European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.1015056 Volume 3 | Issue 10 | 2017

THE EVALUATION OF MATHEMATICS LITERACY IN TURKEY BASED ON THE 2015 PISA RESULTS FROM THE PERSPECTIVE OF MATHEMATICS TEACHER CANDIDATES' OPINIONS AND RECOMMENDATIONS FOR SOLUTIONS

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Abstract:
The aim of the present study to evaluate mathematics literacy in Turkey based on the Turkish report of the 2015 PISA test from the perspective of mathematics teacher candidates' opinions as well as to discuss recommendations for solutions. The study is a special case study, the participants of which are 19 mathematics teacher candidates at Necmettin Erbakan University, Ahmet Keleşoğlu Education Faculty. The teacher candidates' opinions were elicited by means of sub problems consisting of open-ended questions. With the current study, it was concluded that changes and reforms need to be made in the Turkish education system, that the teachers, who play one of the key roles in the education system, are not adequately qualified and thus need to be open to changes and novelties and participate in professional development activities, and that students' parents also need to undertake some responsibilities.

Keywords: PISA 2015, mathematics literacy, teacher candidates

1. Introduction

There are numerous national and international exams being administered in Turkey for the purpose of obtaining assessment results with a high level of validity and reliability. At the national level, such exams as the Transition from Elementary to Secondary Education (TEOG) exam for the transition from elementary to secondary education, and the University Entrance Exam (YGS) and the Undergraduate Placement Exam (LYS) are

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administered for the transition from secondary to higher education. In addition, at the international level, such exams as the Progress in International Reading Literacy Studies (PIRLS) project, administered by the International Association for the Evaluation of Educational Achievement (IEA), and the Trends in International Mathematics and Science Study (TIMSS) are implemented. Another international study conducted at the international level is the Program for International Student Assessment (PISA). (Türkan, Üner, Alcı, 2015)

Program for International Student Assessment (PISA) which is a research project implemented by the Organisation for Economic Co-operation and Development (OECD) every three years to assess the knowledge and skills of 15-year-old students. The primary aim of PISA is to gain a clear insight into various aspects of youngsters, that is to reveal their learning motivation, their performance in the lessons and their preferences regarding learning environments. Within the PISA Project, data are collected regarding 15-year-old students' mathematics literacy, science literacy and reading literacy domains as well as their motivation, their self-perceptions, learning styles, school environments, and families at the end of their compulsory and the beginning of their formal education (MEB, 2017). The concept of "literacy" used in the project of PISA is defined as students' competencies in using their knowledge and skills while defining, interpreting and solving problems encountered in various situations in the areas of fundamental subjects, analysing these problems, making logical inferences, and establishing effective communication (MEB, 2016).

PISA is an educational project organized by the Organisation for Economic Co-operation and Development (OECD). This project is run by the PISA Administrative Board, affiliated to the OECD Directorate of Education and Skills. Such activities as the development of the tests and questionnaires used in the Project, the analyses of the data, and preparation of the international reports are done by consortiums established under the supervision of the PISA Administrative Board. Procedures of the PISA at the national level, such as translations and adaptations, implementation of the project, data analyses, and preparation of the national reports are carried out by national centers specified in each country participating in the project. In Turkey, the achievement tests and questionnaires developed within the framework of the PISA project are implemented in the month of April. In the countries participating in the Project, all schools with 15-year-old students enrolled in formal education (Elementary, General High School, Anatolian High School, Science High School, Vocational High School, Anatolian Vocational High School, Multiple Program High Schools, Private Schools etc.) can participate in the PISA Project. The PISA Project was initiated in the year 2000. Turkey started to participate in the Project, which is implemented every three years, in

2003. In the PISA Project, various types of questions, such as multiple-choice, complex multiple-choice, open-ended, and closed-ended are used. The selection of schools and students to participate in the PISA Project are made by OECD via random sampling. In 2015, computer-based achievement tests were conducted for the first time. Subsequently, questionnaires were administered to these students.

The results of the PISA Project are organized as a national report. These results are used to eliminate the deficiencies encountered in developing teaching-learning programs and as a resource in research studies conducted in the field of education.
The 2015 PISA National Reports were announced by the OECD secretariat in December 2015 at http://www.oecd.org/pisa. The National Report of the results related to Turkey can be accessed at pisa.meb.gov.tr.

The 2015 PISA, which was the 6th implementation of PISA, was conducted in 2015 with the participation of approximately 540,000 students, representing approximately 29 million students in 72 countries and economies, 35 of which were OECD members (MEB, 2016).

In numerous countries across the world, PISA, which aims to measure students' level of knowledge and skills primarily assesses their skills in the domains of science, mathematics and reading. While this assessment is done, these primary domains are defined by using the concept of "literacy". The skills needed for mathematics literacy are problem solving, the computation skill, and interpretation, evaluation and in-depth analysis of mathematical results.

Ersoy (2003) defined mathematics as a separate universal language and nations' common culture structured upon the foundation of native language and culture. Ersoy asserted that it would be misleading to talk about technology without science, and about science without mathematics. Within this context, Ersoy emphasized mathematics literacy by mentioning students' learning of mathematics and their being aware of mathematical ideas. Ersoy draws attention to the fact that individuals with a low level of mathematics literacy may experience problems in pursuing their life and in life-long learning. In addition, Ersoy lays emphasis on the need to take measures in increasing mathematical literacy.

With the developments in technology, new problems, which prior generations did not experience, are encountered. For this reason, there is a more pressing need for individuals who value mathematics, has a developed mathematical thinking ability, and can use mathematics in modelling and solving problems (MEB, 2013).

As of the administration of the 2012 PISA, in every administration to what extent students possess fundamental knowledge and skills in an innovative area is assessed.

While this new area was "creative problem solving" in 2012, it was "co-operative problem solving" in 2015 (MEB, 2016).

Problem solving is an inseparable component of the mathematics subject. A problem should not be perceived as an exercise and questions whose method of solution is known beforehand. For a mathematical situation to be a problem, there should be a need to use various knowledge and skills together and there should not be a routine based method of solution. The problems should be associated with the student's life, should be interesting for the students and a need for them should be felt by the students. In such a situation, the mathematical knowledge and skills students learn will be more meaningful and it will be easier for them to apply this knowledge to different situations. Open-ended questions should also be given place in the mathematics subject. These are those types of questions which can be solved by using more than one strategy or can yield different results (MEB, 2011).

The problem solving skill includes the skills necessitated for the problems that students will face encounter in life. The subskills of problem solving can be listed as follows: understanding the problem, finding the sub-steps or the roots of the problem if necessary, planning to solve the problem appropriately, observing the work during the operations, changing the strategies and plans when necessary, experimenting the methods, evaluating the data and knowledge obtained during the solution, evaluating the meaningfulness and usefulness of the solution once the solution is reached, and becoming aware of the problem (MEB, 2013).

The PISA test aims to assess how students make meaning out of what they know and how to apply their mathematical knowledge in new and different situations. To this end, the majority of the PISA mathematics units and questions makes reference to real life situations in which mathematics skills are essential to solve a problem (MEB, 2016).

The area of mathematics literacy aims to measure students' skills in being able to formulize, use and interpret mathematical situations. It can be seen in the table below that the level of performance in mathematics literacy in PISA 2015 was lower when compared to PISA 2009 and PISA 2012.

Table 1: Average mathematics literacy scores by years (MEB, 2016)

	PISA 2015	**PISA 2012**	**PISA 2009**
Average of OECD	490	494	496
Average of all countries	461	470	465
Average of Turkey	420	448	445
Ranking	50	44	41
Number of participant countries	72	65	65

1.1. Literature

When the literature on the PISA test reports of Turkey is reviewed, this exam, which has been administered in Turkey since the year 2003, draws attention to the fact that Turkey is not at the desired level in terms of both mathematics literacy and students' performances in other areas, and as regards the results of the questionnaire implemented at the end of the exam.

Erslan (2009), who conducted one of the comparative studies on PISA, has drawn attention to four important elements in Finland's education system underlying the success of Finnish students in the PISA exam. These are teacher training programs, conventional school life, a cultural perspective to the teaching profession and in-service teacher education. In light of these factors, Erslan has maintained that for Turkey, raising qualified teachers and making the necessary changes and organizations toward this is of priority.

Using the 2003 PISA data, Akyüz and Pala (2010) examined in their study the impact of student, family and grade variables on students' mathematical literacy and problem solving skills. They advocated that while exploring the factors affecting success, comparisons with other countries should be made and, thus, they made comparisons by establishing structural equality models for each country. They found that the level of education and professions of the students' parents had a positive impact on their mathematics literacy and problem solving skills in the three countries compared. Moreover, they reported that there was a positive correlation between students' attitudes towards mathematics and their mathematics literacy.

In their evaluation of the 2009 PISA results, Özenç and Arslanhan (2010) stated that even though the curriculum programs in formal and non-formal education underwent gradual changes, were renewed and implemented and, within this scope, the education programs of many subjects were renewed between the years 2005 and 2009, Turkey proved to display limited improvement in the 2009 PISA results and that these applications did not yield success in increasing Turkey's score as a whole to a higher level. They indicated that what had been done so far remained in vain and that it was for this reason that there was a need for a comprehensive change in the curricula and, in fact, a need for a comprehensive educational reform.

In a study by Çelen, Çelik and Seferoğlu (2011), it was highlighted that the PISA results played an important role in evaluating changes and determining deficiencies, and that such topics as the strengths and weaknesses of the current education system, educational policies, teaching programs, teaching methods and techniques, and competencies of teachers can be addressed with the help of the data obtained from the results.

İnan and Bekler (2014) conducted a descriptive study by employing the literature survey method. It was observed that, based on the exam results, Turkey was behind particularly the other OECD countries. In this study, Turkey's performance in the PISA exams is evaluated and certain recommendations regarding teacher education is made for Turkey to take place at higher levels in the ranking.

A study by Türkan, Ünel and Alcı (2015) aimed to examine whether the 2012 PISA Mathematics Test scores showed variation in terms of certain variables. As a result of the analyses, it was found that success scores in the 2012 PISA Mathematics Test varied by gender, the age at which the computer was first used, whether the mother worked, whether there was a computer in the home, whether the student had a bedroom of his/her own, and the number of books at home.

A study conducted by Şahin and Yıldırım (2016) on the Turkish sample of the 2012 PISA tested the hybrid model test, which is defined with the variables of instrumental motivation, mathematics identity concept, mathematics self-efficacy, mathematics anxiety, and interest in mathematics, which are believed to affect mathematical behavior and mathematical literacy, and examine whether or not the model varied by gender and type of school (general high school, Anatolian high school, vocational high school). As a result of the study, they arrived at the finding that the established model accounted for 44% of mathematical behavior and 39% of mathematics literacy.

Döş and Atalmış (2016) conducted a study in which they explored how the data on the education of countries present in the OECD reports predicted the countries' PISA scores. Regression analysis and ANOVA were used to analyze the data. As a result of the linear regressional analysis, they found that the sole variable that significantly predicted the mathematics, reading and science scores in PISA was the salary of the teacher.

Aksu and Güzeller (2016), who examined the 2012 PISA mathematics literacy results in Turkey, aimed to categorize the students who were successful and unsuccessful in the exam in terms of their interest in the mathematics subject, their attitude, motivation, perception, self-efficacy, anxiety and study habits and to reveal the impact of these variables on the categorization. They stated that their perception of self-efficacy, and their attitude towards and study habits in the mathematics subject were the most important affective features. They stressed that certain adjustments should be made by focusing on these factors in order for Turkey to rise to higher levels in the PISA exam.

A study by Çetin and Solmaz (2017) presented the international assessment results as regards the education field in Singapore and Turkey and comparatively

examined the history of the integration of cognitive technologies in both countries' field of education. This comparative study was based on the method of historical analysis. Under the light of the research findings, they stated that integration was essential, but it would be useful and effective only if it supported the process learning and teaching to meet the needs of the current era. In addition, they emphasized that during the planning of the integration of cognitive technologies, instead of focusing solely on the ability to use technological devices, the use of cognitive technologies in the process of learning and teaching in all subject areas should be focused on.

1.2 The Purpose of the Study

Thanks to the PISA Project, to what extent the fundamental knowledge and skills of students graduating from compulsory education in countries where the test is applied is assessed. In the year 2015, approximately 540,000 students were administered this test. That Turkey ranked 50th in the area of mathematics literacy in this implementation, in which 72 countries and economies participated was the starting point of this study. The aim of the study was to evaluate mathematics teacher candidates' opinions regarding the results and to propose recommendations for solutions under the guidance of the 2015 PISA Turkey National Report and the related literature. As the topic under discussion is the mathematics literacy of the PISA research, it is inevitable that the opinions of the current teacher candidates, who will be teaching in this area in the future, are addressed. The opinions and recommendations of the teacher candidates were received by means of open-ended questions based on the sub problems of the research. The study tried to reveal the reasons underlying the fact that Turkey was not at the upper levels of success, and opinions regarding possible recommendations for solutions were elicited. It is discussed in more detail in the section on findings and interpretations.

2. Method

In the present study, the special case approach was used. A study by Baxter and Jack (2008) reported that special case studies have the potential to deal with complicated situations as it focuses on one case. Furthermore, they stressed that it gives the researcher the opportunity to ask the questions "how" and "why", to collect data from various sources and to combine all this to enlighten a special case. Thus, with the special case study method, the present research study seeks to answer open-ended questions with the aim of investigating what factors affect the Turkey's results in the 2015 PISA.

2.1 Research Group and Sample

The sample group of the present study was comprised of 19 mathematics teacher candidates at Necmettin Erbakan University, Ahmet Keleşoğlu Education Faculty. The open ended questions based on the sub problems of the study were posed to the teacher candidates during the 2016-2017 academic year.

2.2 Means of Data Collection and Data Analysis

The data collection tools were identified by taking into consideration the sub problems to be researched. 4 questions were prepared to examine Turkey's situation in the PISA exam and to reveal what could be done as regards this topic. The questions were prepared with the aim of investigating the following sub problems:

1. What are the factors that have a negative impact on Turkey's success based on the PISA exam results?
2. What are some recommendations for solutions regarding Turkey's situation based on the PISA exam results?
3. What can be done to increase the level of students' mathematics literacy?
4. What can be done to increase students' problem solving skills?

3. Findings and Interpretations

In this section, the statistical analyses run according to the responses of the teacher candidates are presented in detail. Moreover, interpretations are made of the findings that the study yielded.

The teacher candidates' responses to the sub problem, "*What are the factors that have a negative impact on Turkey's success based on the PISA exam's results?"* were examined, and the distribution of the sub themes that emerged in the responses are presented in Table 1.

Table 1: The distribution of the answers given by the participants to the question regarding the sub problem of "*What are the factors that have a negative impact on Turkey's success based on the PISA exam's results?"*

Sub-Themes	Frequency (f)	Percentage (%)
The education system	12	66.6
Technology	5	27.7
Students' deficiencies in meaningful and permanent learning	2	11.1
The education level of the parents	1	5.5

As can be understood from the table, the teacher candidates mentioned the factors negatively affecting Turkey's success in the PISA exams under four sub themes. A majority of the teacher candidates, 66%, mentioned the education system as a factor having a negative impact on success, while 27.7% of the teacher candidates participating in the study mentioned technology, 11.1% mentioned students' deficiencies in learning and 5.5% mentioned parents' level of education as factors having a negative impact on success.

The detailed responses related to the first sub theme – "Education system" – are presented in Table 2.

Table 2: Detailed Responses Related to the First Sub Theme

Teacher Candidate Code	
T1	Confusions experienced due to changes in the education system
T2	The lack of a student-centered education
T3	Deficiencies in the education system
T4	An exam-based education system
T5	An education system based on rote memorization
T6	Frequent changes in the education system
T7	Teachers' lack of motivation

The education system problem, which ranked first among the factors having a negative impact on success, should be considered to have various aspects and should be addressed from different perspectives. In a study by Nayir (2016), it is emphasized that the Turkish Education System is a rather extensive system with the number of teachers and students and that frequent changes within this system adds to the existing problems. In addition, it is asserted that the daily politics and applications in teacher education programs changes the dimension of the problem and at this point is important in revealing the problems experienced within the system and the possible solutions. Furthermore, it is stated that to identify the problems, the stakeholders within the system should be aware of the problems and express their opinions regarding these problems. Indeed, when teacher candidates participating in the research become aware that this is a problem, it will be a first step in eliminating the missing parts constituting the whole. PISA is accepted as a determinant factor in assessing countries' education systems. As a result, the test results should be examined not only by eduationalists but also by politicians. The investments in Turkey should be shifted to the area of education in order for changes and reforms to take place in the system of education. With an

increase in investments in the area of education, identification and elimination of the deficiencies and flaws and more immediate and permanent solutions will be achieved.

The education system in Turkey has in recent years undergone numerous reforms. Among the primary reasons are increasing the quality of education and establishing an education system in which qualified individuals will be raised. Importance has been attached to establishing enjoyable and useful courses that are associated with daily life and to avoiding courses based on rote-memorization. The curricula have undergone changes and the weight of the topics has been lightened. Nevertheless, a decrease in the level of success based on the PISA results have been observed in recent years. According to the research results, the main reason underlying this decrease in success is the education system, whereas the reforms in the system targeted a more qualified education system. It is evident that there are deficiencies at this point.

Educators and students should undertake more responsibilities in this area. Students' exam-oriented study habits and teachers' inability to implement student-centered lessons are among the important factors affecting success. Moreover, the teacher candidates report that the centralized national exams administered in Turkey have a significant role the education system that is based on rote-memorization and exam-oriented study habits. Starting with TEOG, this marathon continues with YGS and LYS. Students who proceed their education with an anxiety for the future focus on these exams during their education. This leads to the other problems in the education system. Furthermore, in terms of teachers' lack of motivation, it is observed that the number of teachers who can keep up with technology and science in a rapidly changing and developing world, who want to develop themselves professionally and who have a high level of motivation is low. There are numerous reasons underlying this situation, one of which is the salary of the teachers in Turkey. This is one other area where the economic resources of the country can be transferred to the field of education. Hence, we can say that the 'to do' list for an education system aiming to raise qualified individuals is long and that this list should be addressed in a way that yields permanent solutions.

The detailed responses for the second sub theme – "Technology" – are presented in Table 3.

Table 3: Detailed Responses for the Second Sub Theme

Teacher Candidate Code	
T1	The negative impact of the social media on students
T2	The unconscious use of technology
T3	The lack of responsibility in students caused by technology
T4	The impatience in students caused by the rapid development in technology
T5	Students' designating a large amount of their time to the use of technology

The rapid development in technology is not only stunning but also provides certain conveniences. Time is undoubtedly the most valuable treasure. One of the greatest gifts of technology to human life is time saving. When we think of the periods when there was no calculator, we can understand how time consuming, long and tiring the calculations we did using pen and paper were; today we can make our air flight with a single display of a data matrix on our smart phones. We are in an era in which we can build houses by means of 3D printers. Naturally, there are certain consequences of positive and negative uses of all kinds of innovations. When the responses of the teacher candidates are taken into consideration, it can be understood that students' association with technology today is more geared towards entertainment and loss of time, whereas the use of technology in education can enable abstract knowledge to be concretized and permanent and experiential learning to be realized. In a study by Aydın and Yavuz (2016), it was highlighted that thanks to the rapidly developing technology, the information that one wants to reach is very easy. Today, the place of knowledge and technology in production is rapidly increasing. To be a productive society, we need to use technology in life effectively. However, this does not mean wasting most of the time available on technology. One must act on the view that time is money, so we need to use technology effectively when necessary, that is, at the point of accessing information. We should raise students' awareness in using technology in their social life usefully, without making it a hindrance to their education.

Ensuring that learning is permanent and meaningful is primarily the responsibility of educationalists. Effective methods lead to information retention (Yavuz and Çenberci, 2016). Teachers should use different methods and approaches to make permanent learning active for students. For example, Tol, Çenberci and Yavuz (2016) came to the conclusion in their study that teaching mathematics together with its historical development results in a more effective and permanent learning environment and individuals will learn by arriving at a meaningful and permanent understanding of a concept rather than memorizing it. Another study, conducted by Çelen, Çelik and

Seferoğlu (2011), examined the education system of Turkey based on the PISA results. The researchers claimed that for evident changes to take place in the results, quantitative changes need to be followed by qualitative changes in education. Moreover, for permanent learning, opportunities in access to technology and information should be provided in order to make use of multiple environments appealing to more than one sense for permanent learning.

5.5% of the teacher candidates stated that one of the factors having a negative effect on success in PISA exams is parents' level of education. Aydın, Sarıer and Uysal (2012) maintained in their study that the higher the level of education of the parents is, the higher the level of success students reach. While the percentage of (35-44-year-old) parents who are high school graduates was found to be 25% in Turkey, in successful countries this percentage is nearly 90%. Furthermore, Akyüz and Pala (2010) asserted in their study that one of the factors having a negative effect on mathematics performance was students' socio-economic status. They stated that there are studies conducted with different ethnic groups, which indicate that the higher the educational level of the students' family is, the higher the academic performance student's show. Indeed, we can say that the level of education of the parents contributes to education not only by helping students with their lessons or homework, but also by guiding them and raising their awareness appropriately. Another study, conducted by Çelenk (2003), reported that the children from families who displayed a supportive attitude in terms of education and were in agreement with the common program and in regular communication with the school had a higher level of school success; that family care, affection, and protection were important factors in increasing school success; and that parents who provided educational support within a common understanding had a higher level of success at school. Consequently, it is proposed that parents should be informed of the teaching activities implemented in the classroom and the educational approaches implemented by the school, and that the school and family members should co-operate and, within this framework, parents should be trained to pursue active co-operation as regards the education of the student.

The distribution of the responses the participant teacher candidates gave to the question, "*What are some recommendations for solutions for Turkey's situation based on the PISA exam?"* are presented in Table 4.

Table 4: The distribution of the responses the participant teacher candidates gave to the question, "*What are some recommendations for solutions for Turkey's situation based on the PISA exam?"*

Teacher Candidate Code	
T1	The topic presented should also be associated with its place and use in real life.
T2	The quality of education faculties should be improved.
T3	Teachers should pursue their professions with motivation.
T4	Technology should be used consciously.
T5	Qualified teachers should be raised.
T6	Teachers should try to know their students.
T7	Effort should be made to enable students to enjoy their lessons.
T8	Families' level of awareness should be raised.
T9	Students should be made to adopt reading habits.
T10	Multiple choice based tests should be taken out of the exam system.
T11	Education should be well-organized and systematic.
T12	Use of materials in lessons should be increased.
T13	Teachers should be more sensitive.
T14	Homework should be assigned to students not as a punishment or a burden, but as a voluntary task.
T15	Memorization should be refrained from in education.
T16	Education should aim to increase students' level of motivation.
T17	The teaching profession should not be regarded solely as work; it must not be forgotten that a duty is sacred.
T18	Students should undertake more responsibilities.

As can be observed in Table 4, in addition to the education system, technology and family, as factors affecting students' failure, opinions stating that teachers have deficiencies are also highly frequent. We hope that since these responses were given by prospective teachers, who will be teaching in the future, the current teacher candidates will, in the future, try to eliminate these deficiencies, starting with their own deficiencies. Some of the teacher candidates highlighted that teachers need to be motivated while pursuing their teaching profession. We can say that the other responses given to the question related to the sub problem are associated with teachers' doing their profession in a motivated way. The reason is that when a teacher spends more time in planning for a lesson, this means he/she gets to know the students, and thus, knows by experience how they can learn more effectively and prepares accordingly, uses technology effectively to ensure permanent learning, prepares real life samples to increase students' motivation, dwells on concepts that can be associated

with other disciplines, and finds problems that enables students to think critically rather than engage in rote-memorization.

Considering that teacher candidates are also students, we can say that they may have given responses to some questions by establishing empathy because neither students nor teacher candidates are happy about the multiple choice based centralized exams. The KPSS, which they will have to take upon graduating from the faculty of education, may be the reason underlying their response, or they may give such a response owing to the fact that critical thinking and interpretation is limited in multiple choice exams, when compared to open-ended questions.

Another topic that was assessed within the 2015 PISA Survey administration was teacher behaviors hindering learning. The data obtained from the views of school administrators are displayed in the graph below.

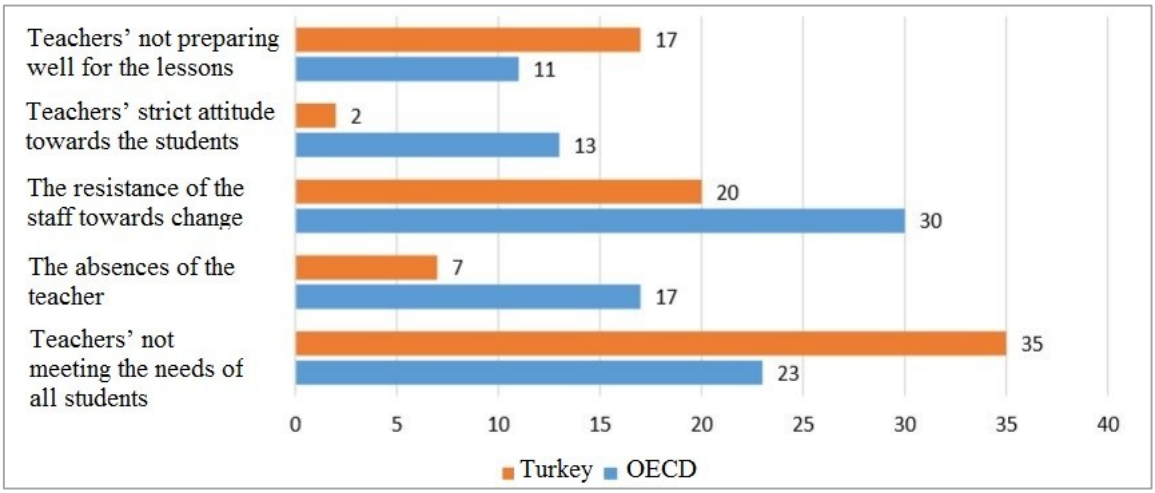

Figure 1: The teacher behaviors hindering learning from the perspective of school administrators (MEB, 2016)

In addition, recent studies carried out to raise qualified teachers should be examined. It was stated in the 2015 PISA National Report that there are three fundamental principles in teaching: teachers' professional autonomy, participation in colleague networks, and development of teaching knowledge. Supporting participation in teachers' Professional development activities is one way to develop teaching knowledge, which is one of these fundamental principles. As in other professions, teachers should also follow up on the developments in their own fields and participate in professional development activities. According to the 2015 PISA national report, less than one quarter of the teachers in Turkey had participated in a professional development program in the last three months. This percentage is far behind the percentage reported in other countries.

The responses given by the teacher candidates participating in the research to the question "*What can be done to increase the level of students' mathematics literacy*" are presented in Table 5.

Table 5: The responses given by the teacher candidates participating in the research to the question *"What can be done to increase the level of students' mathematics literacy"*

Teacher Candidate Code	
T1	Teachers who are competent in their fields and open to novelties should be raised.
T2	Mathematics should be taught by associating it with dialy life.
T3	Mathematics lessons should be made enjoyable for students.
T4	Students should be able to express what is required in the problem.
T5	Qualified teachers should be raised.
T6	Importance should be given to science and technology.
T7	The constructivist approach should be taken into consideration.
T8	Mathematics groups should be established.
T9	Individuals who are interested should take the mathematics courses.
T10	Students should be encouraged to learn actively.
T11	The number of hours for mathematics lessons should be increased and students' level of awareness should be increased in this area.
T12	Education based on rote-memorization should be refrained from.
T13	Topics related to mathematics literacy should be added to the curriculum.
T14	Meaningful learning should be made more active.
T15	Open-ended questions should be preferred in exams.
T16	Students should be enabled to understand the transition from verbal representation to numerical representation.
T17	Reading comprehension should be given importance to in classes.
T18	Students should play an active role during mathematics lessons.

When Table 5 is examined, it can be observed that in general the responses show parallelism with the responses given to the previous sub problem mentioning education based on rote-memorization and the concept of qualified teachers as well as recommendations specific to mathematics lessons. It is believed that especially classroom activities are important as they keep students' perceptions alert and their attitude towards the mathematics lesson positive. In addition, it is claimed that open-ended questions should be used, as opposed to multiple choice items. It is evident that teachers have an important duty to create positive changes in students' attitudes towards the mathematics course. Initially, preparation should be made to draw

students' attention to the course, enable them to become motivated and most importantly, ensure that they enjoy and like the course. The impact of experiential learning on permanent learning cannot be denied. Accordingly, the activities prepared for the mathematics lessons should be selected and implemented carefully. Students should be given an active role in learning and their interest and motivation should be increased so that learning becomes enjoyable on the part of not only the teacher but also the student. Some concepts should be made to raise curiosity in students and instil in them the desire to do research and, thus, encourage them to engage in active learning.

Dibek and Demirtaşlı (2017) stated in their study that mathematics literacy was mostly associated with the variable of classroom discipline. They recommended that the courses that teachers take in teacher education programs should develop their classroom management skills, should teach them how to effectively teach the use of cognitive activation strategies or ensure that new courses are introduced.

The responses that the teacher candidates who participated in the study gave to the question, *"What should be done to increase students' problem solving skills?"* are presented in Table 6.

Table 6: The responses that the teacher candidates who participated in the study gave to the question, *"What should be done to increase students' problem solving skills?"*

Teacher Candidate Code	
T1	Students should be made to apply the steps to follow in solving problems.
T2	More effective observations should be made to increase these skills in students.
T3	Students should be made to solve problems via the discovery method.
T4	The constructivist approach should be taken into consideration.
T5	Questions based on problem solving should be asked.
T6	Students should be made to engage in activities that involve problem solving.
T7	Traditional methods should be refrained from.
T8	Students' awareness should be raised for the phase of structuring the problem.
T9	The critical thinking skill should be developed.
T10	Students should be encouraged to think independently, without being under pressure.
T11	The level of association between the problem solving skill and the mathematics course is high. For this reason, the importance of mathematics should be taught.
T12	Students should feel no family pressure. A democratic family environment should be developed.
T13	Courses based on problem solving should be offered in faculties.
T14	Teachers should treat students fairly and encourage them to solve problems.
T15	A democratic classroom environment is compulsory.

When Table 6 is examined, it can be observed that four teacher candidates did not respond to this sub problem. They may have thought that they do not have the necessary knowledge to make interpretations on the concept of problem solving.

Akyüz and Palan (2010) stated in their study that there was a high correlation between the domain of problem solving and the other areas, specifically with mathematics literacy. They highlighted that such skills as particularly inferencing and reasoning were important for both mathematics and problem solving. Accordingly, we can say that what needs to be done to increase students' mathematics literacy is also valid for increasing problem solving skills. It can be said that considering the teacher candidates' responses, teachers and families need to undertake responsibilities in this area. Appropriate learning environments both at school and at home need to be established for students to be successful in problem solving. Teachers should be equipped with the necessary skills in terms of developing students' problem solving skills, should effectively use their own skills during the preparation phase of the lesson and during the lesson and establish the appropriate environment for the students. In addition, as highlighted by the teacher candidates, instead of using the traditional methods, the innovative methods in education should be used to guide and support students. Within the family environment, such factors as the presence of a democratic environment, the family members freely expressing themselves, not being under the pressure of a certain person in the family and the presence of an effective communication enable students to think more freely and comfortably and, thus, engage in critical thinking and produce more creative methods of solutions to problems. Furthermore, families' giving responsibilities to children, including children into the process of seeking solutions to problems experienced within the home, and asking for children's opinions too during the brainstorming done to produce a solution to a problem all contribute positively to students' problem solving skills.

As students become more successful in problem solving and feel the value attributed to their methods of solution, their self-confidence in solving mathematics problems will also increase. Hence, students will adopt a more patient and creative attitude while solving problems. They will learn to communicate by means of mathematics and develop high level thinking skills (MEB, 2011). Consequently, it can be advocated that being successful in problem solving will have a positive impact on the level of mathematics literacy and, thus, lead to success in some national and international exams.

4. Conclusion and Recommendations

In the current study, which was conducted based on the 2015 PISA National Report and the related literature, teacher candidates were posed questions related to the sub problems prepared in relation to the factors impacting Turkey's place in the PISA ranking and recommendations that can be made for solutions. Evaluations have been made based on the teacher candidates' opinions. It was emphasized that primarily changes should be made in the Turkish education system; in addition, some measures need to be taken regarding teachers, who undertake one of the key roles in the education system. That teachers need to be equipped with the essential skills was evident in the responses given to all the sub problems. Hence, the conclusion that teachers should be open to change and novelties as well as participate in professional development activities was reached. Moreover, the conclusion that families, who have a significant impact on students' success, have important duties to undertake, and thus, families need to be in co-operation with the school and for this reason, they need to be trained so that their awareness is raised, and ultimately they can contribute to students.

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