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An Investigation of Pre-service Mathematics Teachers' Skills in the Development of Activities

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Abstract

The purpose of this research is to determine pre-service mathematics teachers' skills in the development of activities. The research was carried out using the case study which is descriptive method. For the collection of data, 57 pre-service mathematics teachers' in their final year secondary math teachers' education department attended the research. Pre-service teachers were asked to develop 5 activities for the concept of function a high school mathematics curricula. After obtaining the data, it was analyzed using the descriptive analysis method. The developed activities were first examined to see if they qualified as activities, which would be used in the learning process stage, and then examined to see which skills were reflected in the activities. The findings indicated that more than half of the pre-service teachers could develop activities, although some pre-service teachers could not develop activities, and some situations were not regarded as activities. It was determined that activities typically were intended for reaching and understanding a concept and its rules. In addition, it was observed that connecting mathematics to the real world, providing multiple representations and guiding questions were used for thinking/interpreting, predicting, and generalizing. In this study, there are reflections on the difficulties of pre-service mathematics teachers' in the development activities.

Key Words

Concept of Function, Development Activity, Mathematics Course, Pre-service Teachers.

Learning mathematics through activities can be seen as a fundamental building block in the learning process. Because the aim of learning activities is to ensure that students are active both mentally and physically during the learning process and that they will make a contribution through their efforts. Hence, it is important that activities appropriate for this purpose are developed and applied in the classroom environment.

Learning activities are thought of as tasks specifically designed to develop the learning of students (Northcote, Kendle, Ingram, & Thompson, 2001). Özmantar and Bingölbali (2009) define activity as the actualization of a task by way of a certain pedagogic approach. Whereas Doyle (1988) puts forth that activity is made up of four basic elements: *product, operation, resource* and *responsibility*.

The development and application of activities is observed in the constructivist learning approach. The learning process in the constructivist learning approach is made up of contemporary activities that can be carried out for life (Yurdakul, 2005). In this approach it is therefore expected to develop strategies that ease learning and support the

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constructivist philosophy, such as introducing the topic through activities and animations (Garfield, 1995; Garfield & Ahlgren, 1988) as well as teaching the lesson through activities (Garfield, 1995) (as cited in Miller, 2002, p. 2). However, it is also desired that the activities and samples that are designed to teach concepts and information are meaningful and original for students (Durmuş, 2001). Therefore, it is expected that these activities establish a relationship between other scientific fields and the real world in addition to pre-learning (Elçi, Bukova-Güzel, & Alkan, 2006). It is critical that the problems to be solved and activities to be discussed in the learning environment be ones that attract the attention of students (Brooks & Brooks, 1993). When all these conditions are met, activities prepared using the constructivist learning approach contributes to mathematics education as an effective way for reaching the targeted behavior (Bukova-Güzel & Alkan, 2004).

Teachers should primarily develop and apply activities to give students a chance to work in the classroom (Marx & Walsh, 1988). Learning through different activities and methods should help the student (Stylianides & Stylianides, 2008). Environments where students can work on sophisticated mathematical activities should be created to enhance their performance in math (Henningsen & Stein, 1997). Such mathematical activities include questions like "*What is mathematics?*" and "*What is required to do mathematics?*" (NCTM, 1991).

It is critical in today's learning approaches that multiple learning activities are carried out to create and learn a concept. However, in addition to performing an activity, it is also important how and in what way the activity is carried out (Özgen, 2012). Because the structure of activities can potentially effect or restructure a student's way of thinking and serve to limit or broaden the perspective of their field of study (Henningsen & Stein, 1997), it is important that what is carried out is actually an activity. To this end, Bukova-Güzel and Alkan (2005) have emphasized that activities should not be characterized as simple questioning or sample problem solving. Özmantar and Bingölbali (2009) have thought of the objective of an activity in three dimensions: the reason why the activity is carried out, what gains are aimed with this activity, and what the students will understand from the activity.

It can also be said that the application of an activity is as important as the objective of that activity. It can be stated that the structures of activities are varied and complex (Giaquinto, 2005). Students try to form their own definitions and concepts through the activities carried out during the learning process. In order to attain this, it is asked that students participate effectively and thus gain direct access to knowledge (Özden, 2009).

It has been observed in recent years that various studies are being conducted regarding the concept of activities in mathematics teaching. It is stated that learning with activities has many positive contributions to the learning process along with the acquisition of knowledge and skills. In a study carried out by Bukova-Güzel, Elçi, and Alkan (2006), it was determined that multiple activities prepared to teach the function concept have significant contributions to learning in that they result in the students displaying different approaches in modeling, they decrease faulty concepts, and they increase the skills of connection. Whereas Şen (2008) has put forth that learning through activities based on active learning in the 7th grade mathematics course better motivates students towards the course while also increasing their academic success and interest in the course. Similarly, Savaş, Obay, and Duru (2006) emphasized that mathematics teaching in which learning activities are used increases the academic success of students in comparison with traditional teaching.

Some studies have examined the opinions and difficulties related with the execution of activities along with a description of the process. For instance, Bal (2008) stated in his research that even though elementary school teachers find the new mathematics teaching program to be positive, they experience various problems in its application and that the teachers have a hard time in preparing activities. Whereas Bingölbali (2010) states that the guidance of teachers, activity directives and the tools used play an important role in the difficulties that students face. Özgenç (2010) has concluded that the preparation and application process for game based activities designed and applied in a 7th grade mathematics course is difficult and time consuming, that teacher-student, student-student interaction along with the participation of students is high and that the guiding role of the teacher in the process stands out.

Teachers have important responsibilities regarding the development of activities and the structuring of suitable environments (MEB, 2011). This is explained as follows: "*The teacher, together with the student, should be able to plan the methods, activities,*

course tools-equipment and materials, assessment-evaluation methods in accordance with the objectives and gains given in a special field teaching program"" (MEB, 2008, p. 20). The knowledge, skills and experiences of pre-service mathematics teachers with regard to activity development and application should be at a certain level. It is important that the effect of the theoretical and application courses taken by pre-service mathematics teachers during their education on their ability to develop activities should be applied. However, the number of studies on the knowledge, opinions and experiences of pre-service mathematics teachers towards the concept of activity is limited. In one of these studies Özgen and Alkan (2011) have determined that the preferences and opinions of pre-service mathematics teachers regarding various learning activities with a multiple activity approach carried out during the learning process. In their study, pre-service teachers with different learning styles had similar preferences for the learning activities and learning activities were received positively.

The objective of the presented study is to examine the activity development skills of pre-service mathematics teachers. In this manner, its aim is to reach comprehensive information by examining what pre-service mathematics teachers understand of activities, how they reflect this understanding in their activity development process, and the various approaches they take.

Method

Since the objective of this study was to put forth the activity development skills of pre-service mathematics teachers, the case study was used as a descriptive method. In such studies, a pre-determined event or a special case is examined with an individual or a group and the details of the acquired data are attempted to be explained in terms of cause-effect and the relationships between variables (Çepni, 2007, p. 36).

Study Group

The study was carried out with 57 senior pre-service mathematics teachers continuing their education at the secondary school mathematics teaching department at a state university during the spring semester of the 2011-2012 academic year. All pre-service teachers had taken mathematics, field training and pedagogy courses, and all had completed the application process to be included in the study.

Data Collection Tool

The function concept was selected to describe the activity development skills of pre-service mathematics teachers. To this end, gains towards the function concept in high school mathematics curriculum were examined and 5 gains towards this concept were determined to be directed to pre-service teachers. Each of the pre-service mathematics teachers were asked to develop activities for each of the cases given below.

To teach the function concept;

- Try to put forth the importance of the domain and codomain of a function, and the image set through positive and negative activities.
- Develop activities to distinguish function types.
- Carry out activities to put forth the increasing, decreasing and constant function sub-concepts.
- Carry out activities to relate inverse function concept with the function graph.
- Carry out activities to distinguish single and dual function.

The studies were carried out with pre-service teachers in a field training course. The application was carried out in a class environment and two course hours were allocated. In addition, the pre-service teachers were not given any resource or material support. The pre-service teachers were asked to individually develop the aforementioned activities. The application process was directed by the researchers. It was assumed that pre-service teachers had received information regarding the concept of activity throughout their field education and pedagogy courses and that they had carried out some activities in various courses.

Process

The data acquired in this study examining the activity development skills of pre-service mathematics teachers was evaluated via qualitative analysis. The data for this study was obtained from the activity examples that they developed for teaching the concept of function. The descriptive analysis method was preferred as a qualitative analysis method to carry out data analysis. The data acquired was interpreted by summarizing it according to pre-determined themes. Direct

quotations were frequently used and the results obtained were interpreted and presented to the reader (Yıldırım & Şimşek, 2005). The approach of pre-service teachers regarding "*what is an activity?*" was studied because previously, variety and limitations were observed in the activity perceptions of teachers (Özmantar, Bozkurt, Demir, Bingölbali, & Açıl, 2010). Accordingly, putting forth the meanings attributed to the concept of activity was set as a target by way of examining the activities developed by pre-service mathematics teachers. To this end, it was first examined whether the developed activities were in fact activities or not, and those that did not fit this definition of were eliminated. As an indicator, instances that made the student take an active role, that directed the students towards an effort, and that put forth questions, directive questions, were accepted as activities.

In the second stage, activities were analyzed in the order of use during the learning process. Accordingly, classifications of "*activities to reach a concept/rule*" and "*activities to reinforce, use and apply the concept" were defined*. Previous studies had determined that teachers applied activities in one stage of the learning process while they did not need to apply the applications in other stages (Çetin, 2009). However, application and reinforcement states are very important for learning. Hence, it was expected from the pre-service teachers to develop activities of the second type, whereas in the last stage, activities were evaluated and examined in terms of the reflected skills. In other words, skills such as problem solving, modeling, connection, use of different representations, interpretation, estimation and use of technology, which are among the skills targeted in teaching mathematics, were examined.

Descriptive statistics such as frequency and percentage were used during the analysis of acquired data. Validity in qualitative analysis can be determined by asking whether there is harmony or not between the problems/objectives of the study and its tools (Gökçe, 2006, p. 83). To this end, these criteria were given special attention during the stages of the development of the data acquisition tool, its application, and the analysis of the acquired data. In addition, the acquired data was analyzed by researchers at different times to ensure the reliability of the data analysis. Accordingly, codings for which there was no agreement were re-evaluated, and a final decision was given. Data was examined by the researcher to ensure the reliability of the study and the formula of P (Agreement Percentage) = [Na (Agreement) / Na (Agreement) + Nd (Disagreement)] X 100 (Miles & Huberman, 1994) was used. As a result of this calculation, the values of 83.4%, 76.2% and 78.5% were found for each theme respectively and the study was accepted as reliable.

Results and Interpretations

The first set of evaluated results is related to whether the activity suggestions developed by pre-service teachers are activities or not.

Data analysis has resulted in categorization of the activities developed by pre-service teachers as an "activity not developed," "not an activity," or an "activity." All pre-service teachers tried to develop an example of an activity for the first goal, however only 61.4% of these were considered to be an activity. On the contrary, 15.7% of the pre-service teachers could not develop an activity for the 2nd goal. However, just 64.9% of the developed activities could be considered as an activity. 8.7% of the pre-service teachers could not develop an activity for the 3rd case whereas 59.6% could. In addition, 21% of the pre-service teachers could not develop an activity for the 4th activity case while 52.6% could do so. Finally, 38.5% of the pre-service teachers could not develop an activity for the 5th activity case while only 36.8% of the activities developed were accepted as activities. Apart from the 5th case, it can be stated that more than half of the pre-service teachers were able to develop an activity. In general, the activity development ratios in different instances are observed to be similar. However, it was determined that pre-service teachers had difficulty in developing the 5th activity. This may be due to a lack of content knowledge or the failure to merge content knowledge with the

Table 1.
Evaluation of Activities Regarding Whether They are Activities or Not

Sub Theme	1st Activity		2nd Activity		3rd Activity		4th Activity		5th Activity	
	f	%	f	%	f	%	f	%	f	%
Activity not developed	-	-	9	15.7	5	8.7	12	21.0	22	38.5
Not an activity (definition, example...)	22	38.5	21	36.8	18	31.5	15	26.3	14	24.5
Activity	35	61.4	37	64.9	34	59.6	30	52.6	21	36.8

Table 2.
Evaluation of the Activities Regarding the Stage Used in the Learning Process

Sub Theme	1st Activity		2nd Activity		3rd Activity		4th Activity		5th Activity	
	f	%	f	%	f	%	f	%	f	%
Activities to reach a concept/rule	19	33.3	18	31.5	25	43.8	23	40.3	18	31.5
Activities to reinforce, use and apply a concept	16	28.0	9	15.7	9	15.7	7	12.2	3	5.2

right pedagogic approach. In reality, the ratio of examples that are not considered as activities in other cases is considerably high. This can be seen as an indication of limitations and difficulties in the perceptions of activities or activity development skills of the pre-service teachers.

It was observed as a result of data analysis that pre-service teachers developed "activities to reach a concept/rule" more when compared with all activities. Sample activities were developed to the highest level (43.8%) for the 3rd activity, first sub-theme, whereas activities were the least developed (31.5%) for the 2nd and 5th activities. The level is lower in the "Activities to reinforce, use and apply a concept" field. In this theme, activities were the most developed for the 1st activity case (28.0%) and least developed for the 5th activity case (5.2%). This emphasizes the fact that activities to "learn a concept" are more acceptable in the perceptions of pre-service teachers.

It is understood by the analysis of data that especially "questions directing one to think/interpret, estimate, make generalizations and draw conclusions" along with the skills "connected with real world" have stood out. On the contrary, it is observed that skills such as problem solving, using different representations, connecting with other concepts and using technology are reflected less in the activities. It has been observed that the activities developed by pre-service teachers for the 1st, 2nd, 3rd and 4th activity cases reflect connections with the real world, thinking, interpreting, generalizing skills are used more. Whereas skills such as connection with other concepts, problem solving and modeling have been reflected in the activities for the 5th Activity case. In addition, only one of the pre-service teachers suggested the use of technology in activities. This general circumstance may be due to the given gains (nature of the field) or the limited perspective of pre-service teachers regarding activities because other important skills in the mathematics learning process have been neglected despite the positive reflections of candidates on connections with the real world and reflections regarding high level cognitive skills.

Discussion

Data acquired as a result of the analysis has put forth the perceptions and perspectives of pre-service mathematics teachers along with the meanings attributed to the concept of activity by them. Accordingly, a majority of the pre-service teachers were able to develop activities for all activities other than the 5th activity case. This indicates that they perceive the activity correctly. Even so, some pre-service teachers were not able to develop activities directed towards the determined gains. Most of the cases that were not accepted as being an activity were cases in which pure content knowledge, definition, or examples were put forth. Here, shortcomings arose such as not making an effort or not being able to think differently rather than a lack of knowledge from the pre-service teachers. Definitions and explanations regarding the concept of an activity see active participation of the student as the common point for all activities (Bozkurt, 2012; Özmantar et al., 2010). In addition,

Table 3.
Evaluation of the Activities in Terms of Reflected Skills

Sub Theme	1st Activity		2nd Activity		3rd Activity		4th Activity		5th Activity	
	f	%	f	%	f	%	f	%	f	%
Activity has been connected with real world	25	43.8	12	21.0	16	28.0	8	14.0	-	-
Use of different representations	15	26.3	11	19.2	21	36.8	20	35.0	8	14.0
Questions have been used directing one to think/interpret, estimate, make generalizations and draw conclusions	25	43.8	16	28.0	27	47.3	20	35.0	16	28.0
Connection with other concepts	3	5.2	1	1.7	1	1.7	1	1.7	2	3.5
A case for solving problems has been put forth	6	10.5	2	3.5	10	17.5	1	1.7	-	-
Cases to generate mathematical models have been given.	1	1.7	1	1.7	4	7.0	-	-	-	-
Use of technology has been suggested	-	-	-	-	-	-	1	1.7	-	-

it was also requested that activity directives and guiding questions should serve this purpose and support learning. To this end, various properties were taken into account among activity evaluation criteria such as presence of directives along with language and expression.

The fact that majority of the pre-service teachers were able to develop activities can be evaluated as a positive outcome. On the other hand, the fact that there were pre-service teachers who were not able to develop activities despite the low number of participants can be seen as a significant problem. Because this study was carried out during the spring semester with senior pre-service teachers who were close to graduation. Therefore, it was observed that pre-service mathematics teacher still have some difficulties in their perceptions and mental schemes regarding the concept of an activity. Similarly, various studies carried out previously have also put forth the limitations of the perceptions and perspectives of teachers regarding the concept of an activity (Açıl, 2011; Bozkurt, 2012; Uğurel, Bukova-Güzel, & Kula, 2010).

The importance of activity directives have been observed in this study. Hence, activities developed in our study by pre-service teachers which did not have directives or lacked guidance were not accepted as activities. It was observed in many sample cases that activities did not have directives or guiding questions, or they did not suit students in terms of language and expression. It is inevitable that various problems will arise for both the teacher and the student in the application process of such an activity.

The activities developed by pre-service teachers were also evaluated in terms of learning process stages. The fact that pre-service teachers are more successful in developing "activities to reach a concept/rule" emphasizes that they are familiar with the subject theoretically. Whereas the fact that they are at a lower level in terms of developing "activities to reinforce, use or apply a concept" indicates that they have difficulties in establishing relationships between the subject and other subjects or concepts. The appearance of this situation can be based on the perceptions of pre-service teachers regarding the nature of gains. It can be stated that pre-service teachers have a strong perception regarding the fact that activities will be used in the first stages of the learning process.

Learning activities can be used in all stages of the learning process if they are developed properly. Activities can be used in learning a new concept, in relating with pre-learning, usage and application of what is learned or adaptation to different or complex cases. Teachers or pre-service teachers generally prefer to develop and apply activities that are in accordance with their own education or those that they can carry out with their current knowledge, skill and experience. The results of our study indicate that pre-service teachers behave accordingly.

Connection with real world, use of different representations and questions for thinking, interpreting, estimating, generalizing and drawing conclusions have been used more among the skills reflected in the activities developed in this study by pre-service teachers. It is understood that problem solving, modeling and connection with other concepts are less preferred in the developed activities. Even though the obtained results seem to be partially positive, it is emphasized that in general there are some difficulties in reflecting mathematical skills to activities. It is important in designing an activity for a specific purpose that the structure and objective of the activity be in agreement with the purpose. Activities designed in accordance with the purpose can be handled together with various skills in reaching the desired gain. When it is considered from this perspective, it can be stated that skills comprise the primary principles for mathematics learning in mathematics teaching program (MEB, 2011) and NCTM (2000) standards. Targeted skills can be integrated with proper approaches in activity design by the teachers. At this point, the importance of the nature or the structure of the activity appears. In a study carried out by Aslan (2010), it has been put forth that the nature of the chosen activity along with the pedagogic approach of the teacher are some of the factors that affect the roles of teachers and students during the activity application process. Our study results are in accordance with the results of that study. Because in this study, pre-service teachers have preferred questions related with high level cognitive processes and connections with the real world more.

Another result is that the approach of the teacher is important for activity design and the application process. Toptaş (2008) has determined in a study that during primary school mathematics course activity application, teachers do not let students develop activities, thereby carrying out teacher-centered activities. It can be stated according to the results of this study that even though there are some difficulties in the activities developed by pre-service

teachers, they will contribute more to learning since they are student centered. However, when those who did not develop activities in the study along with those whose activities were not accepted as activities are considered, it cannot be stated that the approach of these pre-service teachers are fully student-centered. This can be due to habits from the past, flaws in the education process of teachers and the existing teacher based learning approach causing different perceptions to arise in their minds. It has been determined in previous studies that there are impressions of this approach. Güven and Karataş (2004) have determined that primary school pre-service mathematics teachers generally design teacher-centered classroom environments in the design models they conjure in their minds. A similar study carried out by Özgen, Tataroğlu, and Alkan (2011) has put forth that pre-service mathematics teachers generally want to learn through reinforcement activities, by listening from the teacher or through the use of higher level cognitive skills. The results of previous studies along with the results of the current study put forth that pre-service teachers cannot break free from teacher-centered learning approaches and that they are under the effect of this approach in their perceptions, opinions and behavior regarding the mathematics learning/teaching process.

On the other hand, it has been put forth in various studies that there are some limitations regarding the activities included in the mathematics curriculum and textbooks (Dündar & Soylu, 2012; Kerpiç & Bozkurt, 2011). To this end, mathematics curriculum, teacher guide books and textbooks should ease the process of learning mathematics through activities. The activity concept should be cleansed of vague cases and explanations regarding its design and application. It is observed that resources guiding and informing teachers more about the concept and design of activities are necessary. In addition, more comprehensive studies carried out by education specialists will contribute to this process. Because different definitions and approaches for the activity concept may force teachers and pre-service teachers to a teacher-based education. Meanwhile, this may cause teachers to shift towards various complex, limited and sometimes wrong perceptions with an activity concept.

In this study, a limited number of pre-service mathematics teachers were asked to develop activities for the function concept. In future studies, pre-service teachers may be asked to develop activities for other mathematical concepts, thus giving us an opportunity to see the effects of the nature of the topic on the development of activities. In addition, the activities developed by the pre-service teachers in this study were evaluated according to various criteria. Examinations can be carried out on other activity design principles that were not handled in this study. In addition, studies can be carried out to determine the reasons along with solutions regarding teachers who are not able to develop activities or who have limited perceptions on the concept of activity.

References/Kaynakça

Açıl, E. (2011). *İlköğretim öğretmenlerinin etkinlik algısı ve uygulanışına ilişkin görüşleri* (Yüksek lisans tezi, Gaziantep Üniversitesi, Sosyal Bilimler Enstitüsü, Gaziantep). http://tez2.yok.gov.tr/ adresinden edinilmiştir.

Aslan, B. (2010). *Matematiksel etkinliklerin uygulanması sırasında ortaya çıkan öğretmen ve öğrenci rolleri* (Yüksek lisans tezi, Gaziantep Üniversitesi, Sosyal Bilimler Enstitüsü, Gaziantep). http://tez2.yok.gov.tr/ adresinden edinilmiştir.

Bal, A. P. (2008). Yeni ilköğretim matematik öğretim programının öğretmen görüşleri açısından değerlendirilmesi. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 17*(1), 53-68.

Bingölbali, F. (2010). *Matematik öğretimi etkinlik uygulamalarında karşılaşılan öğrenci zorluklarının nedenleri ve öğretmen müdahale türleri* (Yüksek lisans tezi, Gaziantep Üniversitesi, Sosyal Bilimler Enstitüsü, Gaziantep). http://tez2.yok.gov.tr/ adresinden edinilmiştir.

Bozkurt, A. (2012). Matematik öğretmenlerinin matematiksel etkinlik kavramına dair algıları. *Eğitim ve Bilim, 37,* 101-115.

Brooks, J. G., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms.* Alexandria: VA: Association for Supervision and Curriculum Development.

Bukova-Güzel, E. ve Alkan, H. (2004, Eylül). *Matematik öğretiminde, geliştirilen öğrenme etkinlikleri ile yapılandırmacı yaklaşımın örneklenmesi.* VI. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi'nde sunulan bildiri, Marmara Üniversitesi, İstanbul.

Bukova-Güzel, E. ve Alkan, H. (2005). Yeniden yapılandırılan ilköğretim programı pilot uygulamasının değerlendirilmesi. *Kuram ve Uygulamada Eğitim Bilimleri Dergisi*, *5*, 385-420.

Bukova-Güzel, E., Elçi, A. N. ve Alkan, H. (2006, Eylül). *Çok yönlü etkinlik yaklaşımları ile matematiksel kavram oluşturma*. VII. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi'nde sunulan bildiri, Gazi Üniversitesi, Ankara.

Çepni, S. (2007). *Araştırma ve proje çalışmalarına giriş* (3. basım). Trabzon: Celepler Matbaacılık.

Çetin, Ö. (2009). *İlköğretim matematik öğretmenlerinin ders içi etkinlik ve davranışlarının betimlenmesi üzerine nitel bir çalışma* (Yüksek lisans tezi, Yüzüncü Yıl Üniversitesi, Fen Bilimleri Enstitüsü, Van). http://tez2.yok.gov.tr/ adresinden edinilmiştir.

Doyle, W. (1988). Work in mathematics classes: The context of students' thinking during instruction. *Educational Psychologist, 23*(2), 167-180.

Durmuş, S. (2001). Matematik eğitimine oluşturmacı yaklaşımlar. *Kuram ve Uygulamada Eğitim Bilimleri Dergisi*, *1*, 91-107.

Dündar, S. ve Soylu, Y. (2012). İlköğretim matematik programında yer alan etkinliklerin kazanımlara uygunluğunun belirlenmesi. *Çankırı Karatekin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *3*(1), 161-176.

Elçi, A. N., Bukova-Güzel, E. ve Alkan, H. (2006, Nisan). *Yapılandırmacı öğrenme yaklaşımına uygun çalışma yaprakları.* Eğitimde Çağdaş Yönelimler-III: "Yapılandırmacılık ve Eğitimde Yansımaları" Sempozyumu'nda sunulan bildiri, Tevfik Fikret Okulları, İzmir.

Giaquinto, M. (2005). *Mathematical activity*. In P. Mancosu, K. Jorgensen, & S. Pedersen (Eds.), *Visualization, explanation, and reasoning styles in mathematics* (pp. 75-90). Dordrecht, Netherlands: Springer.

Gökçe, O. (2006). *İçerik analizi. Kuramsal ve pratik bilgiler*. Ankara: Siyasal Kitabevi.

Güven, B. ve Karataş, İ. (2004). İlköğretim matematik öğretmen adaylarının sınıf ortamı tasarımları. *İlköğretim-Online, 3*(1), 25-34.

Henningsen, M., & Stein, M. K. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *Journal for Research in Mathematics Education*, *28*(5), 524-549.

Kerpiç, A. ve Bozkurt, A. (2011). Etkinlik tasarım ve uygulama prensipleri çerçevesinde 7.sınıf matematik ders kitabı etkinliklerinin değerlendirilmesi. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 16,* 303-318.

Marx, R. W., & Walsh, R. (1988). Learning from academic tasks. *The Elementary School Journal*, *88*(3), 207-219.

Miles, M. B., & Huberman, A.M. (1994). *An expanded source book: Qualitative data analysis*. London: Sage.

Miller, J. B. (2002). Examining the interplay between constructivism and different learning styles. *ICOTS6, 2002*. Retrieved from http://www.stat.auckland.ac.nz/~iase/publications/1/8a4.

Milli Eğitim Bakanlığı. (2008). *Öğretmenlik mesleği genel yeterlikleri. 1-38.* http://otmg.meb.gov.tr/YetGenel.html adresinden edinilmiştir.

Milli Eğitim Bakanlığı. (2011). *Ortaöğretim Matematik (9, 10, 11 ve 12. Sınıflar) Dersi Öğretim Programı*. Ankara: Yazar.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Northcote, M., Kendle, A., Ingram, D., & Thompson, E. (2001). *Activities for learning. Practical advice for enhancing your teaching and learning*. Retrieved from http://www.catl.uwa.edu.au/resources/advice.html.

Özden, Y. (2009). *Öğrenme ve öğretme* (9. basım). Ankara: Pegem Yayınları.

Özgen, K. (2012). *Yapılandırmacı öğrenme yaklaşımı kapsamında, öğrencilerin öğrenme stillerine uygun öğrenme etkinlikleri geliştirilmesi: Fonksiyon ve türev kavramı örneklemesi* (Doktora tezi, Dokuz Eylül Üniversitesi, Eğitim Bilimleri Enstitüsü, İzmir). http://tez2.yok.gov.tr/ adresinden edinilmiştir.

Özgen, K. ve Alkan, H. (2011). Matematik öğretmen adaylarının öğrenme stiline göre etkinliklere yönelik tercih ve görüşlerinin incelenmesi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *41,* 325-338.

Özgen, K., Tataroğlu, B. ve Alkan, H. (2011, April). *Matematik öğretmenliğine kayıt olan öğretmen adaylarının öğrenme ve öğrenme sürecine yönelik görüşleri.* Paper presented at the 2nd International Conference on New Trends in Education and their Implications, Antalya, Türkiye.

Özgenç, N. (2010). *Oyun temelli matematik etkinlikleriyle yürütülen öğrenme ortamlarından yansımalar* (Yüksek lisans tezi, Karadeniz Teknik Üniversitesi, Sosyal Bilimler Enstitüsü, Trabzon). http://tez2.yok.gov.tr/ adresinden edinilmiştir.

Özmantar, M. F. ve Bingölbali, E. (2009). Etkinlik tasarımı ve temel tasarım prensipleri. E. Bingölbali ve M. F. Özmantar (Ed.), *İlköğretimde karşılaşılan matematiksel zorluklar ve çözüm önerileri* içinde (s. 313-348). Ankara: Pegem Akademi.

Özmantar, M. F., Bozkurt, A., Demir, S., Bingölbali, E. ve Açıl, E. (2010). Sınıf öğretmenlerinin etkinlik kavramına ilişkin algıları. *Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi*, *30*, 379-398.

Savaş, E., Obay, M. ve Duru, A. (2006). Öğrenme etkinliklerinin öğrencilerin matematik başarıları üzerindeki etkisi. *Journal of Qafqaz University*, *17*(1), 1-8.

Stylianides, A. J., & Stylianides, G. J. (2008). Studying the classroom implementation of tasks: High-level mathematical tasks embedded in real life contexts. *Teaching and Teacher Education, 24*(4), 859-875.

Şen, F. (2008). *İlköğretim 7.sınıflarda matematik dersi "I. dereceden bir bilinmeyenli denklemler konusunda" aktif öğrenme temelli etkinliklerin öğrenci başarısına etkisi* (Yüksek lisans tezi, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Ankara). http://tez2.yok.gov.tr/ adresinden edinilmiştir.

Toptaş, V. (2008). Geometri öğretiminde sınıfta yapılan etkinlikler ile öğretme -öğrenme sürecinin incelenmesi. *İlköğretim Online*, *7*(1), 91-110.

Uğurel, I., Bukova-Güzel, E. ve Kula, S. (2010). Matematik öğretmenlerinin öğrenme etkinlikleri hakkındaki görüş ve deneyimleri. *Buca Eğitim Fakültesi Dergisi*, *28,* 103-123.

Yıldırım, A. ve Şimşek, H. (2005). *Sosyal bilimlerde nitel araştırma yöntemleri* (5. basım). Ankara: Seçkin.