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An Investigation of Mathematically Promising Students' Cognitive Abilities and Their Contributions to Learning Environment

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In this study, through the observation of mathematically promising students in regular classrooms, relevant learning environments and the learning needs of promising students, teacher approaches and teaching methods, and the differences between the promising students and their normal ability peers in the same classroom were investigated. Correlational survey research was conducted. The sample of this research was composed of selected and non-selected students. The selected students were 21 students who were attending the Science and Art Center in Erzincan. The non-selected students were peers of the selected students in the same classroom at their schools. The differentiated classroom observation form, which was adapted into Turkish, and written interview questions for teachers were the data collection instruments used in this study. Structured non participant observation was conducted in regular classrooms in which selected mathematically promising and their non-selected peers attended. The data collected through observation form were analyzed quantitatively through Mann Whitney U test and the data collected through teacher interviews were analyzed qualitatively through direct quoting. The findings of *the study suggest that the mathematically promising students were more active in classroom activities and communicated more frequently with their teacher compared to their normal ability peers. In contrast, their classroom respect levels were lower. The repetition of some topics and concepts, and not being praised enough may be counted as the reasons behind these disrespected behaviors.

Keywords: Mathematically promising students, regular classroom, cognitive abilities, teaching methods

INTRODUCTION

The modernization of a country depends on how efficient the human resources of that country are used. Therefore, the discovery and education of today's gifted children, which are the most important human resources of a society to be developed, is one of the most significant responsibilities of the system (Senol, 2011). Modern life appears to be changing each passing day, and this change brings a need for highly educated people. This need can be met primarily by highly gifted students (Budak, 2008), and the meeting of this need starts with the correct identification of these students.

It is noteworthy to define what promising means, as the term "promising students" is mentioned for the students who come before the gifted ones. The ability levels of promising students have not yet been determined. These students can attract attention since they have some behaviors and characteristics that distinguish themselves apart from their peers (Usiskin, 1999). Receiving sufficient scores in scales that measure the abilities of promising students and the identification of certain ability types identifies them as gifted students.

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State of the literature

- The learning environments should especially develop the mathematical thinking skills of these students.
- Greenes and Mode (1999) notes that promising students' interest may be lost, performances may be weakened and even their interests in mathematics may burn out if they do not face challenges or do not receive guidance.
- Westberg and Daoust (2004) found that education given in regular classrooms causes some problems for both gifted and average intelligence students. They concluded that the current curriculum and teachers were not able to meet the needs of the students.

Contribution of this paper to the literature

- This study found that being in the same classroom environment with their normal ability peers causes some advantages and disadvantages for these gifted students. While their ability of understanding the subjects much quicker is an advantage, teachers' repetition of some topics for their normal ability peers causes some disadvantages such as getting bored.
- This study indicates that even in low-profile activities the promising students in mathematics, stay active by making connections between their prior and current knowledge by asking questions. The promising students in mathematics can mobilize themselves with their own internal motivation and enthusiasm for learning.
- The promising students in mathematics, who have higher-order thinking skills, can use both procedural and conceptual learning methods at the same time. These students give more special attention to conceptual learning than their normal ability peers. They learn faster and more permanent compare to the average ability students.

A promising student in mathematics is a candidate for becoming a highly gifted student in mathematics. Identification of promising students through the use of specific identification tools in mathematics will help to reveal gifted students, and being considered as gifted in a certain area can be possible after passing through some identification processes (Budak, 2007).

According to NCTM (1995), the identification of promising students in mathematics can be carried out in non-formal ways. Such students can present their abilities by showing a willingness to solve challenging mathematical questions in the classroom, their solution approaches for open-ended questions, being members of math clubs, participating in math competitions and the effective use of technologies. Each student has different characteristics in terms of cognitive and affective qualifications such as ability, performance and creativity. This fact distinguishes the educational needs of the students. Some students prefer to study in a silent environment, whereas others prefer to study in an environment with music; and some students like to study individually, but some prefer studying as a group. These preferences may change over time, depending on the type of learning activity. The most ideal learning environments offer flexibility in a level that meets individual preferences, and are wide-ranging. For example, highly gifted students can find the opportunity to explore their own ideas and interests in student-orientated classroom environments rather than regular lectures. At such a point, it is important for the content to support the development of students' cognitive level. In addition, most highly gifted students need learning environments in accordance with their interests and in which they can behave individually (Metin & Dağlıoğlu, 2004). It is obvious that the learning habits of gifted students require different teaching-learning cases. In particular, classroom activities should allow students to express their ideas and experience the sense of discovery. Students should be free to create their own classroom materials where the materials of the curriculum are insufficient to their needs. The learning environments should especially develop the mathematical thinking skills of these students (Hirsch & Weinhold, 1999). Therefore, there are certain duties for the teachers, as implementers of classroom activities.

Teachers responsible for educating gifted students should be good enough in their fields and possess the necessary intellectual knowledge. Thus, the teacher should know what students need and don't need, and treat them accordingly (Gökdere, Küçük & Çepni, 2003). The teachers are expected to give opportunity to those that are promising in mathematics in order to demonstrate their skills. These students should be encouraged to participate in problems and projects in order to identify them and to determine their strengths and weaknesses. The problems posed to students should allow them to use complex skills in mathematics as follows: problems must be suitable for multiple comments, applying the knowledge of sub-disciplines (arithmetic, statistics, geometry, etc.) and various interrogation techniques; because, each mathematically promising student has different skill types. Therefore, it is important for teachers to have a wide range of abilities and knowledge in order to address these requirements. In addition to these qualifications, teachers should know the improvement, characteristics, age groups, and needs of highly gifted students based on their abilities (Metin & Dağlıoğlu, 2004).

A cooperative and healthy learning environment can be created by combining the academic experiences of the teachers with good classroom management. Let us assume that the classroom is a stage, and the teacher is the director. In fact, the most important aspect of a stage play is not the play itself, but the things around the play. So, rather than being valuable simply as a play, it is more important to emphasize that the director and individuals have their own roles. A successful director has to create a perfect environment for the play in terms of effectiveness and physical properties. The director needs two things for this. First, he/she has to know each single performer very well (strengths and weaknesses, preferred methods, life experiences...), and secondly, he/she has to see how they can create a composition as a team, or in other words, how to integrate the individual and create the shared harmonies of team spirit (Tomlinson & Imbeau, 2010). It should be also noted that promising students' interest may be lost, performances may be weakened and even their interests in mathematics may burn out if they do not face challenges or do not receive guidance. Therefore, each student's difficulties based upon his/her learning potential must be addressed with solid support and guidance (Greenes & Mode, 1999).

In Turkey, promising students in mathematics have their education in learning environments provided by formal education institutions. These students' education is conducted in regular classrooms with mostly average intelligence level students, including with other promising peers. Regular classrooms can be defined as places that provide programmed teaching and learning activities under the same roof for a combination of mixed-ability students within formal education.

Education given in regular classrooms causes some problems for both gifted and average intelligence students. In a study on this subject, it was concluded that the current curriculum and teachers were not able to meet the needs of the students (Westberg & Daoust, 2004). In addition, they especially focused on gifted students, and observed that gifted students receive less education than other students in classrooms that provide a single type of learning environment. Therefore, gifted students consider schools as restrictive and annoying places (George, 2005). In addition, it is also observed that students compete with each other in the regular classrooms, with importance given to finishing the curriculum on time. According to the studies focused on the profiles of regular classroom teachers, they had insufficient classroom management skills, as well as difficulties to adapt the curriculum to different abilities in the classroom; they were not active enough in using resources and materials, and their pedagogical knowledge and planning skills were inadequate (Hirsch & Weinhold, 1999; Stepanek, 1999; Parke, 1992; Van Tassel-Baska & Stambaugh, 2005; Westwood, 1997). Gifted students often face difficulties to express themselves in classroom activities due to their unmet needs in the regular classroom. As a result, these students may become problematic children since they ask lots of questions, question the rules and methods, and often finish their assignments before anyone else in the regular classroom (Davaslıgil, 2012). There are few studies in the literature addressing the problems and solutions for these highly gifted students in Turkey. In particular, there are only a few studies related to promising students in mathematics. It is aimed to fill the gap in the literature in terms of the identification of promising students in mathematics, understanding their characteristics, their learning habits, and their needs in terms of learning environments. In addition, it is also important to identify the status of learning environments for promising students in mathematics in Turkey, their learning needs, and the approach of teachers to these students, the teaching methods offered, and the differences between regular students and those who are considered gifted. In this regard, this study will seek to answer the following questions; "What differences exist between average level intelligence students and gifted students in terms of demonstrating elementary school math skills and what do their math teachers think about their abilities and behaviors?" These differences will be discussed in terms of attendance to the lectures, cognitive taxonomy levels, conceptual or procedural learning of math, managing the learning and instruction effects and the influences affecting the role of the teacher.

METHOD

The correlational model was used in the study aiming to determine the existence or degree of a change between two or more variables (Karasar, 2010). In this model, data were collected by observation techniques. The unattended-structured observation approach was carried out. Unattended observation is a method in which the researcher is only a passive observer, although the identity of the researcher, subject and duration of the research are all clearly known (Ekiz, 2009). The structured observation is a method in which a recognized structure, orientation and systematic approach are used for the target (Büyüköztürk, 2009).

Sampling

The students participating in the research sample were grouped in two categories: Selected and unselected students. There were 21 promising students selected from the Sciences and Arts Center (SAC) of Erzincan Province. SACs are the organizations funded by the government to identify and improve gifted students' abilities from kindergarten to high school through after school programs. These students were in the 3rd grade (4 students), 4th grade (3 students), 5th grade (5 students) and 6th grade (9 students) at the time of data collection. In addition all the selected students were identified as mentally gifted. Therefore, they were accepted as potentially promising students in mathematics and observed in their regular mathematics classrooms with their normal ability peers. The unselected students were another 285 students from the same schools who were the classmates of the selected students. The 21 students were selected from 17 different classrooms. The total number of selected and unselected students in the sample was 306 from 17 classrooms. In some classrooms, there were more the one mathematically promising student and more than one observation made. Thus the statistical comparisons were carried out between the data of 21 observations of selected students and 21 observations of unselected students.

Instruments

For data collection, two instruments were used: a classroom observation form and a written interview form.

Differentiated Classroom Observation Form. This form was developed by Cassady et al. (2004) in order to observe gifted students and students of an average level of intelligence in the same classroom environment. The form was adapted to Turkish, and the adapted version of the form was used.

The observation form is two pages, with two evaluation columns for selected and unselected students on both pages. In addition to these two pages, an "Instructional Activity Codes" page is included. The meaning of the activities observed in the class environment is encoded. The first page of the form consists of five sections: classroom activities, engagement rating, cognitive taxonomy, learning director, and observer comments/notes. The first section includes the classroom activity codes; students are evaluated based on these codes. The engagement rating section evaluates the participation level of both student groups as low, moderate or high. The cognitive taxonomy section presents the cognitive level of both groups of students. This section was used as adapted by Krathwohl (2002). In the taxonomy, a hierarchy was followed from the lower- order to higher-order thinking skills: remember, understand, apply, analyze, evaluate, and create. For each classroom, the observation form filled out for both selected and non-selected group of students. A total of 21 observations made for each group of students, and some classrooms observed more than one.

Asking questions, systematic and critical thinking, problem solving, analysis, evaluation and synthesis of new information are the features of higher-order cognitive skills. The skills based on knowledge, understanding and implementation are the lower-order cognitive skills (Zoller, 1993, 2000; Zoller & Tsaparlis, 1997). The researcher has evaluated the cognitive progress in learning by coding one of six levels of the updated Bloom taxonomy. On the second page of the observation form, there is a 5 point Likert-type scale consisting of 18 items for selected and unselected groups. There is a rating range in the scale from "Strongly disagree" to "Strongly agree". The learning Director section allows us to determine the effect of learning environment guidance from a teacher-centered to the student-centered learning. In this part, the matter of "Teacher directs all learning" was rated as 1, whereas "Students direct all learning" was rated as 5.

The permission to use the observation form has been obtained, and then the adaption into Turkish process has started. The adaptation constitutes the pilot of this study. The first step of the adaptation process was to ensure linguistic equivalence. For this purpose, researchers consulted three math educators who are experts in their fields in the original language of the form. The translation of the items in the observation form was carried out by the researchers from English to Turkish. The consistency of the translation with the original language of the scale in terms of meanings has been achieved by the consensus of the three experts. For each item, a scale which shows how the Turkish translation corresponds to the original as; "full", "partial" or "no correspondence" was formed. If one of the experts considered the translation as "partial" or "no correspondence", it was replaced with a new translation with the consensus of three experts.

The second step of the adaptation was the validation study. First, the validity of the content was carried out based on two experts' opinions. The Turkish structure of the observation form, in which linguistic equivalence was ensured, was presented to two mathematics educators for their opinions. The sufficiency of the items in the form that would present the cognitive skills and participation to the learning environment of both selected and unselected students has been ensured through the opinions of the experts.

The final step of the adaptation process was the reliability study. The internal consistency coefficient, which is a commonly used reliability measure, and correlation between the codes were evaluated for the reliability study. The internal consistency reliability measures whether several items that propose to measure the same general construct produce similar scores (Karasar, 2010). According to the data obtained from the observation form, the reliability coefficient of the scale was found as $\alpha = 0.89$. The reliability coefficient between the coders has been obtained by the three researchers filling out the forms for the same classroom environment, and then calculating the correlation between these forms. The preliminary correlation coefficient between the coders was calculated as 0.71. One of the coders who was not familiar with and has no time to study the codes dropped out the coding. The correlation coefficient after that was 0.90. As a result, it was concluded that the observation form is reliable.

Written Interview. The written interview is a data collection tool for teachers of the classrooms in which the observations were conducted. The interview was performed in order to eliminate any bias that the teachers may have had about both the selected and unselected students. In addition, the interview data will be used to bring to light any situations that may have escaped from researcher's attention during the observations.

The four questions that made up the interview have been prepared in accordance with the sub-problems of the research. The questions were asked in order to determine the participation level of the students in the lecture, their degree of cognitive taxonomy, and the learning director and learning types (procedural or conceptual learning) of both groups. The interviews were conducted with 17 elementary school teachers they either teach or do not teach in the classes of these students.

Data Collection

Research observations were made during the math courses of 17 classrooms. During the classes, an observation form was filled out for each selected student. As a result of the observations made in classrooms that had one or more "selected students", the comparison was made between the selected and unselected students' observation mean scores. Therefore, in total, 21 observation forms have been completed. In some cases, the researcher noted to the "Comments and Notes" section of the "Differentiated Classroom Observation Form". After the observation data was obtained, the process was completed by performing written interviews with the teachers.

Data Analysis

Students' engagement ratings in the observation form were coded as low, moderate and high, and rated as 1, 2 and 3, respectively; likewise, each step of the cognitive taxonomy was rated as 1, 2 and 3, and lastly learning director was rated with numbers from 1 to 5. Afterwards, the normal and homogenous data distribution was checked by considering the number of samples of less than 30 cases (Eymen, 2007). The suitability of the observation form scores to normal distribution was tested by the Kolmogorov Smirnov test, and most of the items' significance level was found less than 0.05. The analysis shows that the observation form items do not have a normal distribution and are homogenous. At times where the data do not show normal distribution, non-parametric tests are used (Büyüköztürk, 2009). In analyzing the observation data, Mann-Whitney U test, a non-parametric test was used through the SPSS 15.0 statistical computer program. The teachers' responses to the interview questions were analyzed qualitatively.

RESULTS

The results are composed of qualitative and quantitative data The results related to comparisons between promising students (selected group) and students of an average level of intelligence (unselected group) are shown in tables throughout this section. Different teacher opinions gathered during the interviews were presented as direct quotes.

Results Related to Classroom Engagement

Students' engagement in class activities were compared through observation data. The statistics of the comparison are given in Table 1.

According to Table 1, there was a significant difference between the selected and unselected students in terms of participation to the classes; $U=81.00$, $p<0.05$. The participation of the selected students was higher than their counterparts when rank averages are considered.

The question of "what are your opinions related to the engagement levels of the promising students and students with average intelligence in the classrooms?" was asked to the teachers during the written interview. One of the teachers responded; "They are the most participative students in the class and they also listen better than the others; they cannot remain passive". One other teacher replied; "The participation of promising students is very good. They listen very carefully and concentrate very well, no matter what course they are taking. They contribute to the course positively by adding their comments and opinions. The participation rate of the other students with average intelligence was low at first, but increases accordingly with the number of activities." Another stated that; "Their participation is at the highest level in the course. They do not miss any details. They try to prove that they are also good in cases where other students come to the forefront." Another teacher replied; "They do not answer simple and memory-based questions, or talk a lot. They like to make a few, but good comments."

The responses of the teachers show that the promising students prefer to deal with questions that require higher-level cognitive abilities and questioning, rather than dealing with simple or memory-based questions. There are also some cases where the promising students are not interested in the course and

Table 1. The results of the Mann-Whitney *U* test related to the classroom engagement

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	28.14	591.00	81.00	0.000*
Unselected Group	21	14.86	312.00		

*: $p<0.05$

Table 2. The results of Mann-Whitney *U* test related to the cognitive taxonomy levels

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	30.33	637.00	35.00	0.000*
Unselected Group	21	12.67	266.00		

*: $p<0.05$

Table 3. The results of Mann-Whitney *U* test related to the learning director

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	27.76	583.00	89.00	0.000*
Unselected Group	21	15.24	320.00		

*: $p<0.05$

showed low level of engagement. One of the teachers stated that: "The promising students immediately adapt to the course and learn the subject after they listen to it once. However, when we repeat the subject for the students of average intelligence, the promising students get bored and make them busy with other things."

The Results Related to the Levels of Cognitive Taxonomy

The comparisons of cognitive taxonomy levels of the student groups in the classroom environments include both selected and unselected students are given in Table 2.

According to Table 2, there was a significant difference between the selected and unselected students in terms of cognitive taxonomy levels; U=35.00, p<0.05. When looking at the rank averages, it was observed that the promising students reached to higher cognitive level compared to their counterparts.

The observation data was supported by the data from interviews carried out with teachers. The interview question asked to the teachers was: "Could you tell us at what level of cognitive taxonomy (knowledge, comprehension, application, analysis, evaluation, creation) the promising students and average level students are, by considering the classroom activities? Give us some examples." According to the responses of most of the teachers in the interviews, all their students are at a level of analysis and evaluation, thus at the higher cognitive levels. The teachers also stated that the questioning abilities of the promising students can be seen clearly; they develop different solution methods in mathematics; they have powerful eloquences and also help to create a positive classroom environment by proposing different points of view and perspectives during the course. One of the teachers explained this as: "They develop different solution methods for questions asked in the math class, explain the question and also attract attention through their strong communication skills."

The Results Related to Type of Mathematics Learning

It is presented that either conceptual or procedural learning methods were used in the math courses by both the selected and unselected students with data obtained in the interviews. The question of "In which category can you evaluate the promising students and other students of average level intelligence in terms of procedural and conceptual learning types?" was asked to the teachers. The teachers stated that most of the promising students use conceptual learning types, but some of them use both. One of the teachers expressed an opinion related to promising students in math as follows: "I think these students use both learning methods. First, they learn the main outline of the subject and use this knowledge in problem solving and other matters." According to the opinion of another teacher; "They do not have any difficulties about the concepts, because they have a good memory with a strong infrastructure.

They prefer to solve a few questions (which require interpretation, visual, fun and allow them to show off), rather than solving a lot of questions." It can be said that the promising students in math think conceptually rather than procedurally, and their readiness helps them to think in this way. In another example of conceptual thinking of promising students in mathematics, the

Table 4. The results of Mann-Whitney *U* related to the content of instructional activities

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected	21	16.31	342.50	111.50	0.004*
Unselected	21	26.69	560.50		

*: $p<0.05$

Table 5. The results of Mann-Whitney *U* related to students' prior knowledge

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	26.07	547.50	124.50	0.007*
Unselected Group	21	16.93	355.50		

*: $p<0.05$

Table 6. The results of the Mann-Whitney *U* test about the student awareness

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	23.36	490.50	181.50	0.300*
Unselected Group	21	19.64	412.50		

*: $p<0.05$

Table 7. The results of Mann-Whitney *U* test related to anchoring activities

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	20.26	425.50	194.50	0.485*
Unselected Group	21	22.74	477.50		

*: $p<0.05$

teacher said that "these students can find the value of pi number" (even if it is not in the curriculum).

Most of the teachers claimed that students of average level of intelligence have procedural knowledge. One of the expressions obtained from the interview was: "The average-level student mention immediately about what they sum-up or subtract, without understanding the problem. In the end they cannot pull it off."

The Results of Learning Director

Table 3 presents the differences between the selected and unselected student groups' rank averages on leading the learning in the classroom.

The results given in Table 3 shows that there was no significant difference between the promising and average students' rankings in terms of directing learning; U=177.50, p>0.05. The activities used in the course were not sufficient enough to reveal the differences between the two groups in terms of managing learning.

Table 4 presents whether or not students' needs were fulfilled in the learning environment. There was a significant difference between the promising students in mathematics and the other average students; U=111.50, p<0.05. When considering the rank averages, the capability of meeting the needs of the students was in favor of the average students in the learning environment. This finding shows that the needs of the promising students in the regular mathematics classrooms were not met.

According to Table 5, there was a significant difference between the prior knowledge of the promising students in mathematics and the average students in terms of the effectiveness of the activities and teaching strategies used in the learning environment; U=124.50, p<0.05. Considering rank averages of both student groups, the promising students in mathematics had higher values. Thus, the prior knowledge of promising students in mathematics was more effective than their counterparts on the classroom activities and instructional strategies.

As shown in Table 6, there was no significant difference between the groups in terms of being aware of what was expected from them during the classes ; U=181.50, p>0.05.

According to Table 7, for being readily available of anchoring activities did not create any significant difference between the promising students in mathematics and the other average students; U=195.50, p>0.05. Both the promising students in mathematics and the other average students were affected almost equally from the acquirements and classroom activities.

Both student groups face certain learning experiences in the heterogeneous classroom environments; however, their level of learning performance was different or equal. The relation between the learning performances of the promising students in mathematics and other average students are given in Table 8.

Table 8. The results of Mann-Whitney *U* test related to learning performance

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	21.43	450.00	219.00	0.968*
Unselected Group	21	21.57	453.00		

*: $p<0.05$

Table 9. The result of Mann-Whitney *U* test related to individual assistance

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	13.69	287.50	56.50	0.000*
Unselected Group	21	29.31	615.50		

*: $p < 0.05$

Table 10. The results of Mann-Whitney U test related to problem solving and investigation

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	22.12	464.50	207.50	0.731*
Unselected Group	21	20.88	438.50		

*: p>0.05

Table 11. The results of the Mann-Whitney *U* test related to the respect level of students

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	23.57	495.00	177.00	0.242*
Unselected Group	21	19.43	408.00		

*: $p>0.05$

According to Table 8, there was no significant difference between the groups in terms of their learning performances in the classes; U=219.00, p>0.05. Thus, both the promising students in mathematics and the other average students show learning performances approximately at the same rates. During an observation, the researcher observed that in presence of an outspoken promising student in the same classroom with another promising student, less outspoken promising student became less active.

According to Table 9, there was a significant difference between the groups in terms of how much individual assistance they received from their teachers; U = 56.50, p<0.05. Considering the rank averages, it was observed that the average students received more individual assistance from teachers in the learning environment.

According to Table 10, there was no significant difference between the groups in terms of the encouragement of the lessons seeking and valuing multiple modes of problem solving and investigation activities; U=207.50, p>0.05.

According to Table 11, there was no significant difference between the two student groups in terms of expected level of respect in the classroom environment; U=177.00, p>0.05. In this study, the meaning of "respect" was taken as the responsibility demonstrated by a student to his/her classmates and teachers. The respect demonstrated by the students contributes to positive classroom management and control of the class by the teachers. Based on the observations, the promising students couldn't maintain respect to their classmates and teachers compared to their normal ability peers. The researcher observed that since the promising students did not have any missing prior mathematical knowledge and the quality of the lessons were low; they didn't concentrate very well and could not maintain their respect to others.

The Results about Teacher Role

The effects of students on the role of teacher in the class were compared. The results were presented in Table 12.

According to Table 12, there was no significant difference between both groups' feelings about their teachers' expertise in the field; U=164.50, p>0.05. However, the observation data showed that the questions of the promising students in mathematics were not fully met and many times, passed over.

According to Table 13, there was no significant difference between the promising students in mathematics and other average students in terms of transitions between activities; U = 204.50, p > 0.05.

Table 12. The results of Mann-Whitney *U* test related to teacher expertise

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	18.83	395.50	164.50	0.132*
Unselected Group	21	24.17	507.50		

*: $p>0.05$

Table 13. The results of Mann-Whitney *U* test related to the transition between activities

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	22.26	467.50	204.50	0.660*
Unselected Group	21	20.74	435.50		

*: $p>0.05$

Table 14. The results of Mann-Whitney *U* test related to classroom management strategies

Group	*n*	Rank Average	Rank Total	*U*	*p*
Selected Group	21	21.17	444.50	213.50	0.855*
Unselected Group	21	21.83	458.50		

*: $p > 0.05$

Table 15. Widely used teaching activities, their codes and percentages

Teaching Activities	Codes	Percentage (%)
Lecture with Discussion	LD	42
Classroom Discussion	CD	33
Lecture	L	29
Manipulative	M	14
Technology use-Teacher	TT	14
Questioning by Teacher	Q	11
Role Playing	RP	9
Technology use-Students	TS	0

According to Table 14, there was no significant difference between the groups in terms of being affected by teacher's classroom management strategies; U=213.50, p>0.05. Thus, both promising students in mathematics and the other average students were affected to a close or same degree from classroom management strategies. In addition, the observation data showed that some of these promising students were not in a classroom environment allowing them to express themselves.

Teachers' classroom management strategies are affected by the activities or techniques used in the classrooms. The percentages of widely used teaching activities and codes are shown in Table 15.

According to Table 15, the most common methods and techniques used by the teachers of regular classrooms were Lecture with Discussion and Classroom Discussion; whereas the least used method or technique was the use of Technology by the Students. It was also observed that the teachers barely use technology and manipulatives in classroom activities. In addition, questioning by the teacher technique, requiring deep thinking in the learning environments, was barely used.

DISCUSSION AND CONCLUSION

It is concluded that the mathematically promising students are more active in classroom activities and they improve the communication between the teacher and the students. The majority of promising students in mathematics were seen in the analysis or evaluation steps of the taxonomy. That indicates mathematically gifted students have higher-order cognitive skills compare to their normal ability peers. The majority of average ability students were at application level of the taxonomy, which is considered lower-order thinking. This result is supported by other studies as well (Zoller, 1993, 2000; Zoller & Tsaparlis, 1997). In addition, the promising students in mathematics, who have higher-order thinking skills, can use both procedural and conceptual learning methods at the same time. These students give more special attention to conceptual learning than their normal ability peers. They learn faster and more permanent compare to the average ability students.

Being in the same classroom environment with their normal ability peers causes some advantages and disadvantages for these gifted students. While their ability of understanding the subjects much quicker is an advantage, teachers' repetition of some topics for their normal ability peers causes some disadvantages such as getting bored. This boredom brings out some unacceptable or disrespectful behaviors. Another characteristic of promising students in mathematics is having high energy. When they get bored from the course and start to lose their respect or interest in the class; the negative behaviors and attitudes come along in the regular classrooms since these students always need something to do because of their high energy (Karakurt, 2003). This is not the only reason why these promising students lose their respect and interest in the course; it may be a perceived lack of appreciation of these students. In regular classrooms, the promising students try to get attention by some other means if they do not receive enough appreciation (Cutts & Moseley, 2004). This not only makes it difficult for teachers to control the classroom, but it also destroys the positive learning environment in which promising students in mathematics can contribute. The teacher must retake control of the classroom in order to restore this atmosphere of positive learning with a good classroom management strategy. Ozgan and Yılmaz (2009) mentioned six characteristics that a teacher has to have for good classroom management: the teaching-learning process, subject area and pedagogical content knowledge, classroom's physical status, class domination, communication and other. We found that the physical conditions of the classrooms are not good enough for a mathematics class such as insufficient number of manipulatives. The reasons that affecting the classroom management strategies are a) promising students do not show enough respect/interest in the course as expected b) insufficient individual assistance from teachers and c) using teacher-centered teaching methods.

Another factor affecting the students in regular classrooms was the mathematics content. The observed course content was inadequate in addressing the needs of the promising students in mathematics, as well as in revealing their higher-order thinking skills, in having them face challenging and compelling mathematical problems, and in pushing them for further investigation.. According to a study carried out by Uğurel and Moralı (2010), the teaching method in regular classrooms is teacher-orientated and based on mostly practices, applications and solving tests. This form of teaching offers students only lower-order thinking skills because there are insufficient activities or problems that include and require analysis, synthesis and evaluation skills.

The findings suggest that the mathematically promising students ask more advance questions in class and in cases where students' questions are not taken into account, the quality of lessons drops. Teachers' superficial responses to those questions do not satisfy their academic needs. The development of students' ability to ask questions and problem posing skills are just as important as answering questions (Metin & Dağlıoğlu, 2004). Students can ask questions to teachers only if they feel that the teacher is an expert in that subject. In line with the comments and findings of the research, it was observed that, in times, the teachers were not taken as experts by promising and average students. One of the conditions for teachers to be effective in the course is being well-educated in the subject matter and organizing activities consistent with the level of the students (Cubukçu & Girmen, 2008).

We conclude that the lessons shape around the mathematically gifted students. Even in low-profile activities the promising students in mathematics, stay active by making connections between their prior and current knowledge and by asking questions. The promising students in mathematics can mobilize themselves with their own internal motivation and enthusiasm for learning. Course content only meets the needs of students at the average level.

RECOMMENDATIONS

There is a lack of healthy learning environment to reveal the mathematical skills of the students in regular classrooms. A newer education program is needed in the regular classrooms to cater for promising students in mathematics.. The differentiated curriculum, which aims to design the education based on the needs of different ability students, may fulfill this curriculum need. The differentiated curriculum is designed based on the interest of the student, learning profiles and readiness for all ability levels. According to domestic and international literature, the implementation of differentiated curriculum has brought about successful results (Assouline & Lupkowski-Shoplik, 2011; Beler, 2010; George, 2005; Tomlinson, 2001, 2007; VanTassel-Baska, 1994). The differentiated curriculum should be at a level that allows students to gain higher-order thinking skills. The activities should primarily target conceptual learning, and should maintain the interest of students at a high level.

In regular classrooms, the most important tasks belong to the teachers. The teachers should attend the in-service training courses in order to identify the promising students in mathematics and how to implement the differentiated curriculum. The teacher must know the qualities of both promising students and the average students in order to meet their needs within the same classroom. In addition, teachers should closely follow the developments related to mathematics and teaching mathematics; thus, they may have the cultural background, new teaching techniques and expertise to respond the higher-level questions posed by promising students in mathematics. These skills will enable teachers to answer the challenging questions more confident, manage the classroom more professionally and demonstrate a productive teaching environment.

Some practices may be offered to the promising students in mathematics in order to improve their creative thinking skills in regular classrooms. Reading the life stories of some mathematicians, facing challenging math problems to make them think as a mathematician and organizing activities about the history of math can help them to see mathematics from different points of view. From an early age, promising students in mathematics should have the mathematical thinking skills by examining the products of previous mathematicians. Knowing or copying problem-solving methods or math proofs of previous mathematicians will inspire the next generation. The unique and original solutions or proofs may begin with the copying of previous ones.

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REFERENCES

Assouline, S., Lupkowski-Shoplik, A. (2011). *Developing math talent: A comprehensive guide to math education for gifted students in elementary and middle school* (2nd ed.). *Prufrock Press*: Waco, TX.

Beler, Y. (2010). Farklılaştırılmış öğretim ortamının sınıf yönetimine ve öğrencilerin akademik başarısına etkisi. Unpublished Master's Thesis. Maltepe University, Istanbul.

Budak, I. (2007). Matematikte üstün yetenekli öğrencileri belirlemede bir model. Unpublished Doctoral Dissertation. Karadeniz Technical University, Trabzon.

Budak, I. (2008). Üstün yeteneklilik kavramı ve tarihsel gelişim süreci. Journal of Qafqaz University. 1 (22). 164-173.

Büyüköztürk, S. (2009). Sosyal bilimler için veri analizi el kitabı. (10. Bs). Ankara: Pegem Akademi.

Cassady, J., Neumeister, K., Adams, C., Cross, T., Dixon, F., & Pierce, R. (2004). The differentiated classroom observation scale. *Roeper Review, 26,* 139-146.

Cutts, N. E. & Moseley, N. (2004). Üstün Zekâlı ve Yetenekli Çocukların Eğitimi. (Çev: İ. Ersevim). İstanbul: Özgür Yayınları.

Cubukçu, Z. & Girmen, P. (2008). Öğretmenlerin sınıf yönetimi becerilerine ilişkin görüşleri. Bilig Türk Dünyası Sosyal Bilimler Dergisi, 44, 123-142.

Davaslıgil, U. Türkiye'de üstün zekâlı çocukların eğitimi ile ilgili bir model geliştirme projesi. Nisan 29, 2012 tarihinde http://www.istanbul.edu.tr/hay/bilgi.php?islem=genel&b=12 adresinden alınmıştır.

Ekiz, D. (2009). Bilimsel Araştırma Yöntemleri. Ankara: Anı Yayıncılık.

Eymen, U. E. (2007). SPSS 15.0 veri analizi yöntemleri. İstatistik Merkezi Yayın No:1.

George, P. S. (2005). A rationale for differentiating instruction in the regular classroom. Theory into Practice. 44 (3), 185–193.

Gökdere, M., Küçük, M. & Çepni, S. (2003). Gifted Science Education in Turkey: Gifted Teachers' Selection, Perspectives and Needs, Asia-Pacific Forum on Science Learning and Teaching, 4 (2), Article 5.

Greenes, C. & Mode, M. (1999). Empowering teachers to discover, challenge, and support students with mathematical promise. In L. J. Sheffield (Ed.), Developing mathematically promising students (p. 121-132) Reston, VA: National Council of Teachers of Mathematics.

Hirsch, C.R. & Weinhold, M. (1999). Everybody counts-including the mathematically promising. In L. J. Sheffield (Ed.), Developing mathematically promising students. (p. 233-241). Reston, VA: National Council of Teachers of Mathematics.

Karakurt, B. (2003). Sınıf yönetiminde üstün zekâ ve yetenekli öğrencilere yönelik öğretmen tutumu. Mayıs 28, 2012 tarihinde http://www.egitisim.gen.tr/site/arsiv/35-2/107-sinif-yonetiminde-ustun-yetenekli-ogrenciler.html adresinden alınmıştır.

Karasar, N. (2010). Bilimsel araştırma yöntemi. (21.Bs.) Ankara: Nobel Yayınevi.

Krathwohl, D. R. (2002). A revision of bloom's taxonomy: An overview. Theory into Practice, 41 (4), 212-218.

Metin, N. & Dağlıoğlu, E. (2004). Üstün yetenekli çocukların eğitiminde öğretmenin rolü. I. Türkiye Üstün Yetenekli Çocuklar Kongresi. 23-25 Eylül 2004, İstanbul, Türkiye.

NCTM (National Council of Teachers of Mathematics) (1995). Report of The NCTM Taskforce on The Mathematically Promising, NCTM News Bulletin 32 (December): Special Insert, NCTM Inc., Reston, Virginia.

Ozgan, H. & Yılmaz, S. (2009). Müfettişlerin, Öğretmenlerin sınıf yönetimindeki eksiklikleri hakkındaki görüşleri. Ahi Ervan Üniversitesi *Kırşehir Eğitim Fakültesi Dergisi, 2* (10) , 57-65.

Parke, B.N. (1992). Challenging gifted students in the regular classroom. (Report No. EDO-EC-92-3). Reston, VA: Council for Exceptional Children. (ERIC Document Reproduction Service No. ED 352 774).

Stepanek, J. (1999). The inclusive classroom. Meeting the needs of gifted students: Differentiated mathematics and science instruction. Portland, OR: Northwest Regional Educational Lab.

Senol, C. (2011). Üstün yeteneklilerin eğitim programına ilişkin öğretmen görüşleri (BİLSEM örneği). Unpublished Master's Thesis. Fırat University, Elazığ.

Tomlinson, C. A. (2001). How to differentiate instruction in mixed-ability classrooms. USA, Alexandria, VA: Association for Supervision and Curriculum Development.
Tomlinson, C. A. (2007). Öğrenci gereksinimlerine göre farklılaştırılmış eğitim (Çev. Diye Kültürlerarası İletişim Hizmetleri), İstanbul: Sev Yayıncılık.
Tomlinson, C.A. & Imbeau, M. B. (2010). Leading and managing a differentiated classroom. Alexandria, VA: ASCD.
Uğurel, I. & Moralı, S. (2010). Ortaöğretim öğrencilerinin kümeler konusundaki öğrenmelerinin değerlendirilmesi-I. Akademik Bakis, Uluslararası Hakemli Sosyal Bilimler E-Dergisi, 22 (4), 1-25.
Usiskin, Z. (1999). The Mathematically Promising and the Mathematically Gifted, Developing Mathematically Promising Students. In L. J. Sheffield (Ed) Developing mathematically promising students. (p. 57-70). Reston, VA: National Council of Teachers of Mathematics.
VanTassel-Baska, J. (1994). Comprehensive curriculum for gifted learners. (2nd ed.). Toronto: Allyn and Bacon.
VanTassel-Baska, J. & Stambaugh, T. (2005). Challenges and Possibilities for Serving Gifted Learners in the Regular Classroom. Theory into Practice, 44 (3), 211–217.
Westberg, K. & Daoust, M. E. (2004). The results of the replication of the classroom practices survey replication in two states. Storrs: National Research Center on the Gifted and Talented, University of Connecticut.
Westwood, P. (1997). Commonsense methods for children with special needs: Strategies for the regular classroom. (3rd Ed.) Routledge: London and New York.
Zoller, U. (1993). Are lecture and learning compatible? Maybe for LOCS; unlikely for HOCS. Journal of Chemical Education, 70 (3), 195–197.
Zoller, U. (2000). Interdisciplinary systemic HOCS development – the key for meaningful STES- oriented chemical education. Chemistry Education: Research and Practice in Europe (CERAPIE), 1, 189–200.
Zoller, U. & Tsaparlis, G. (1997). Higher-order and lower-order-cognitive skills: The case of chemistry. Research in Science Education, 27, 117-130.

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