australia: Mathematical Association of Victoria.

Seah, W. T., & Bishop, A. J. (2000, April). *Values in mathematics textbooks: A view through two Australasian regions*. Paper presented at the 81st Annual Meeting of the American Educational Research Association, New Orleans, LA.

Sertöz, S. (2006). *Matematiğin aydınlık dünyası*. Ankara: TÜBİTAK

Sriraman, B. (2005). Conceptualizing the model-eliciting perspective of mathematical problem solving. *Proceedings of the 4th European Congress of Mathematics Education* (pp. 1686-1696), Feliu de Guixols, Spain.

Stillman, G., Galbraith, P., Brown, J., & Edwards, I. (2007). A framework for success in implementing mathematical modelling in the secondary classroom. *Mathematics: Essential Research, Essential Practice 2*, 688- 697.

Stipek, D. J. (1998). *Motivation to learn: from theory to practice.* Boston: Allyn and Bacon.

Suharjo, B. (2007). Moral values in mathematics education through cooperative learning: A possibility of values education for 2. grade primary school pupils. *Jurnal Logos 5* (1), 61-70.

Swadener, M., & Soedjadi, R. (1988). Values, mathematics education and the task of developing pupils' personalities: An Indonesian perspective. *Educational Studies in Mathematics, 19* (2), 193-208.

Swan, M., Turner, R., & Yoon, C. (2006). The roles of modelling in learning mathematics. In W. Blum, P. Galbraith, H.-W. Henn & M. Niss (Eds.), *Modelling and applications in mathematics education. The 14. ICMI study* (pp. 275-284). New York: Springer.

Taplin, M. (1998a). *Education in human values through mathematics: Mathematics through education in human values.* Hong Kong: Sathya Sai Baba Center of Hong Kong.

Taplin, M. (1998b). Promoting education in human values in the regular mathematics classroom. *EduMath, 7*, (12/98), 59-72.

Tepecik, B. (2008). *Sosyal bilgiler dersinde sorumluluk değerinin kazandırılmasına ilişkin öğretmen görüşleri.* Yayımlanmamış yüksek lisans tezi, Anadolu Üniversitesi, Eskişehir.

Tepedelenlioğlu, N. (1983). *Kim korkar matematikten.* Ankara: Bilim ve Sanat Yayınları.

Türk Eğitim Derneği [TED]. (2010). *Ortaöğretime ve yükseköğretime geçiş sistemi.* Ankara: Dumat Ofset.

Umay, A. (2007). *Eski okul arkadaşımız okul matematiğinin yeni yüzü.* Ankara: Aydan Web.

Ünlü, E. (2007). İlköğretim okullarındaki üçüncü, dördüncü ve beşinci sınıf öğrencilerinin matematik dersine yönelik tutum ve ilgilerinin belirlenmesi. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, 19*, 129-148.

Wong, K. Y. (2005, July). *Add cultural values to mathematics instruction: A Singapore initiative*. Paper presented at the 4th Asian Mathematical Conference, Singapore.

Yazıcı, K. (2006). Değerler eğitimine genel bir bakış. *Türklük Bilimi Araştırmaları*, *19*, 499-522.

Zawojewski, S. J., Lesh, R., & English, L. (2003). A models and modeling perspective on the role of small group learning activities. In R. Lesh & H. M. Doerr (Eds.), *Beyond constructivism: A models and modeling perspective on mathematics problem solving, learning and teaching* (pp. 337- 358). Mahwah, NJ: Lawrence Erlbaum Associates.