PRINT: ISSN 0975-1122 ONLINE: 2456-6322
Int J Edu Sci, 15(1,2): 148-156 (2016)
DOI: 10.31901/24566322.2016/15.01-2.17

Anthropological Theory of Didactics and the Probability of the Constructivist Approach Being a Solution to the Common Mistakes Made in Mathematics Lessons

Murat Tezer[1] and Meryem Cumhur[2]

Near East University, Education Faculty, Department of Mathematics Education, Lefkosa, Mersin 10, Turkey 99138
Telephone: +903922236464/110
E-mail: [1]<murat.tezer@neu.edu.tr>, [2]<meryemcumhur1983@gmail.com>

KEYWORDS Constructivism. Mathematics. Problem-solving. Misconception

ABSTRACT In the anthropological didactic teaching method, knowledge is passed to the students through individuals and institutions, which generates problems that may result in multiple misunderstandings in mathematical teaching. These misconceptions become apparent in mathematics lessons as common mistakes. The purpose of this study is to identify teachers' views regarding the common mistakes made during problem-solving in mathematics and whether the constructivist approach is thought to be a solution. The study group consisted of 30 primary school teachers teaching in both state and private schools in Northern Cyprus. The data of the current study was collected through face-to-face interviews with those teachers. All the teachers who participated in the study had supportive and positive answers concerning the common mistakes made during problem-solving in mathematics and considered that the constructivist approach could be a solution.

INTRODUCTION

There have been a number of studies in the literature that aimed to identify and remove misconceptions in mathematics lessons. However, although there are methods, strategies and environments that are used to remove these misconceptions, students start to repeat them after a certain time. Didactical theory claims that educational activities are composed of three components, that is, teacher, student, knowledge, and it tries to examine the relation between these components (Pino-Fan et al. 2015; Nar 2015). If any misconceptions occur it is likely that certain problems may emerge.

The general problems of the transmission of knowledge that have been a reference for teaching have been researched in the anthropological theory of didactics. There are three main concepts of objects (O: a number, a mathematical concept, anxiety, a topic in mathematics), individual (X: student, teacher) and institution (I: mathematics lesson, school, classroom, institute) (Chevallard 1989, 2008). Learning, in this theory, is described as individual X's exchange of personal knowledge that belongs to individual O. This means that if there is no personal knowledge it starts to occur; however, if there is, it starts to develop. One of the most important objects of the anthropological approach is knowledge. Knowledge has to be learnt or taught to be accepted as recognized by an individual. Therefore, learning and teaching should be within an institution. The fact that knowledge has to be learnt or taught means that the common mistakes made in mathematics lessons are learnt by individuals and the knowledge can be transferred again with the constructivist approach. At this point, it is thought that a relation can be established between the anthropological theory of didactics and the constructivist approach (Yildirim and Sahin 2009).

The current research undertaken in primary schools was targeted to help remove the common mistakes and misconceptions that occur in mathematics lessons. These are accepted as an object and the primary school is accepted as an institution, according to the anthropological approach.

The constructivist approach in mathematics education demonstrates how students learn and what teachers can do in order to strengthen

Address for correspondence:
Dr. Murat Tezer
Associate Professor
Near East University, Education Faculty
Mathematics Education, Lefkosa, Mersin 10,
Turkey, 99138
Telephone: +90 392 22 36 464 /110
E-mail: murat.tezer@neu.edu.tr

students'understanding. So, one can conclude that constructivism is quite important in terms of providing more meaning to today's mathematics education system. For this student-oriented approach to reach its aim, teachers have significant roles (Yurdakul 2005; Yoon and Kim 2016). For most scholars, the constructivist approach does not have parallels with the field of mathematics, since there are real and certain results, principles, theories and rules that never change (Ishii 2003). This is why it is thought that the constructivist approach cannot easily be adopted into mathematics. Mathematics has certain results, has connections with other disciplines and with real life. Not surprisingly, a number of meanings are inferred from these connections and it is the main reason why mathematics is best known as a collection of rules.

Teachers often ask questions in order to renew and refresh their students' explanations as well as arguments about their studies. They use different expressions of mathematical ideas to enable their students to gain a better mathematical understanding. These teachers want their students to explain what mathematics is. At this point, the constructivist approach becomes meaningful. In that respect, teachers expect their students to solve distinct problems, adopt mathematics into real life conditions and in addition to all these, improve what they already know. Sometimes they use calculators, and sometimes a paper and a pen (Yoon and Kim 2016). With regard to geometry, a sub-group of mathematics, it can be concluded that it has its own special concepts and formulas within itself. Students need plenty of time to develop trust in using that language. Therefore, the descriptions in geometry should be obtained from the experiences of classification, visualization and construction of figures according to their characteristics. Thereupon, students should be given sufficient time to comprehend as well as consolidate all these descriptions. Consequently, these new descriptions emerge with the construction of students' experiences from the data presented (Cetin-Dindar 2016).

Mathematics lessons seem to be quite difficult for students. It is also the main subject in which students become unsuccessful. According to Alves et al. (2016), most students develop a negative attitude towards mathematics in general and towards geometry in particular. The primary reason for this is that students consider that these lessons are difficult. Ciltas et al.'s (2012) study about the research of articles about mathematics education in Turkey found that there are few studies about geometry up to 2009. This indicates that it is not only the students who develop negative attitudes towards mathematics lessons, but also the mathematics educators. Thus, it can be concluded that the mathematics educators avoid carrying out research about mathematics in general.

Constructivism

Learning is establishing, in the theory of constructivism. In other words, the new knowledge is established over the previously constructed knowledge. Constructivism is not a teaching strategy, it is a learning environment where students are actively busy with learning. In this respect, the teacher is the one who creates this active environment (Ektem 2016). In short, it is learning how to learn, in order to learn (Wang 2015).

Constructivism is a process that directs teaching. The teacher is a guide whereas the student is active. Learning is established inthe cognitive model of the student. The main emphasis in this constructivist approach is how a student learns rather than what he/she learns. Thus, guessing, creating and analyzing have a significant place in that approach. In general, teachers, prefer asking questions such as, "How did you reach that result?", "Why do you think like this?" or "What do you think about this?" in order to allow students to think freely and to help them improve their problem-solving abilities in the constructivist learning processes. Therefore, teachers avoid asking questions that require "Yes" or "No" replies (Ektem 2016).

The constructivist approach motivates students about learning (Cetin-Dindar 2016). In addition to students' desires, the expectations of society are also paid special attention. This approach also encourages students to have dialogues, not only with each other but also themselves. It supports cooperative learning and group working. Students are given the opportunity of gaining new insight and understanding as the result of their authentic experiences (Bas 2012). Learning by doing and living are at the center of the constructivist approach. Students are given the chance to choose teaching techniques and content. A number of activities that

require problem-solving are prepared to give students real life experiences (Bas 2012). There are numerous researchers and theorists who have contributed greatly to the establishment of the constructivist approach. The most prominent are Jean Piaget, John Dewey, Lev Vygotsky, Jerome Bruner, and Von Glasersfeld. The types of constructivist approaches are collected under four main titles of cognitive, socio-cultural, radical and critical constructivism. However, this current study is grounded on cognitive constructivism (Sahin 2007).

Mathematics

Mathematics occupies a large place in students' educational life. It is well known that knowledge, skills and other learning that are provided by mathematics teaching have a vital function in increasing individuals' cognitive development levels and identifying their social status. This is why finding the best method and system in mathematics teaching has always been a subject of discussion and research. It has also been the focus of the process, which is known as movements, that occurs all over the world as well as in mathematics education. In particular, in the last ten years, it has been observed that there have been radical changes in mathematics as the result of the change in mathematics understanding. Within this framework, the curricula of mathematics have been reconstructed (Baki 2008; Ping and Hua 2015).

The new curriculum targets raising students who can discover, find, take a decision, infer logically and use mathematical methods and techniques effectively in order to be solution-oriented (Baki 2008). Therefore, in the new mathe-matics curriculum, calculation skills have declined in importance whereas the questions of "why" and "how" in learning the subject and concepts have gained importance (Kaya and Aydin 2014). Therefore, one of the main purposes of the new curriculum is that students should understand mathematical concepts and systems and be able to establish the relation between them.

Mistakes

Mistakes can exist in places where only the truth is sought, claims are asserted over it and where there is a decision and evaluation (Lyon et al. 2013). The Turkish Language Institute describes the word "mistake" as incorrect, incorrectness, a mistake that is made unwillingly or unknowingly, miscomprehension, to be mistaken, or a crime, sin and defect. However, the word "error" is described as a state of not obeying a certain rule, principle, reality, miscomprehension, or a mistake.

Improvements in the teaching of mathematics have formed a significant as well as a positive approach to students' mistakes. Although there have been improvements, some of the studies carried out with teacher candidates (Basturk 2016; Kapur 2016) have shown that they consider students' mistakes something that should be avoided, because if not abolished immediately the mistake would stay in the students' minds and gain resistance.

Mistakes are not only handled in the learner-centered method. When a mistake occurs, it is not only the student and the question that has to be solved or the activity. Therefore, while analying a student's mistake, students and solution- oriented thinking are not sufficient on their own, in addition an environment where teacher, student and knowledge components are present should be taken into account (Basturk 2016).

In the light these issues, this study was carried out with the idea that the constructivist approach is a solution to the existing situation in mathematics teaching, and that it could abolish a systematic position, which claims that if students' common problem-solving mistakes in mathematics lessons are not abolished immediately they will stay and gain resistance. Every single answer produced and solution method should not be confused with others that have been accepted as correct before. It is believed that they are either correct or incorrect depending on the similarities and the differences they share with the ones accepted previously. For this reason, it can be said that a'mistake' has an indisputable privilege both in science and mathematics. Students' mistakes should not only be thought of as student-oriented, but instead should be thought of as a unity where the components of the teacher, student and knowledge embrace each other.

METHODOLOGY

The case study method was used in this research, together with interview forms, one of the qualitative research methods aimed to obtain information thoroughly. The case study

method focuses on current phenomenon in a real-life framework and it is used in cases where the boundaries between the phenomenon and the content in which it exists are not clearly defined and where there is more than one proof or data source (Yildirim and Sahin 2009).

Study Group

The research study group comprised 10 classroom teachers of 3rd grade, 10 classroom teachers of 4th grade and another 10 classroom teachers of 5th grade who worked for state and private primary schools in Northern Cyprus in the 2015-2016 academic year fall term. Both young and experienced classroom teachers were chosen to identify their views as to whether or not a constructivist approach is a solution to the common mistakes that are made during problem-solving in mathematics lessons.

As seen in Table 1, 10 of the teachers have less than 10 years' professional seniority whereas 20 of them have professional seniorityof over 10 years. The reason why young teachers and teachers with more years of professional seniorities were chosen was to blend their views on this new approach and arrive at a clear conclusion.

Table 1: Professional seniorities of teachers who participated in the research

Years	*f*
Between 1-10 years	10
10 years and over (30)	20
Total	30

Data Collection Instruments

The research data was collected through semi-structured interview forms that were carried out with the teachers. Therefore, with this aim, an interview form that consisted of 15 questions was prepared by the researchers. Particular attention was paid to devise questions in the form of main headings. All the interviews were carried out on a face-to-face basis between 15th October and 30th October 2015. All the data obtained from the interviews was written and recorded.

Experts' views (one professor from the department of curriculum and instruction, one as-

Table 2: Questions on interview forms

	Questions
1)	What might be the reasons for common mistakes made by students in mathematics lessons?
2)	In which stage do common mistakes made in mathematics lessonsmostly appear?(Understanding the question? Mathematical operation stage? etc.)
3)	Which techniques do you use for students to reconstruct knowledge for themselves regarding the common mistakes made by students in mathematics lessons?
4)	Could triggering old knowledge, identifying goals, and presenting new knowledge by describing basic concepts be a solution to the common mistakes made by students in mathematics lessons?
5)	For the knowledge to be understood, could offering students a trial environment during the process of constructing knowledge and giving examples from daily life and the existing environment be a solution to the common mistakes made by students in mathematics lessons?
6)	Could allowing students who have certain viewpoints to embrace their viewpoints, to express them and to defend them be a solution to the common mistakes made by students in mathematics lessons?
7)	Could expressions like "classify", "analyse", "guess" and "form" be a solution to the common mistakes made by students in mathematics lessons when they are dominated in the classroom settings and students are given the opportunity of applying the knowledge?
8)	What statements do you use to your students in order to strengthen the meaning of constructivism in mathematics education?
9)	Could creating an atmosphere for students to establish dialogues comfortably either with each other or with their teachers be a solution to the common mistakes made by students in mathematics lessons?
10)	For creating awareness for knowledge, could giving more care to the establishment of knowledge than to the production of knowledge be a solution to the common mistakes made by students in mathematics lessons?
11)	Could the constructivist learning setting for improving students' mathematical thinking skills be a solution to the common mistakes made by students in mathematics lessons?
12)	Could the existing mathematics education curriculum be a solution to the common mistakes made by students in mathematics lessons? Should the mathematics education curriculum be prepared according to the constructivist approach for the common mistakes made by students?
13)	Do you think that the constructivist approach could be a solution to the common mistakes made by students in mathematics lessons?
14)	Do you think that the constructivist approach has great importance in terms of adding meaning to today's mathematics education system?
15)	What are the problems experienced while adopting the constructivist approach in a classroom context?

sistant professor from the department of elementary mathematics and two primary school mathematics teachers) on the reliability and validity of the interview form were obtained and then the form was prepared for the actual application.

The questions in Table 2 also asked the teachers to provide *"their views onthe probability of the constructivist approach being a solution to the common mistakes made by students in mathematics lessons"*.

Data Analysis Techniques

The content analysis was undertaken on the qualitative data obtained from the results of the study. Coding the data, identifying and arranging themes, and finally describing and interpreting the data were the stages followed by the researchers, respectively. The interpretation of the findings obtained from the study revealed that there are teachers' views indicating that the constructivist approach could be a solution to the common mistakes made by students during problem-solving.

FINDINGS

The teachers' views that constructivist approach could be a solution to the common mistakes made by students during problem-solving in mathematics lessons together with the findings obtained from the interviews are presented in this part. The interview data was subject to content analysis. All the coding and tabulating of the content analysis was undertaken by the researchers themselves. The tables produced by the researchers are given below with the details of the interview questions.

As can be seen from the Table 3, the reasons for the students' common mistakes are primarily carelessness, reading the question quickly, misinformation during learning processes and not comprehending the question. The remaining reasons are finding the operation difficult, inappropriate teaching techniques for children's level, memorization, mental disability, disagreement between teachers and students, being negative, lack of teacher competency and not associating problems with daily life. The reasons listed here could be classified as set out below.

As can be seen in Figure 1, most of the sources of the common mistakes are students. The

Table 3: Teachers' views regarding the reasons for the common mistakes made by students during solving a problem in mathematics lessons

	Views	*Frequencies (f)*
A.	Finding the operation difficult	1
B.	Reading the question quickly	8
C.	Not comprehending the question	7
D.	Impatience	1
E.	Not associating problems with daily life	1
F.	Inappropriate teaching techniques for children's level	3
G.	Carelessness	13
H.	Memorization	4
I.	Misinformation during learning processes	6
J.	Mental disability	1
K.	Disagreement between teachers and students	2
L.	Being negative (The idea of "I can't do")	3
M.	Lack of teacher competency	1

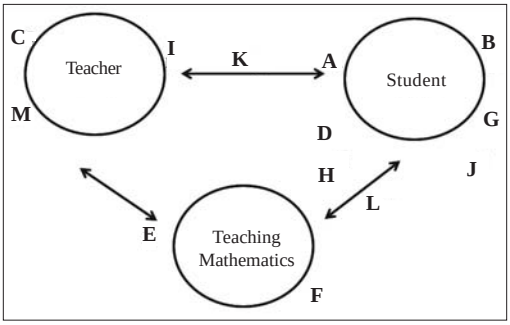

Fig. 1. Classification of the common mistakes in a teacher-student-teaching triangle

common mistakes that resulted from teachers and mathematics teaching are placed in the second and the third ranks, respectively. Teachers' views regarding the stage at which the common mistakes are made in mathematics lessons are given in Table 4.

It is revealed that the common mistakes firstly occur in the stage of understanding the question. However, the stage of operation takes the second place for the occurrence of common mistakes. Next, the views of not comprehending the subject sufficiently and at any stage are given a place.

Table 4: Teachers' views regarding the stage at which the common mistakes are made in mathematics lessons

Views	*Frequencies (f)*
The stage of understanding the question	18 (54.5%)
The stage of operation	12 (36%)
Could be at any stage	1 (3%)
Not comprehending the subject sufficiently	2 (6.5%)

As can be seen in Table 5, re-telling the subject, expressing and comprehending the question by re-reading it and students using daily life as a starting point to reconstruct knowledge, are among the techniques principally used by teachers in order to reconstruct knowledge. Next, group work, group discussion, teaching with discovering, project work, exercise, puzzle and concept maps, study of mathematical thinking, the technique of taking a model, experiment and immediate feedback and correction techniques are used. These statements are supported by the views of certain teachers as follows:

Table 5: The techniques used by teachers for students to reconstruct knowledge for themselves regarding the common mistakes made by students in mathematics lessons

Views	*Frequencies (f)*
Group work	2
Group discussion	1
Students using daily life as a starting point	4
Teaching with discovering	2
Re-telling the subject	4
Expressing and comprehending the question by re-reading it	4
Project work	1
Exercise, puzzle and concept maps	3
Study of mathematical thinking	1
Technique of taking a model	1
Experiment	1
Immediate feedback and correction	1

Ö.G.1: *Although there are common mistakes, the characteristics of students should be taken into account. While some students can correct their mistakes with different methods in iterative telling, others can do it with personal education. Since, every child has distinct learning skills and attention.*

Teachers' views regarding triggering old knowledge, identifying goals, and presenting new knowledge by describing basic concepts as possible solutions to the common mistakes made by students in mathematics lesson were fifty-two percent "yes", forty-four percent "may be" and four percent "yes" for some students. The views of the teachers regarding the solutions of offering students a trial environment during the process of constructing knowledge and giving examples from daily life and the existing environment for the knowledge to be understood were 54.5 percent "yes" and 45.5 percent "maybe". On the other hand, teachers' views concerning allowing students who have certain viewpoints to embrace their viewpoints, to express them and to defend them were fifty-four percent "maybe", forty-two percent "yes" and four percent "no". Finally, the views of the teachers regarding the solution of expressions like "classify", "analyse", "guess" and "form" when they are dominated in the classroom settings and students are given the opportunity of applying the knowledgewere fifty-two percent "may be" and forty-eight percent "yes".

The statements used by the teachers for their students in order to strengthen the meaning of constructivism in mathematics education are given in Table 6.

Table 6: The statements used by the teachers for their students in order to strengthen the meaning of constructivism in mathematics

Views	*Frequencies (f)*
Giving examples from daily life	1
The technique of classifying, forming, and analysing	1
Finding the given	1
Using own knowledge	1
Solving plenty of problems	1
The use of question booklets based on favouredsubjects	1
Amusing group work	1
Daily scheduled studying	1
Doing homework regularly	1
Using daily life problems as a problem-solving technique in actual classrooms	2
The question of "With what other technique could we solve?"	3
Oral studies	3
Working on the board	1
Expressions like "Excellent, well done, this is it, etc."	2

Teachers' views (T.V.) regarding the proposal that an environment that allows students to comfortably establish dialogues with each other and with their friends could be a solution to the common mistakes made in mathematics lessonswere fifty percent "yes" and fifty percent "may be". The views of some teachers are underpinned with the following expressions.

T.V.1: *This is a very important subject. If the environment of trust is created once a child enters the classroom, learning starts immediately. If the appropriate atmosphere is established for the child to express himself/herself, what the child learned could be understood in a comparatively shorter time.*

T.V.2: *Yes, it is a technique that has to be*

used. We can increase students' trust with this established dialogue.

Teachers' views regarding the solution of paying attention to forming the knowledge rather than re-establishing it in order to create awareness of the knowledge were fifty-nine percent "yes" and forty-one percent "maybe". On the other hand, teachers' views regarding the suggestion that a constructive learning environment can improve students' mathematical thinking skills were 56.5 percent "yes" and 43.5 percent "maybe". Could the existing mathematics curriculum be a solution to the common mistakes made in mathematics lessons? Should the curriculum be prepared according to the principle of constructivism for the common mistakes made in mathematics lessons? For these two questions the views of the teachers were fifty-seven percent "yes", twenty-four percent"maybe", nineteen percent "maybe" and fourteen percent "no". Teachers' views regarding the suggestion that the constructivist approach could be a solution to the common mistakes made in mathematics lessons were eighty percent "yes", twenty-four percent "maybe" and five percent "cannot be". However, for the question, do you think that the constructivist approach would give meaning to today's mathematics education system, the "yes" answers reached one hundred percent.It is noteworthy to give some of the teachers' views supporting these statements.

T.V.1: *Yes. The new target of education is to create a new student model who knows how and where to use the knowledge, is aware his/her own learning techniques and can use them effectively and can make use of his/her previous knowledge in producing new knowledge. This is only possible with the constructivist approach.*

The views of teachers regarding the problems experienced in a classroom setting while adopting the constructivist approach are listed in Table 7.

Table 7: The problems encountered in a classroom setting while adopting the constructivist approach

Views	*Frequencies (f)*
Limited time	8 (38%)
Curriculum intensity	7 (34%)
Students' negativity towards mathematics lesson	2 (9%)
Crowded classroom settings	4 (19%)
Students' basic knowledge	4 (19%)
Examination system	1 (5%)
Students' distractibility	3 (14%)

As can be seen in Table 7, curriculum is in first place. Second place is shared by crowded classroom settings and students' basic knowledge. The rest of the problems are students' negativity towards mathematics lessons, examination system, students' distractibility, difficulty of motivation and lack of equipment, respectively.

Yavuz's (2009) didactical transformation theory involved a four-session teaching scenario in a mathematics lesson. He claimed that the reason for the common mistakes and misconceptions of students are limited time, curriculum intensity and impracticality of teachers in solving a problem. It is significant to point out that this result shows parallelism with the results given in Table 6.

CONCLUSION

The constructivistapproach to mathematics education has an important place today and its significance and value are growing day by day. The constructivist approach is one of the new approaches that enable students to be active in the learning process, to assume responsibility, to construct concepts in their minds according to their previous knowledge and learning styles (Altun and Yabas 2009). This study reported on teachers' views regarding the proposal that the constructivist approach could be a solution to the common mistakes made in mathematics lessons. After an examination of these views it was found that almost all the answers collected from the interviews were positive answers. This apparently indicates that the constructivist approach has an important place in a mathematics lesson. Teachers' views regarding the solutions of paying attention to forming the knowledge rather than re-establishing it in order to create awareness of the knowledge were all in the positive direction.

The constructivist approach that has been adopted in mathematics lessons is a teacher-student-teaching triangle and is a unity where everything is interconnected. When the problems encountered while adopting the constructivist approach in a mathematics lesson are taken into consideration, curriculum intensity and limited time take first place. It is thought that the primary reason for that is shortage of infrastructure in the education system.

The findings of the relevant literature indicate that the reason for the common mistakes

made during solving problems in mathematics lessons and misconceptions is that the knowledge cannot be constructed correctly by students. In a number of studies carried out, it was found that mathematics teachers have different didactical organizations. It is thought that as long as teachers play a more centered role in mathematics classrooms according to the authors of textbooks, they will bring their didactical organizations into prominence and they will enable students to construct the knowledge they gained.It is strongly believed that doing all these things would be a solution to the common mistakes made during problem-solving.

RECOMMENDATIONS

The following recommendations have been developed based on the findings of teachers' views regarding the suggestion that the constructivist approach could be a solution to the common mistakes of students during problem-solving in mathematics lessons:

a) A number of in-service training sessions and seminars can be held for primary classroom teachers and mathematics teachers in order to help them improve their instruction, as well as emphasize the constructivist approach that has an important place in today's mathematics education. Furthermore, teachers can be encouraged to use student-centered strategies in their lessons.
b) Teachers can be enlightened about constructivism by arranging a number of conferences and seminars about constructivist learning in educational institutions.
c) In the light of this study, constructivist learning environments can be prepared for the geometry subject, which is a subbranch of mathematics. There can also be research about the extent to which this type of learning environment affects students' success.
d) The use and adaptation of the constructivist approach in mathematics lessons, particularly in primary school 2nd and 3rd grades, can be a solution to the possible common mistakes during problem-solving in the future.
e) Regarding the common mistakes of students, with the use of modeling concepts used in the anthropological theory of didactics, all the steps of mathematical knowledge that are placed in the process of didactical transformation can be described and this can be seen as an important theoretical framework that could be used by researchers.

REFERENCES

Altun S, Yabas D 2009. The effects of differentiated instructional design on students' self-efficacy beliefs, metacognitive skills and academic achievement. *Hacettepe Üniversitesi Egitim Fakültesi Dergisi,* 37: 201-214.

Alves M, Rodrigues CS, Rocha AMA, Coutinho C 2016. Self-efficacy, mathematics' anxiety and perceived importance: An empirical study with Portuguese engineering students. *European Journal of Engineering Education*, 41(1): 105-121.

Baki A 2008. *Mathematics Education from Theory into Practice.* Ankara: Harf Egitim Publishing.

Bas G 2012. The effects of cooperative learning method on students' achievement and attitudes towards English lesson. *Journal of Theory and Practice in Education,* 8(1): 72-93.

Basturk S 2016. Primary pre-service teachers' perspectives on constructivism and its implementation in the schools. *Universal Journal of Educational Research,* 4(4): 904-912

Cetin-Dindar A 2016. Student motivation in constructivist learning environment. *Eurasia Journal of Mathematics, Science and Technology Education*, 12(2): 233-247.

Chevallard Y 1989. Le concept de rapport au savoir. Rapport personnel, rapport institutionnel, rapport officiel, *Actes du séminaire de Didactique des Mathématiqueset de l'Informatique,* LSD-IMAG, Grenoble, 211-236.

Chevallard Y 2008. Steps Towards a New Epistemology in Mathematics Education. In: M Bosch (Ed.): *Proceedings of the 4th Conference of the European Society for Research in Mathematics Education (CERME 4),* Sant Felir Spain.

Ciltas A, Guler G, Sozbilir M 2012. Mathematics education research in Turkey: A content analysis study. *Kuramve Uygulamada Egitim Bilimleri Dergisi,* 12(1): 565-580.

Ektem IS 2016. A study on prospective teachers' self-efficacy beliefs regarding the implementation of constructivist approach (A case of Konya). *Journal of Education and Training Studies,* 4(3): 118-125.

Gokalp M 2016. Investigating classroom teaching competencies of pre service elementary mathema-tics teachers. *Eurasia Journal of Mathematics, Science & Technology Education,* 12(3): 503-512.

Ishii DK 2003. Constructivist Views of Learning in Science and Mathematics. *ERIC Clearing House for Science Mathematics and Environmental Education,* 2004-3.

Kapur M 2016. Examining productive failure, productive success, unproductive failure, and unproductive success in learning. *Educational Psychologist,* 1-11.

Kaya D, Aydin H 2014. Elementary mathematics teachers' perceptions and lived experiences on mathematical communication. *Eurasia Journal of Mathematics, Science and Technology Education,* 10(6): 619-629.

Lyon TD, Quas JA, Carrick N 2013. Right and righteous: Children's incipient understanding and evaluation of true and false statements. *Journal of Cognition and Development*, 14(3): 437-454.

Nar MS 2015. An anthropological approach to structuralism: Levi-Strauss and structuralism. *Ankara University Journal of Anthropolgy*, 29: 29-46.

Ping OW, Hua AK 2015. Effectiveness of division wheel in basic mathematics operation case study: Primary school perspective. *IOSR Journal of Research & Methodin Education*, 5(3): 52-56.

Pino-Fan LR, Assis A, Castro WF 2015. Towards a methodology for the characterization of teachers' didactic-mathematical knowledge. *Eurasia Journal of Mathematics, Science & Technology Education*, 11(6): 1429-1456.

Sahin U 2007. *The 1st Level Primary School Teachers' Perceptions Towards Constructivism Based Mathematics Curriculum.* PhD Thesis, Unpublished. Denizli: Pamukkale University.

Tezer M, Soykan F 2011. Teacher opinions on the use of terminal constructed (n-computing) computer laboratories. *Procedia-Social and Behavioral Sciences*, 15: 4076-4082.

Wang X, Saroyan A, Aulls M 2015. Epistemic dissonance encountered: Academic adaptation experiences of. *Global Perspectives and Local Challenges Surrounding International Student Mobility*, 243.

Yavuz I 2009. Didactical transformation theory and its applications in mathematics education. *Marmara University Atatürk Education Faculty, Journal of Educational Sciences*, 30: 173-187.

Yildirim M, Sahin F 2009. Anthropological theory of the didactic and science teaching. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, 3(1): 46-57.

Yoon HG, Kim BS 2016. Preservice elementary teachers' beliefs about nature of science and constructivist teaching in the content-specific context. *Eurasia Journal of Mathematics, Science and Technology Education*, 12(3): 457-475.