STUDENTS' PERCEPTIONS OF KNOWING AND LOVING MATHEMATICS AS REFLECTED FROM THEIR DRAWINGS

by

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Dedicated to

my dear uncle Kanber Öztoprak and

my dear aunt Hüsniye Öztoprak

for their endless support and love

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ABSTRACT

STUDENTS' PERCEPTIONS OF KNOWING AND LOVING MATHEMATICS AS REFLECTED FROM THEIR DRAWINGS

The aim of this study is to clarify the images that the primary school students have of knowing/not knowing and loving/not loving mathematics as reflected from their drawings. Draw-A-Man Test-DAM (Goodenough, 1926) and Draw-A-Scientist Test- DAST (Chambers, 1983) gave birth to "Draw-A-Student who knows/not know/loves/not loves Mathematics Test-DASMT" which then used in order to measure students' perceptions of knowing/not knowing and loving/not loving mathematics. The sample of the study consists of 72 female and 97 male students (N=169) of Orbay Primary School from different grade levels.

Results indicated that there are 60 images drawn by the students to reflect their perceptions of knowing/not knowing and loving/not loving mathematics. Baykal's (1978) "system view of instructional process" was utilized to describe and explain these images. Based on the system view, some of the images were described as an indicator of major components of the instructional system which are "objectives", "social settings", "physical settings", "instructional media", "instructional procedure", and "teacher". The images with high frequencies and not described with system view, were explained as the finer discriminations which were the images "smiles", "sadness", and "question mark" in this study. Lastly, the discriminations between the cognitive aspects of mathematics (knowing and not knowing) and affective aspects of mathematics (loving and not loving); and between positive standings of mathematics (knowing and loving) and negative standings of mathematics (not knowing and not loving) were examined. In conclusion, the results indicated that the students do not have a system view in reflecting knowing, not knowing, loving, and not loving mathematics, in fact, they individualized it.

ÖZET

ÖĞRENCİLERİN ÇİZİMLERİNDEN YANSIYAN MATEMATİK BİLME VE MATEMATİK SEVME ALGILARI

Bu çalışmanın amacı, ilköğretim öğrencilerinin matematik bilen/bilmeyen/seven/sevmeyen öğrencilere yönelik imgelerini, öğrencilerin çizimlerini kullanarak ortaya çıkartmaktır. Bu imgeleri ortaya çıkarmak amacıyla "Bir Adam Çiz" (Goodenough,1926), ve "Bir Bilim İnsanı Çiz" (Chambers,1983) testlerinden yola çıkılarak "Matematik bilen/bilmeyen/seven/sevmeyen bir öğrenci çiz" testi kullanılmıştır. Bu ölçek, farklı sınıf düzeylerindeki 72 kız ve 94 erkek (N=169) ilköğretim öğrencisi üzerinde uygulanmıştır.

Bu çalışma sonucunda öğrencilerin matematik bilme/bilmeme ve sevme/sevmeme algılarını yansıtmak için 60 tane farklı imge kullandıkları görülmüştür. Bu imgeler sistem yaklaşımına (Baykal, 1978) göre "hedefler", "toplumsal doku", "fiziksel ortam", "öğretim donanımları", "öğretim yöntemleri", ve "öğretmen" şeklinde tanımlanmıştır. Bu yaklaşıma göre açıklanamayan ve sık kullanılan "gülme", "üzülme", ve "soru işareti" imgeleri de ayrıca incelenmiştir. Bu çalışmada ayrıca öğrencilerin matematiği bilişsel (bilme ve bilmeme) ve duyuşsal (sevme ve sevmeme) açıdan, ve olumlu (bilme ve sevme) ve olumsuz (bilmeme ve sevmeme) açıdan ayırt etme eğilimi olup olmadığı incelenmiştir. Sonuç olarak öğrencilerin matematik bilme/bilmeme/sevme/sevmeme imgelerini yansıtırken sistem yaklaşımını kullanmadıkları, bireysel bir yaklaşım kullandıkları görülmüştür.

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LIST OF SYMBOLS / ABBREVIATIONS

N	Number
f	Frequency
p	Significance level
χ^2	Chi-square
df	Degrees of freedom

1. INTRODUCTION

Since mathematics is one of the oldest organized disciplines of human knowledge, it has been fundamental topic in school curricula. Betz (1978) claimed that mathematics is critical for many occupations including scientific and technical fields, business social sciences and even humanities, especially at the turn of twenty first century (Erol, 1989). So, in modern society, mathematics is one of the most important subjects in schools (Bishop, 1998).

In fact, Ernest (1989) stated that "mathematics teachers have long been aware of the importance society attaches to their subject" (p. 175). In general, "people in communities and in the larger society hold beliefs, attitudes, values, and often deep emotions about a variety of issues-teaching, learning, assessment, the nature of mathematics, the nature of schools in a democratic society, race, class, gender, sexual orientation, culture and language, and they affect student learning" (Weissglass, 2002, p. 35).

However, most people are very reluctant to talk about mathematics although these people agree with the importance of mathematics in daily life and its usefulness in career (Lazim *et al.*, 2002). From this point the perception is that "mathematics is the same objective knowledge everywhere in the world and the fact that mathematical knowledge is essentially context-free both lead to the community- held view that mathematics is culture- and value-free (Bishop and Seah, 2000, p. 1).

Attitudes toward mathematics have been examined many times through years. Many instruments have been developed and used for this purposes. In fact, the study started with "value to mathematics in society" and in literature most common accepted idea that mathematics is value-free but Bishop *et al.* (1998) stated that mathematics is not value free. So, firstly an instrument was wanted to develop but then it was seen that "value to mathematics in society" was included in attitude assessment instruments. Then, the decision of preparing an instrument to measure value to mathematics was changed since it was not really what wanted. Because the beginning purpose was to examine students' thoughts about mathematics and values, the study turns toward how students can explain their thoughts without any restriction. Then the literature pointed “drawings”, since the drawings were explained as an important source of explaining a child’s thoughts and feelings and also his/her inner-world. So the purpose of the study is to examine the images drawn by the students to reflect their perceptions of knowing and loving mathematics.

2. LITERATURE REVIEW

2.1. Drawing

Activities such as speaking, acting, writing and drawing are all normal everyday activities and sometimes one will reveal information about himself/herself while engaged in these activities. Drawing is another form of communication and it reveals information about the artist's personality, intelligence, concerns and attitudes (Zians, 1997).

The complex world around an individual can be expressed personally by using drawings. Further, drawings can be a good indicator of mental development. Moreover the drawings which are created with children's own enterprise will reveal details about themselves and their development. Also drawings can be used by a child as a tool to communicate with the external world, since it is an easy form of expression (Yavuzer, 1990).

Drawing is an effort to represent the world, Piaget (1971) has evaluated drawings as a means of revealing mental images. Further, he views drawings as being a symbolic game and mental images. Similarly, Eyüboglu (1962) mentioned that "only one can search for how a child fits into the world by what he/she says and draws" (p. 13). However, Freud explained children's drawing as being greatly influenced by subconscious desires and fears (Yavuzer, 1990).

Polyani (1958) views drawings as being powerful conveyers of perceptions organized by personal knowledge and experience (Chula, 1998).

Since, human thoughts, ideas and emotions have been recorded thanks to drawings many times throughout history, drawings, especially children's drawings, have been studied with a variety of purposes: as an artistic ability and the development of this ability (Di Leo, 1970, as cited in Yahya, 1990); as examples of cognitive development (Koppitz, 1968, as cited in Yahya, 1990); and as expressions of children's inner lives (Wolman, 1972, as cited in Yahya, 1990).

Drawings, from a psycho-pedagogic point of view, have been used to measure the child's intelligence, personality, and the characteristics of his/her close environment and to discover the child's inner world (Yavuzer, 1990), (Yavuzer, 2003).

Therefore, as Golomb (2003) stated "For over a hundred years, the drawings of children have enchanted a rather diverse audience of psychologists, educators, art historians and artists." (p. 1).

Koppitz (1968) mentioned that "studies with children's drawings have varied from descriptive observations to carefully controlled research and the use of statistical analysis.

Through drawings children can express personal feelings and attitudes because these are safe and non-threatening outlet for them and according to Di Leo (1983) and Sarbaugh (1982), drawing techniques work well with language deficient, shy or with different language children (Zians, 1997). Moreover, Hammer stated that drawing techniques are popular because it is easy and economical to administer (Zians, 1997).

2.2. Projective Drawings

The term projection is one of the central constructs in psychoanalytic theory and it is defined as one of the defense mechanisms that was identified and defined with Freud's writing (Yahya, 1990).

Elliott *et al.* (1961) defined projection techniques in their book as "a projective is an instrument that is considered especially sensitive to covert or unconscious aspects of behavior, it permits or encourages a wide variety of subjective responses, is highly multidimensional, and it evokes usually rich or profuse response data with a minimum of subject's awareness concerning the purpose of the test. Further, it is very often true that the stimulus material presented by the projective test is ambiguous, interpreters of the test depend upon holistic analysis, the test evokes fantasy responses, and there are no correct or incorrect responses to the test" (p.45, as cited in Yahya, 1990).

Rabin (1986) defined projection traditionally as “the general tendency to externalize in our responding to the environment and interpreting it. The essential feature of a projective technique is that it evokes from the subject what is in various ways expensive of his private world and personally process. We emphasize the fact that projective techniques tap, or are sensitive to, “unconscious aspects of behavior” (Seitz, 2001, p.17). Also, according to Harris (1997) “projection is a clinical term that an artist unconsciously imbues the picture drawn with self-perceptions, regardless of the intended picture’s subject.” Projective drawing procedure is assumed that one projects his/her private and subconscious feeling into pictures he/she draws (Zians, 1997).

“Drawing is different than other projective techniques like completing sentences and word association. It is also encompasses important dimensions such as fantasy and imagination. It is for this reason; drawing is an ideal projective technique for discovering a child’s inner world” (Yavuzer, 1990, p. 14).

Zians (1997) mentioned that today, there are many projective techniques which are designed to elicit especially sensitive and subconscious aspects of our behavior. For instance, Harn’s (1997) mentioned about four types of projective measurements which are personality, perceptions of self in relation to others, collectively held values, and specific attitudes (Harris, 1997, Yavuzer, 2003). On the other hand, nonprojective drawings techniques have been used to measure a child’s developmental level or intellectual maturity (Klepscin and Logic, 1982, as cited in Harris, 1997; Yavuzer, 2003).

2.3. History and Development of Drawing Techniques

Children’s drawings have a long and well documented history (Koppitz, 1968). As early as 1885, an article appeared in England by Ebenezer Cooke in which he described developmental stages in children’s drawings (Goodenough, 1926, as cited in Koppitz, 1968). Then Koppitz (1968) stated that numerous other studies and papers have followed by psychologists and educators.

Children’s drawings were first presented as psychodiagnostic tools when Corracto Ricci published the work that contained reproductions of children’s art in 1887, and then according to Klepsch and Logic (1982) a number of studies of children's drawings followed (Harris, 1997).

"Initially, many researchers argued that children's drawing was a copy of images in his/her mind, for this reason child's drawing was accepted as a window allowing us to look into the child's mind. Also it is stated that classification according to developmental stages may be the first successful result of research done on children's drawings" (Yavuzer, 1990, p. 22)

The studies of Kershensteiner (1905), Rouma (1913) and Luquet (1913, 1927) with children's drawings have included significant input in defining the developmental phases. Then in 1926, Goodenough published the book "Measurement of Intelligence by Drawings", in opposition to Luquet and other researchers' theories about basic developmental phases, about measuring intelligence through drawings (Yavuzer, 1990), (Yavuzer, 2003).

One of the most widely used techniques of psychologists working with children has been the Human Figure Drawings (Koppitz, 1968). She stated that the studies with HFDs vary and she explained that "two main approaches to the interpretation of HFDs exist today. The first of these is employed mostly by clinicians who regard HFDs as a projective technique and who analyze the drawings for signs of unconscious needs, conflicts and personality traits. Representatives of the second school of thought approach HFDs as developmental test of mental maturity." (p. 1). The book of Goodenough (1926) "Measurement of Intelligence by Drawings" has become a classic as the foremost representative of the developmental approach to HFDs (Koppitz, 1968). Draw-a-man (D.A.M) test, created by Goodenough (1926) was the first drawing assessment device and Harris (1963), Hammer (1968), and Burns and Kaufman (1970) stated that the test was used as a device to measure intellectual and conceptual maturity (Zians, 1997). The well-standardized and validated Draw-a-Man test has become widely accepted and used especially in schools and for research purposes (Koppitz, 1968). Koppitz also stated that "some 35 years later, Harris (1963) went to great lengths to revise and extend the Draw-A-Man Test but found that Goodenough's work was so carefully designed and executed that relatively little could be added to remove it. Harns (1997) reports numerous studies which show a fairly high correlation between scores on the Draw-A-Man test and IQ scores from intelligence tests"(Harris, 1997, p. 2). Draw-A-Man test was based on the idea that the more complete and realistic the figure of a man drawn by the child, the higher they scored in intellectual maturity (Anning and Ring, 2004). Besides measuring intellectual and conceptual maturity, the Draw-a-man test was used by Goodenough (1926), Harris (1963), Hammer (1968), Machover (1949) and Koppitz (1968) to discover personality, feelings and attitudes (Zians, 1997). Then, Draw-A-Man test gave birth to the new drawing assessment devices such as House-Tree-Person, Draw A Family Drawing, Kinetic School Drawing, Draw A Scientist Test, etc.

Machover (1960), Levy (1958), Hammer (1958), and Jolles (1952) were the foremost exponents of the projective approach towards Human Figure Drawings (Koppitz, 1968).

2.4. Drawing and Educational Research

Grugeon (1993) stated that "Drawings have been used for decades as markers and mirrors of personal identity. Drawings offer a different glimpse into human sense making than written or spoken texts do because they can express that which is not easily put into words: the ineffable, the elusive, the not-yet-though, the subconscious. Children have control over drawing, which for them is a natural form of symbolic expression." (Haney *et al.*, 2004).

In education, drawing is an instructional strategy to encourage writing, reading, oral expression, and assessment of student acquired knowledge (Dalke, 1984; Dyson, 1988; Eisner, 1976; Ernst, 1994; Gardner, 1983; Goldberg, 1992; Gross, 1983; Harste *et al.*, 1988; Kantner, 1993; Siegal, 1984; Williams, 1977, as cited in Chula, 1998).

By considering children's drawings more seriously, one will know more intimately what children think and feel (Haney *et al.*, 2004). Further in educational researches, drawings have been used as a tool to gain insight into teacher instructional practices, learning environments and the quality of teacher/student rapport (Chula, 1998). They also have been used as tools for "projection"-to discover children's visions of their ideal worlds-include the work of Getzels (1974) on images of the classroom, Moore (1974) on outdoor environments, Sanoff and Barbour (1974) on archetypal schools and Taylor (1993a), (1993b) on students' conceptions of learning environments (Chula, 1998).

Olson (1995) mentioned that "The paucity of research on drawings as vehicles to gain insight into school culture has drawn the attention of Boston College's Center for the Study of Testing, Evaluation, and Educational Policy, which is immersed in a high profile public school reform initiative. The study utilizes drawings among other exercises, to get at the organization of classroom life from the perspective of students by asking the question, 'Think about the teachers and the kinds of things you do in your classrooms…Draw a picture of one of your teachers working in his or her classroom'" (Chula, 1998, p .11).

Although art educators, psychologists have been aware of children's drawings for decades, according to Weber and Mitchel (1995) educational research has not aware of it (Haney *et al.*, 2004).

Gülek (1999) mention that;

> *Using the descriptors indexed in ERIC, an online search of the ERIC Database suggests that the broad educational literature has devoted a great deal of attention to "questionnaires" as a method of inquiry followed by "observation" (see Table 1). "Projective Measures" which also include "children's art" and "freehand drawings" seem to be much less frequently used in the educational literature indexed in ERIC.*
>
> (Gülek, 1999, p. 2)

Table 2.1. On-line research of ERIC database concerning different research methods

Descriptor	1966-1981	1982-1991	1992-sept. 1997	Total number of entries (1966-sep. 1997)
Questionnaires	15.35	10.70	7.01	33.07
Observation	6.26	5.21	2.90	14.37
Projective measures	230	97	34	361
Questionnaires and observation	533	401	269	1.20
Questionnaires and projective measures	8	8	2	18
Observation and projective measures	7	3	0	10
Questionnaires and observation and projective measures	0	0	0	0

(Gulek, 1999, p. 3)

Moreover, number of studies using projective measures as data collection utilized "freehand drawings" or "children's art" is only 28 (Gülek, 1999). Most of the studies which utilized student drawings as a projective method of assessment limited their analysis of children drawings to clinical use. However, there were no such projective drawing methods to explore the educational ecology of classrooms (Gülek, 1999).

According to Gülek (1999); "Student drawings of the teacher at work may reveal important aspects of students' attitude toward classroom learning and of teacher's approach to instruction. Also, Weber and Mitchel (1995) suggested that children's drawings will be a good place to begin, if educational researches want to know about what children think and feel about their school experiences and to give them more active control over their learning (Haney *et al.*, 2004).

The study of Gülek (1999) utilized student drawings as a method of inquiry in order to gain insight into classrooms and as giving students on opportunity to students to freely express their classroom attitudes and learning experiences.

Over the last decade Haney *et al.* (2004) found that children's drawing of one of their teachers at work in the classroom is a useful way of documenting changes in the classrooms undergoing restructuring.

2.5. Drawing and Stereotypical Images

Stereotypes are defined as fixed and simplified characterizations of groups of humans by Lichtenstein *et al.* (2005). Stereotypes were first described by Walter Lippmann (1922) as devices that simplify and provide order to a complex world", and as "pictures in our heads" (Lichtenstein *et al.,* 2005; Güngör, 2003). Also Lippmann (1922) asserted that the existence of stereotypes in education is a barrier to education (Lichtenstein *et al.*, 2005).

The widely accepted definition of stereotype is that "it is a set of beliefs about personal attributes of a group of people" (Ashmore and Del Boca; 1981, as cited in Güngör, 2003, p. 2).

Stereotypes guide one's both perceptions and understanding in everyday life as he/she encounters huge amounts of information (Hamilton *et al.*, 1994, as cited in Güngör, 2003).

Also, research on stereotypes threat has yielded important evidence that the stereotypes in performance situations will have a negative impact on the performance of targeted individuals (Schmader and Barquissau, 2004).

Moreover, stereotype research threat has demonstrated that "the applicability of negative stereotypes disrupts the performance of stigmatized social groups" (Keller and Dauenheimer, 2003).

The stereotypes of teachers affected the student's stereotyping (Keller, 2001).

The relationship between the drawings and stereotypes is that people's stereotypes clearly influenced the drawings of people (Gülek, 1999).

2.6. Drawing and Stereotype Research Studies in Science

Several studies have been done to assess student images of scientist but most focus on children's respond in writing; so Chambers (1983) developed an instrument which requires children's drawings, since not all children can respond appropriately written instruments (Finson *et al.*, 1995). Several studies have assessed studies' images of scientists over the last two decades (Chambers, 1983; Finson *et al.*, 1995; Huber and Burton, 1995; Krause, 1997; Schibeci and Soransen, 1983). The most common instrument for assessing students' images of scientists is the Draw-a-scientist Test (DAST) developed by Chambers (Barman, 1996). In fact, Draw-a-man Test (Goodenough, 1926) gave birth to DAST (Finson *et al.*, 1995).

Draw-a scientist Test is an excellent instrument since it quickly measures students' global perception of a scientist and requires only the drawing of students as a response (Huber and Burton, 1995). In the DAST, children use a blank sheet of paper and simply draw their idea of a scientist on it, then children's drawing are related according to particular characteristics present or absent in he drawings, thus researches have chance to determine and to describe in detail the stereotypical images of scientists children hold (Finson *et al.*, 1995).

The research on Draw-a Scientist Tests and perceptions of scientist imports to educators that stereotypes are persistent and they extends across age groups, across grade levels, and across decades (Finson, 2002). Moreover exactly what specific factors influence stereotypical images have been inferred, rather than establishing a direct cause (Finson, 2002). From this point, researchers conjectured that the influence of media (movies, comic books, television, etc), primarily television contributed to reinforcement of stereotypical images (Finson, 2002). Also studies indicate that "students who demonstrated a higher number of stereotypes explained that their pictures and explanations were influenced by television (Quita, 2003). Moreover, the works of Krajkovich and Smith

(1982) pointed to the impression of educators on students and these impressions affected student learning an attitudes (Finson *et al.*, 1995). According to Kock (1990) and Peter (1998), the feelings and attitudes of teachers toward science affect their student's feelings and attitudes (Quita, 2003). Some studies also indicate that the environment of the teacher establishes in the classroom and what teachers to in the classroom affect students' achievement and attitudes (Finson, 2002). Rampal's study demonstrated that the stereotypical images of scientists were alive and well in the minds of teachers (Finson, 2002). The affects of media and educators were supported by Gardner (1980) who had suggested that:

> … *Cultural models to which students are exposed can contribute significantly to mental schema, and these influences can be exhibited in drawings made from these schema such models are derived from a multitude of source including television, movies and comic book. Adults, including some scientists, also possess stereotypical images of scientists.*
>
> (Finson, 2002, p. 5)

Furthermore, the Draw-a-scientist test revised prompt (DAST-R) studies pointed out that "students seemed to be drawing what they perceived to be the public stereotype of a scientist, and not necessarily their own perception of a scientist." (Matkins, 1996).

The studies of Beardstee and O'Dawn (1961), Smith and Erb (1986), NSTA (1992), NSTA (1993), and Odell *et al.* (1993) indicated that negative stereotypes of students toward science and scientists led to negative perceptions, which, in classroom, led to negative attitudes toward science (Matkins, 1996). Also, negative stereotypes towards scientists prevent students from pursuing a scientific career (Mays, 2001).

The researches also pointed that there is a positive relationship between the number of stereotypes found with the grade school level and socioeconomic background (Mays, 2001).

2.7. Image Studies in Mathematics

Frunghetti (1993), Henrion (1997), Lim and Ernest (1998), Rock and Shaw (2000) have done several studies to assess the images of mathematics over the last decade (Picker and Berry, 2000). According to Frunghetti (1993) mathematics is a discipline and it has peculiar property so everybody has some mental image of it." (Picker and Berry, 2001). Similarly, Lim and Ernest (1998) defined the term "image of mathematics" as a mental picture, view or attitude towards mathematics, presumably developed as a result of social experiences through school, parents, peers, mass media or other influences. Lim (1999) used questionnaires and semi-structured telephone interviews to assess the public images of mathematics and get the following images which were;

- "Mathematics is a difficult subject"
- "Mathematics is only for the clever ones"
- "Men are better in mathematics than women"
- "Mathematics is computation"
- "The goal of doing mathematics is to obtain the "right answer""
- "The role of mathematics students is to receive mathematical knowledge and to demonstrate that it has been received"
- "The role of mathematics teacher is to transmit mathematical knowledge and to verify that students have received this knowledge"
- "Some people have a math mind and some don't"
- "You must always know how you got the answer"
- "Math requires a good memory"
- "It is always important to get the answer exactly right"
- "Mathematicians do problems quickly in their heads"

2.7.1. Drawings and Image Studies in Mathematics

Rock and Shaw (2000) used both a voluntary survey which placed on the internet and linked to a pair of mathematical problem contest sites and drawings by inviting children to mail their drawings of mathematician at work to give children a chance to explore their thinking about mathematicians at work to give children a chance to explore their thinking about mathematicians and their work.

Rock and Shaw (2000) mentioned that the received drawings (N=132) from kindergarten through fourth grade students indicates that “ virtually all the young children’s pictures showed classroom scenes, often with displays of numbers, calendars, number lines, and such tools as pencils, papers, chalkboards, and erasers. Most of the children’s drawings showed smiling figures and more female than male figures” (p. 553). Moreover the received worded responses from the surveys of the study of Rock and Shaw (2000) were that;

- Mathematicians simply “did math” or “solved math problems”
- Mathematicians “do hard problems other people don’t know”
- Mathematician is “a person who knows math and can do math good”
- Mathematics is what mathematicians do; no more, no less.
- The brain is a significant tool in mathematics.

Picker and Berry (2001) used children’s drawings to investigate and compare the images of mathematicians held by lower secondary pupils (ages 12-13) in five countries. As a result they reported some images and certain stereotypical images of mathematicians in all of the five countries. Figure 2.1, Figure 2.2, and Figure 2.3 are some examples from the drawings of this study.

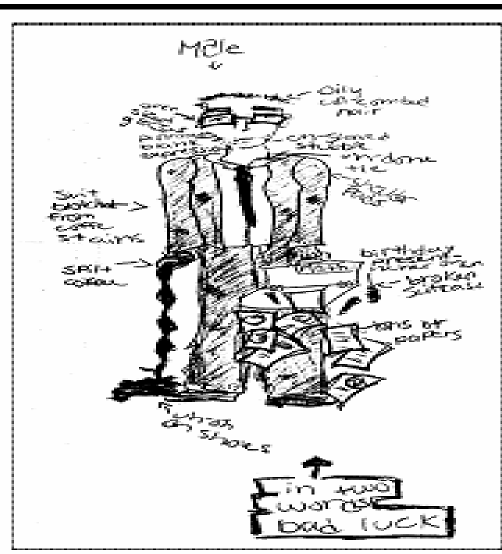


Figure 1 Female 7th Grade (UK Year 8) Pupil

Figure 2.1. Image of mathematician by a female 7th grade pupil from UK

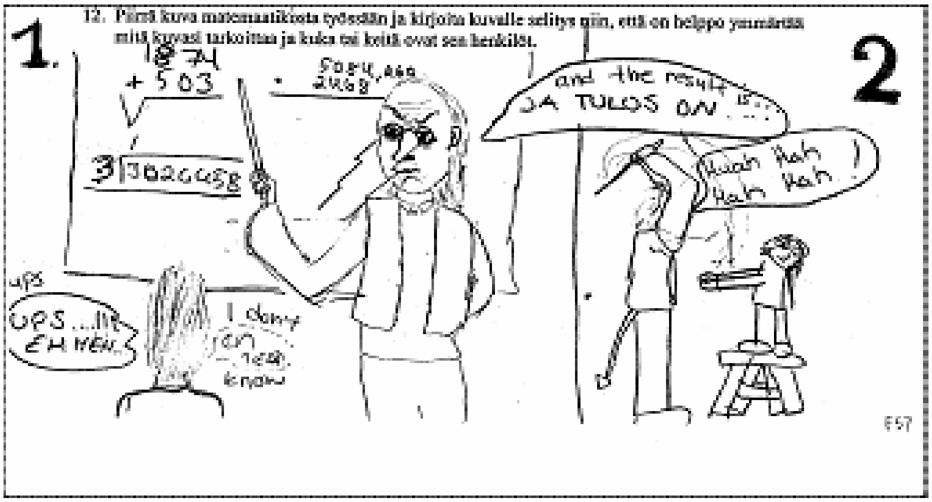


Figure 2 Finland—Female pupil

Figure 2.2. Image of mathematician by a female pupil from Finland

Figure 3 Sweden—male pupil

Figure 2.3. Image of mathematician by a male pupil from Sweden

Picker and Berry (2000) identified seven sub themes from the similarities of these drawings among the different countries which were;

- "Mathematics as coercion, in which pupils drew mathematicians as teachers who use intimidation, violence, or threats of violence on their pupils"
- "The foolish mathematician, in which mathematicians was depicted as lacking common sense, fashion sense, or computational abilities"

- "The overwrought mathematicians, in which mathematicians were depicted as looking wild and being overstrained"
- "The mathematician who can't teach, in which a classroom is drawn which the mathematician cannot control, or in which he doesn't know the material"
- "Disparagement of mathematicians who were depicted by pupils as being too clever or in some other way contemptible"
- "The mathematician with special powers, which may include wizardry and special potions"
- "Mathematicians do applications similar to those they have seen in their own mathematics classes, including computation, area and perimeter and measurement"
- "A Mathematician's work involves accounting, doing taxes and bills, and banking; work which they contend includes doing hard sums or hard problems"

2.8. Knowing and Loving Mathematics

As reviewed up to now in the literature, drawings of students have been used for the purposes of describing developmental stages in children's drawings (Cooke, 1885); measuring intelligence (Goodenough, 1926); measuring intellectual and conceptual maturity (Goodenough, 1926); measuring unconscious needs, conflicts and personality traits of children (Koppitz, 1968); gaining insight into teacher instructional practices, learning environments, and the quality of teacher/student rapport (Chula, 1998); discovering children's visions of images of the classroom (Getzels, 1974), of outdoor environments (Moore, 1974); giving students an opportunity to express their classroom attitudes and learning experiences freely (Gulek, 1999); assessing students' images of a scientist (Chambers, 1983); assessing public stereotype of a scientist (Matkins, 1996); assessing images of mathematics and mathematicians (Rock and Shaw, 2000; Picker and Berry, 2001). Similarly in this study children's drawings are used. For the study the students drew four pictures with the subjects: draw a student who knows mathematics, draw a student who does not know mathematics, draw a student who loves mathematics, and draw a student who does not love mathematics. So firstly the students discriminate knowing mathematics, not knowing mathematics, loving mathematics and not loving mathematics from each other. So in this part of the literature knowing and loving mathematics will be reviewed, then "system view of instructional process" will be mentioned since it will be adopted to described and explained the images got from the students' drawings.

Learning of mathematics was long considered to be only a problem of cognition so the important role of affect was neglected (Schlöglmann, 2001). However, according to McLeod (1992) "Affective issues play a central role in mathematics learning and instruction" and he suggests that "beliefs, attitudes, and emotions should be important factors in research on the affective domain mathematics education" (Schlöglmann, 2001). So, recent researches on mathematics education have mostly pointed both the cognitive and affective domain of the mathematics. For this study "knowing mathematics" was considered as cognitive domain of the mathematics and "loving mathematics" was considered as affective domain of the mathematics.

2.8.1. Knowing Mathematics

- "Knowing mathematics means being able to use it in purposeful ways" (National Council of Teachers Mathematics, 1989).
- "Knowing mathematics means knowing "how to do it""(Ball, 1961, as cited in Ambrose, 2002)
- "Hersh (1986) defined mathematics as ideas; not marks made with pencils or chalk, not physical triangles or physical sets. Underlying his view of mathematics is that knowing mathematics is making mathematics" (Golafshan, 2002).
- ""Knowing" mathematics is "doing" mathematics" (NCTM, 1989).
- "Knowing mathematics is having pupils construct mathematical knowledge in the classroom" (Floden *et al.*, 1990).
- "Learnnig and knowing mathematics is shaped by culture, context, and values" (Montagne, 1992).
- "Knowing mathematics means being able to "get the right answer""(Everybody Counts, 1989).
- "Knowing mathematics means remembering and applying the correct rule when the teacher asks a question" (Everybody Counts, 1989).
- "Knowing mathematics would, under this definition, be a function of who is claiming to know, related to which community, how that knowing is presented, what

explanations are given for how that knowing was achieved, and the connections demonstrated between it and other knowing" (Burton, 1999).

- "Adding It Up (National Research Council, 2001) discusses the recent and rapid evolution of what it means to know mathematics and how this knowledge is to be recognized in students. The authors provide five interwoven "strands" of mathematical proficiency: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. Conceptual understanding reveals itself students in ways such as a student's ability to explain why particular relationships hold in a problem and why certain operations are used in a problem. Procedural fluencies self-explanatory with additional consideration given to flexibility, efficiency, accuracy appropriateness in performing mathematical procedures. Strategic competence is measured by an ability to "formulate, represent, and solve" (p. 116) given problems. Adaptive reasoning is an ability to reason logically about a problem and reflect on, explain, and justify the solution. Productive disposition is revealed as a "habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy" (p. 116)" (Harbaugh, 2005, p.18-19).

2.8.2. Loving Mathematics

- "According to the report of British Council (1995) "many kids don't adapt naturally to mathematics, yet they have to take it. It is a core subject, so they are forced to keep up. They either love it or they hate it"" (Dawson, 1995)
- "Attitude is a feeling about something a tendency to move toward or move away from a thing or topic. "I hate math" is an attitude: so is "I love math." If a kid indeed hates math, no learning occur until the attitude is changed" (Bill pages, 2002)
- "Students learn a love of mathematics in their classes" (Dawson, 1995)

2.9. System View of Instructional Process

Baykal (1978) developed a systems view to describe and explain the organized complexity of the instructional process. Instruction is a system and it includes some components. The objectives, social settings, physical settings, instructional media, instructional procedures and the teacher are the major components of the instructional system (Baykal, 1994-1995). Table 2.2 indicates the major components with some illustrative examples.

Table 2.2. Components of instructional system and some illustrative examples

Components	Illustrative examples
OBJECTIVES	Content and performances
SOCIAL SETT1NGS	Administrators Teachers Students Parents
PHYSICAL SETTINGS	Lab Classroom Others Home Work-places Public-places
INSTRUCTIONAL MEDIA	Textbook Blackboard TV and Video Computer Other Simulators
INSTRUCTIONAL PRODEDURES	Guidance Evaluation Assessment Measurement
TEACHER	Teacher

(Baykal, 1994-1995, p. 78)

The administrators, teachers, students, and parents are the illustrative examples for the "social settings". Baykal (1978) stated the most seen interaction between the social settings is student-student, teacher-student, and student-parent. As seen from the table "teacher" given as an illustrative example of the social settings and also it is a component of the instructional system. According to Baykal (1978) the teacher has the ability and skill to manage the all components of the instructional system so it is separated from other components. The instructional media includes the materials and resources which are required to make physical settings appropriate for instruction for the desired behavior. For example "table" is an example for physical settings but the table which is used as a material to draw then is an example for the instructional media. Classroom, laboratory, library, home, swimming pool, factory, work-places and public-places can be other examples for physical settings and textbooks, blackboard, television and video, and computer can be examples for instructional media.

3. SIGNIFICANCE OF THE STUDY

Although mathematics is the same objective knowledge everywhere, people in societies hold different beliefs, attitudes, values, images, and deep emotions about mathematics from different points such as teaching, learning, assessment, the nature of mathematics and gender. Similarly students hold different perceptions about mathematics and they affect their learning mathematics. So different studies have been conducted and many instruments have been developed for it. However, drawings of students seem to be less frequently used in studying students' perceptions, beliefs, attitudes, values, images and emotions about mathematics in literature. Thus this study utilized students drawings as a method of inquiry in order to give students an opportunity to freely express their perceptions of knowing and loving mathematics.

4. STATEMENT OF THE PROBLEM

The purpose of the study is to examine the images drawn by the students to reflect their perceptions of knowing and loving mathematics.

4.1. Research Questions

This study tries to find answers to the following questions:

1. What are the images drawn by the students to reflect their perceptions about knowing/not knowing and loving/not loving mathematics?
2. Is there a tendency to reflect objectives (what they learn) as an element of knowing/not knowing and loving/not loving mathematics?
3. Is there any tendency to include “the social settings” as an element of knowing/not knowing and loving/not loving mathematics?
4. Is there a tendency to include “the physical settings” as an element of knowing/not knowing and loving/not loving mathematics?
5. Is there a tendency to include “the instructional media” as an element of loving/not loving and knowing/not knowing mathematics?
6. Is there any tendency to include “methods/procedures” as an element of knowing/not knowing and loving/not loving mathematics?
7. Is there a tendency to include “the teacher” as an element of knowing/not knowing and loving/not loving mathematics?
8. Can students discriminate between cognitive (knowing and not knowing) aspect of mathematics and affective (loving and not loving) aspect of mathematics?
9. Can students discriminate between positive standing (knowing and loving) and negative (not knowing and not loving mathematics) standing in mathematics?
10. Can students make finer discriminations among knowing mathematics, not knowing mathematics, loving mathematics, and not loving mathematics?

5. METHODOLOGY

5.1. Procedure

In this study, an instrument, namely "Draw a student who knows/not know/love/not love mathematics" (DASMT) was developed. Then it is applied to the sample (N=169). Each student depicted four drawings: draw a student as knowing mathematics, draw a student as not knowing mathematics, draw a student as loving mathematics, and draw a student as not loving mathematics. Then the researcher studied on the drawings. This study consists of two parts. For the first part of the study the drawings of the sample were examined by noting every images drawn by the sample, on an excel sheet. Thus sixty images were established. After that the researcher scored each image by 1 if the drawings include the image and by 0 if the drawings do not include the image. Figure 5.1. is an example for the scoring study..

Name	Surname	G	C	Female student				Male student				Female teacher			
				knowing	not knowing	loving	not loving	knowing	not knowing	loving	not loving	knowing	not knowing	loving	not loving
Yalçın	Girginer	2	3	0	0	1	0	0	0	0	0	0	0	0	0
Sena Nur	Çakmakçı	1	3	1	1	1	0	0	0	0	0	0	0	0	0
Durmuş Ali	Çakmakçı	2	3	0	0	0	0	0	0	0	1	0	0	0	0
Emre	Gülen	2	3	0	1	1	0	0	0	0	0	0	0	0	0
Ebru	Kuruçay	1	3	0	0	0	1	1	1	1	0	0	0	0	0

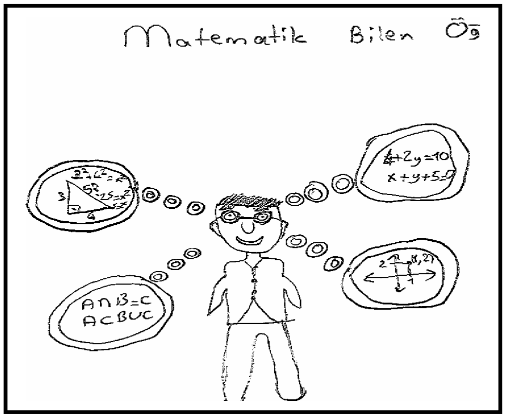
Figure 5.1. An example from the scoring study of drawings

Scorer 1 (the researcher) scored each image for each students' drawings. Then scorer 2 (a teacher) scored the images for each drawings. Then the reliability study was done. After that the frequencies and the percentages of the images were established. Beside them, cross tabulations, chi-square analysis, and graphing methods were used to establish quantitative results. Then, system view of instructional process (Baykal, 1978) was adopted to describe and explain the images reflected by the sample as an indicator of knowing/not knowing/loving/not loving mathematics. The images which were not described with system view were examined as “finer discriminations” which are the images reflected by the sample with high frequencies to discriminate knowing/not knowing/loving/not loving mathematics. Lastly, a proposed spread sheet is developed for data entry (see Appendix A).

For the second part of the study, one of the four drawings of each sample was selected randomly. Forty two drawings were selected randomly from the drawings of a student as knowing mathematics; forty three drawings were chosen randomly from the drawings of a student as not knowing mathematics; forty two drawings were chosen randomly from the sample drawings of a student as loving mathematics; and forty two drawings were selected randomly from the drawings of a student as not loving mathematics. Thus one hundred and sixty nine drawings were selected randomly in total. Then for practical purposes a coding system was used to differentiate the selected drawings. So each drawing was numbered according to this system. For it four digits were used. From the left the first three digit were used to number the place of pictures in excel sheet and the last digit was used for the category of “knowing”, “not knowing”, “loving”, and “not loving”. The number 1 is used for “knowing”, and the number 2 is used for “not knowing”, the number 3 is used for “loving”, and lastly the number 4 is used for “not loving”. For instance, the mean of the following number 1233 is that, this picture is the 123rd picture in excel sheet and the student draws it for the “loving” mathematics part.

After numbering the drawings, the symbolic, verbal, and mathematical explanations were cleared from those randomly selected 169 drawings. Figure 5.1.2 indicates a drawing of a sample before and after clearing the explanations.

Before clearing the explanations



After clearing the explanations

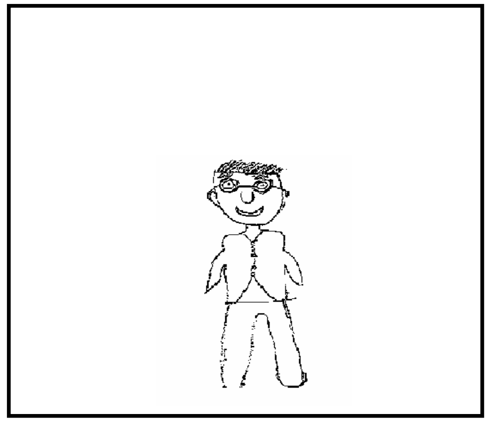


Figure 5.2. An example of the clearing the explanations from the drawings

Then the judges were selected. For it, another 95 students of Orbay Primary School from the grade levels of three, five, and six; and 74 students of Piyalepaşa Primary School from the grades seven and eight were selected. For practical reasons Orbay Primary School and Piyalepaşa Primary School were chosen for this part of the study. Like Orbay Primary School Piyalepaşa Primary School is a state school located at Beyoglu in Istanbul Also both schools were located in the same district, namely, Kasımpaşa (see Appendix B). Table 5.1 indicates the distribution of the number of participated judges by school and grade levels.

Table 5.1. Number of judges by grade level and schools

Grade	Name of the School	Number of judges
3	Orbay Primary School	29
5	Orbay Primary School	32
6	Orbay Primary School	34
7	Piyalepaşa Primary School	33
8	Piyalepaşa Primary School	41
Total Sample		169

After that the cleared drawings were given to the judges then they decided whether the student, drawn by the sample, on the picture is a student who knows/ not know/ loves/ not love mathematics. Then the perceived standings by the judges were cross tabulated with the intended standings in the original drawings and chi-square analysis was done in order to see the relationships. Moreover, "knowing" and "loving" mathematics were categorized as positive standings of mathematics, and "not knowing" and "not loving" mathematics were categorized as negative standings of mathematics; and "knowing" and "not knowing" mathematics assumed as cognitive aspects of mathematics, and "loving" and "not loving" mathematics assumed as affective aspects of mathematics. Then the cross tabulation and chi-square analysis were conducted in order to see whether the students can discriminate between positive and negative standings of mathematics; and cognitive and affective aspects of mathematics.

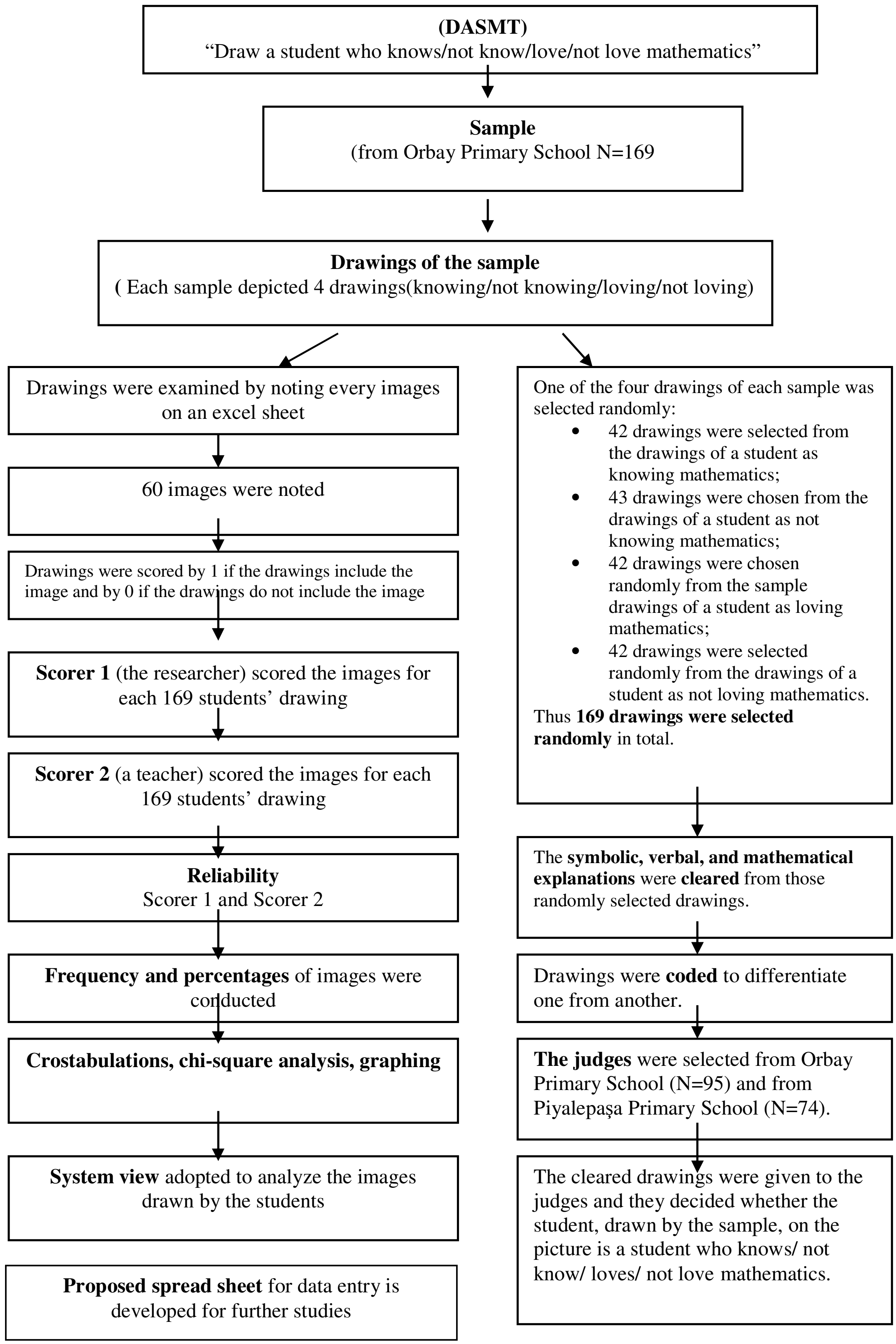


Figure 5.3. The procedure of the study

5.2. Sample

The sample consisted of 169 students of Orbay Primary School. The school is at Beyoglu in Istanbul. The selection of this school was for practical reasons, since the researcher was a mathematics teacher of the sixth, seventh, and eighth graders at this school. So the sixth, seventh and eighth graders were selected as sample. Moreover the third graders and the fifth graders were chosen since their teachers were eager to help the researcher. In fact at the beginning the sample consisted of 189 students but the researcher did not use 20 students' drawings since they preferred to use explanations instead of drawings. There are some examples in Appendix C for not selected studies of these students. Table 5.2 below indicates the number of participated students by grade level, number of classrooms and gender.

Table 5.2. Distribution of sample by gender and grade level.

Grade Level	Number of class	Gender		N
		F	M	
3	1	14	15	29
5	1	16	16	32
6	2	11	23	34
7	2	11	22	33
8	2	20	21	41
Total	8	72	97	169

5.3. Instruments

Drawings of students were used as an instrument. Two papers were given to students and the students were wanted to divide each paper into two part. Then they wrote their names to the other part of the paper. After that the researcher wanted them to select one of the papers and draw a student who knows mathematics to the one part of the divided paper and draw another student who does not know mathematics to the other part of the paper. Then, they continue their drawing with the second paper. The researcher wanted students to do the same work for the second paper for the subjects “drawing a student who loves mathematics” and “drawing a student who does not love mathematics”. Besides drawings, students are also free in explanation their drawings. Approximately forty minutes were used for this part of the study.

5.3.1. Reliability Analysis of the Instrument

Reliability is necessary for a test. Especially, since the analysis of drawings is subjective, inter-rater reliability is the most fundamental for these kinds of studies. So for this study, another scorer scored each picture independently. Statistical information about this analysis was given in Table 5.3. as seen from the table the correlation is significant at the .001 level.

Table 5.3. Pearson correlation table for reliability study

		The second scorer	The researcher
The second scorer	Pearson correlation	1	0.97
	Sig. (2-tailed)		0.00
	N	169	169
The researcher	Pearson correlation	0.97	1
	Sig. (2-tailed)	0.00	
	N	169	169

5.3.2. Validity Analysis of the Instrument

For the validity study, another 95 students of Orbay Primary School from the grades three, five, six; and 74 students of Piyalepaşa Primary School from the grades seven and eight were selected as the judges of the study. The judges were the peers of the samples and they had no idea about this study. Piyalepaşa Primary School is located at Beyoğlu in Istanbul. This school was selected for practical reasons since it is in the same district in

Kasımpaşa as Orbay Primary School. Table 5.2 indicates the distribution of participating judges by school and grade level.

Table 5.4. Number of judges by grade level and the school

Grade	Name of the school	Number of judges
3	Orbay Primary School	29
5	Orbay Primary School	32
6	Orbay Primary School	34
7	Piyalepaşa Primary School	33
8	Piyalepaşa Primary School	41
Total sample		169

Randomly, one of the drawings of each student was selected. Forty two drawings were selected from “knowing”, forty three of them were selected from “not knowing”, forty two of them were selected from “loving” and forty two of them were selected from the” not loving” pictures of students. After selection, the verbal, symbolic and mathematical explanations were erased. For practical purposes a coding system was used to differentiate the pictures. So each picture was numbered according to this system. For it four digits were used. From the left the first three digit were used to number the place of pictures in excel sheet and the last digit was used for the category of “knowing”, “not knowing”, “loving”, and “not loving”. The number 1 is used for “knowing”, and the number 2 is used for “not knowing”, the number 3 is used for “loving”, and lastly the number 4 is used for “not loving”. For instance, the mean of the following number 1233 is that, this picture is the 123rd picture in excel sheet and the student draws it for the “loving” mathematics part. After that the cleared drawings were given to the judges then they decided whether the student, drawn by the sample, on the picture is a student who knows/ not know/ loves/ not love mathematics. Then the perceived standings by the judges were cross tabulated with the intended standings in the original drawings and chi-square analysis was done in order to see the relationships

5.3.2.1. Statistical Analysis. Table 5.5 indicates the distribution of the frequencies of the intended standings in the original pictures with respect to the perceived standings by the judges. Table 5.5 indicates that the intended standings of knowing mathematics in the original perceived as loving by the judges with the high frequency (f=15). However, the standings of not knowing mathematics in the original picture perceived as not knowing mathematics with the high frequency (f=15) and loving mathematics perceived as loving mathematics by the judges frequently (f=22). The judges tend to perceive the intended standings of not loving mathematics as not knowing (f=12), loving (f=12), and not loving (f=12) mathematics. Moreover, the chi-square tests indicate that there is a significant association between the intended standings in the original pictures and the perceived standings by the judges at .001 level (χ^2=28.924, df=9, p≤.001).

Table 5.5. Frequency distribution of intended standings in the original pictures vs. perceived standings by the judges

		Perceived standings by the judges				Total
		Knowing	Not knowing	Loving	Not loving	
Original picture	Knowing	15	5	18	4	42
	Not knowing	4	15	12	12	43
	Loving	10	3	22	7	42
	Not loving	6	12	12	12	42
Total		35	35	64	35	169

6. DATA ANALYSIS

To study with students' drawings quantitatively the images, used by students, on their drawings were examined. Sixty images were noted. These images are shown on Figure 6.1.There are some examples for these images in Appendix D.

	Images		Images
1	Male Student	31	Book
2	Smile	32	Exam Mark
3	Talking Balloon	33	Heart
4	Operations	34	Raising Hand
5	Explanation	35	Bank/Market/Grocer
6	Classroom	36	Ball
7	Female Student	37	Monster
8	Blackboard	38	Exam Paper
9	Desk	39	Glasses
10	Notebook	40	Rubbish
11	Name Of The Drawn Student	41	Father
12	Chair	42	Mother
13	Sadness	43	School Garden
14	Chalk	44	Magazine
15	Pencil	45	Bed
16	Question Mark	46	TV
17	Male Teacher	47	Flag
18	Peer	48	Armchair
19	Female Teacher	49	Report Card (Karne)
20	Rubber	50	"Istiklal Marşı/Gençliğe Hitabe/Andımız"
21	Board Rubber	51	Library
22	Home	52	Earring
23	Teacher Table	53	Car
24	Math Symbols	54	Light Bulb
25	Tie	55	Computer
26	Math Book	56	Library
27	Someone	57	Balloon
28	Problem	58	Clock
29	Geometrical Shapes	59	Machine
30	Street	60	Weapon

Figure 6.1. Sixty images which were used by the sample on their drawings

Then each of these images was controlled whether they were used then scored with 1 (present), and whether they were not used then scored with 0 (absent). For it, an excel sheet was used. Table 6.1 indicates an example of how a student's drawing (Figure 6.2) were scored on the excel sheet.

Table 6.1. Scoring system of the images

Name	Surname	G	C	Female Student				Male Student				Female Teacher				Male Teacher				Mother			
				Know	Not Know	Love	Not Love	Know	Not Know	Love	Not Love	Know	Not Know	Love	Not Love	Know	Not Know	Love	Not Love	Know	Not Know	Love	Not Love
Birday Dursun	Topal	E	5	**0**	**0**	0	1	**1**	**1**	1	0	**0**	**0**	0	0	**0**	**0**	0	0	**0**	**0**	0	0

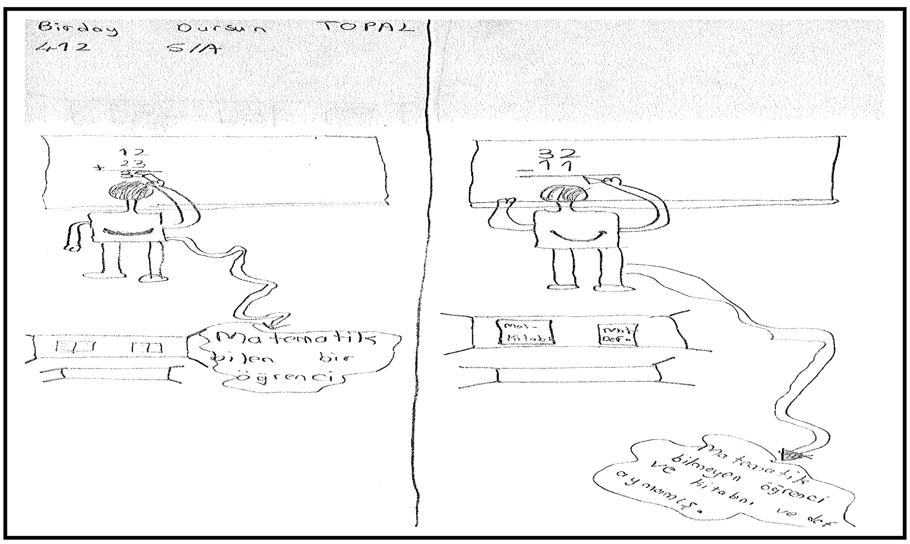


Figure 6.2. A student's drawing

After all drawings were scored on the excel sheet, the frequencies and the percentages of each image were computed by using the functions of the Excel program. Also "SPSS 13.0 for Windows" program was used for Cross Tabulation, Chi-Square analysis and Graphing functions of the program. Table 6.1 indicated the images depicted by the students and "system view" of Baykal (1978) was adopted to describe and explain the images. As mentioned in the literature instruction is a system and it includes some major components which are "objectives", "social settings", "physical settings", "instructional media", "instructional procedures", and "the teacher". Table 2.2 indicates the components and some illustrative examples to the components. Then 34 images used by the students as an indicator of knowing/not knowing/loving/not loving mathematics were described as examples to the components as seen from the Table 6.2.

Table 6.2. Components of the instructional system, some illustrative examples and examples from the images used by the sample

Components	Illustrative examples	Examples from the images
OBJECTIVES	Content and Performances	Operations Math Symbols Math Problem Geometric Shapes
SOCIAL SETT1NGS	Administrators Teachers Students Parents	Male Student Female Student Peer Male Teacher Female Teacher Someone Father Mother
PHYSICAL SETTINGS	Lab Classroom Others Home Work-places Public-places	Classroom Home Street Bank/Market/Grocer School Garden Library Laboratory Desk Teacher table Chair
INSTRUCTIONAL MEDIA	Textbook Blackboard TV and Video Computer Other Simulators	Blackboard Notebook Chalk Pencil Rubber Board Rubber Math Book Book Magazine
INSTRUCTIONAL PRODEDURES	Guidance Evaluation Assessment Measurement	Exam Paper Exam Mark Report Card
TEACHER	Teacher	Teacher

(See Table 2.2, p. 19)

7. RESULTS

7.1. Analysis of Images

Research Question 1: What are the images drawn by the students to reflect their perceptions about knowing/not knowing and loving/not loving mathematics?

Sixty images were established from 676 (169x4=676) drawings of the students. Table 7.1 indicates the frequency and percentages of each image that depicted by samples. Students drew “male student” with the highest frequency.

Table 7.1. Frequencies and percentages of all images observed

	Images	Frequency	Percentage		Images	Frequency	Percentage
1	Male Student	466	12.80	31	Book	15	0.41
2	Smile	377	10.35	32	Exam Mark	14	0.38
3	Talking Balloon	372	10.22	33	Heart	14	0.38
4	Operations	237	6.51	34	Raising Hand	11	0.30
5	Explanation	226	6.21	35	Bank/Market/Grocer	9	0.25
6	Classroom	212	5.82	36	Ball	8	0.22
7	Female Student	194	5.33	37	Monster	8	0.22
8	Blackboard	187	5.14	38	Exam Paper	7	0.19
9	Desk	162	4.45	39	Glasses	7	0.19
10	Notebook	128	3.52	40	Rubbish	7	0.19
11	Name Of The Drawn Student	112	3.08	41	Father	6	0.16
12	Chair	103	2.83	42	Mother	5	0.14
13	Sadness	102	2.80	43	School Garden	5	0.14
14	Chalk	77	2.11	44	Magazine	5	0.14
15	Pencil	70	1.92	45	Bed	5	0.14
16	Question Mark	54	1.48	46	Tv	5	0.14
17	Male Teacher	47	1.29	47	Flag	5	0.14
18	Peer	42	1.15	48	Armchair	4	0.11
19	Female Teacher	37	1.02	49	Report Card (Karne)	4	0.11
20	Rubber	34	0.93	50	"Istiklal Marşı/Gençliğe Hitabe/Andımız"	4	0.11
21	Board Rubber	34	0.93	51	Library	3	0.08
22	Home	28	0.77	52	Earring	3	0.08
23	Teacher Table	27	0.74	53	Car	3	0.08
24	Math Symbols	26	0.71	54	Light Bulb	2	0.05
25	Tie	23	0.63	55	Computer	2	0.05
26	Math Book	22	0.60	56	Library	1	0.03
27	Someone	16	0.44	57	Balloon	1	0.03
28	Problem	16	0.44	58	Clock	1	0.03
29	Geometrical Shapes	16	0.44	59	Machine	1	0.03
30	Street	15	0.41	60	Weapon	1	0.03

*Research Question 2***:** Is there a tendency to reflect objectives (what they learn) as an element of knowing/not knowing and loving/not loving mathematics?

Four images were used as an indicator of “the objectives” in this study. Table 7.2 indicates the percentages and frequencies of the images as an indicator of “objectives” which are “operations”, “math symbols”, “math problem”, and “geometric shapes”. The table shows that the most frequent image reflected by the sample is “operations”. The percentage of using operations is 80.34 per cent in this table. Moreover, as seen from the Table 7.1 the operations used by the student as the fourth most frequent images (f=237, and 6.50 per cent)

Table 7.2. Distribution of images as an indicator of “objectives”

Images of “objectives”	Frequency	Percentage
Operations	237	80.34
Math symbols	26	8.82
Math problem	16	5.42
Geometric shapes	16	5.42
Total	295	100

Table 7.3 indicates the distribution of the frequencies and the percentages of the usage of operation in knowing/not knowing/loving/not loving mathematics’ part of sample’s drawings. The percentage of using operation as an indicator of knowing mathematics is 49.1 per cent, as an indicator not knowing mathematics is 43.8 per cent, as an indicator of loving mathematics is 24.9 per cent, and as an indicator of not loving mathematics is 20.7 per cent. Operations were most frequently used to reflect knowing and not knowing mathematics in the drawings.

Table 7.3. Absence or presence of the operations as an indicator of knowing/not knowing/loving/not loving mathematics

Operations as an indicator of knowing mathematics	Frequency	Percentage
Absent	86	50.9
Present	83	49.1
Total	169	100
Operations as an indicator of not knowing mathematics	Frequency	Percentage
Absent	95	56.2
Present	74	43.8
Total	169	100
Operations as an indicator of loving mathematics	Frequency	Percentage
Absent	127	75.1
Present	42	24.9
Total	169	100
Operations as an indicator of not loving mathematics	Frequency	Percentage
Absent	134	79.3
Present	35	20.7
Total	169	100

Figure 7.1 indicates the distributions of the frequencies and percentages of reflecting operations as an indicator of knowing/not knowing/loving/ not loving mathematics. the percentages of using operations as an indicator of knowing (35 per cent) and not knowing (32 per cent) mathematics are higher than the percentages of using operations as an indicator of loving (18 per cent) and not loving mathematics (15 per cent).

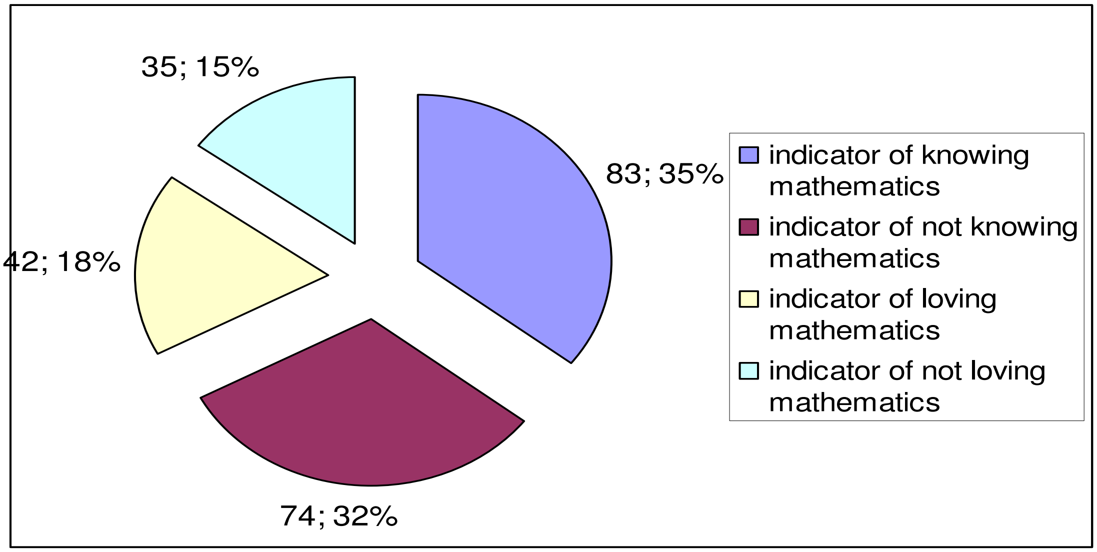


Figure 7.1. Frequencies and percentages of the operations reflected as an indicator of knowing/not knowing/loving/not loving mathematics

Table 7.4 indicates the frequency and percentage distribution of the operations with respect to students' usage of operations with right answer, with wrong answer, and with no answer as an indicator of knowing/not knowing/loving/not loving mathematics. Moreover Figure7.2 indicate the distribution of the percentages of operations with right answer, wrong answer, and with no answer as an indicator of knowing/not knowing/loving/not loving mathematics.

The students have a tendency to use the operation with its right answer to reflect that the student knows mathematics. As seen from the Table 7.4, the Figure 7.2, the frequency (f=75) and the percentage (44.4 per cent) of using operation with its right answer is the highest for the drawings of a students as knowing mathematics. Also, Table 7.4 and Figure 7.2 indicate that no students use an operation with its right answer as an indicator of not knowing mathematics. Interestingly, students have a tendency to use operations with no answer (29.6 per cent) instead of using operations with wrong answers (14.2 per cent) as an indicator of not knowing mathematics..

Table 7.4. Absence or presence of the operations with right answer, with wrong answer, and with no answer as an indicator of knowing/not knowing/loving/not loving mathematics

Operations as an indicator of knowing mathematics		Frequency	Percentage
Absent		86	50.9
Present	with right answer	75	44.4
	with wrong answer	3	1.8
	with no answer	5	3.0
Total		169	100
Operations as an indicator of not knowing mathematics		Frequency	Percentage
Absent		95	56.2
Present	with wrong answer	24	14.2
	with no answer	50	29.6
Total		169	100
Operations as an indicator of loving mathematics		Frequency	Percentage
Absent		127	75.1
Present	with right answer	33	19.5
	with wrong answer	2	1.2
	with no answer	7	4.1
Total		169	100
Operations as an indicator of not loving mathematics		Frequency	Percentage
Absent		134	79.3
Present	with right answer	4	2.4
	with wrong answer	6	3.6
	with no answer	25	14.8
Total		169	100

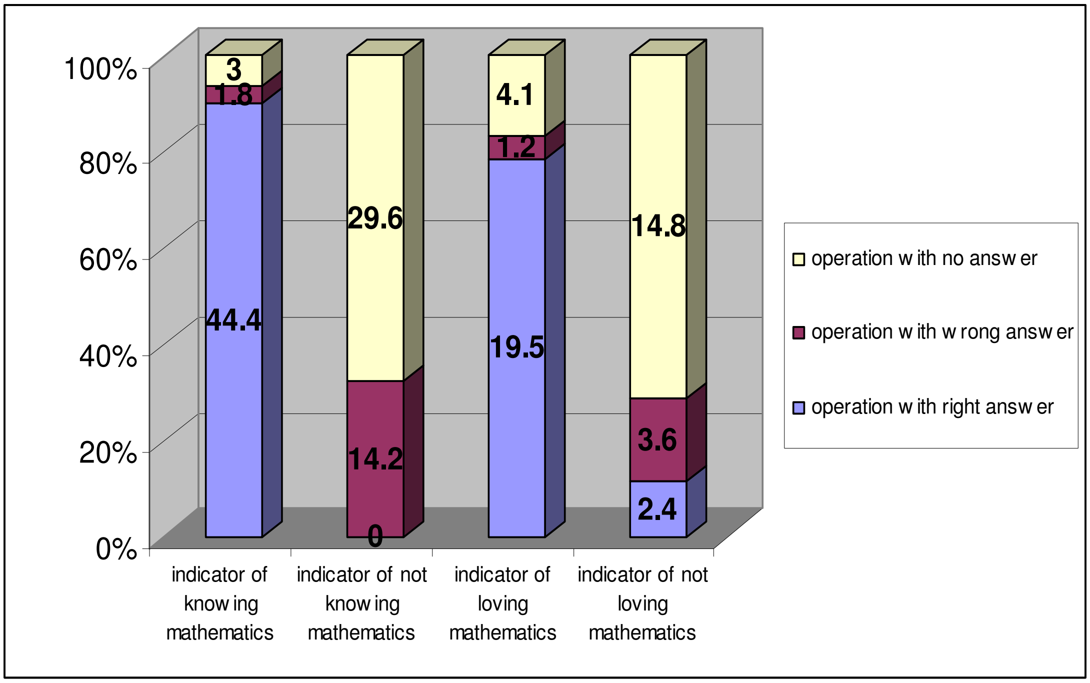


Figure 7.2. Percentages of the operations with right answer, with wrong answer, and with no answer as an indicator of knowing/not knowing/loving/not loving mathematics

Table 7.5 indicates frequency distributions of the type of operations (addition, subtraction, multiplication, division). Figure 7.3, Figure 7.4, Figure 7.5, and Figure 7.6 indicates the percentage distributions of the type of operations (addition, subtraction, multiplication, division). As seen from the table and the figures the percentage and the frequency of using addition and multiplication are higher than the percentages and the frequencies of using subtraction and division.

Table 7.5. Absence or presence of the type of operations

		Indicator of knowing math	Indicator of not knowing math	Indicator of loving math	Iindicator of not loving math
		f	f	f	f
Absent		86	95	127	134
Present	Addition	31	29	13	11
	Subtraction	5	9	3	4
	Multiplication	29	22	17	15
	Division	2	13	2	4
	Two operation	12	1	6	1
	All	4	0	1	0
Total		169	169	169	169

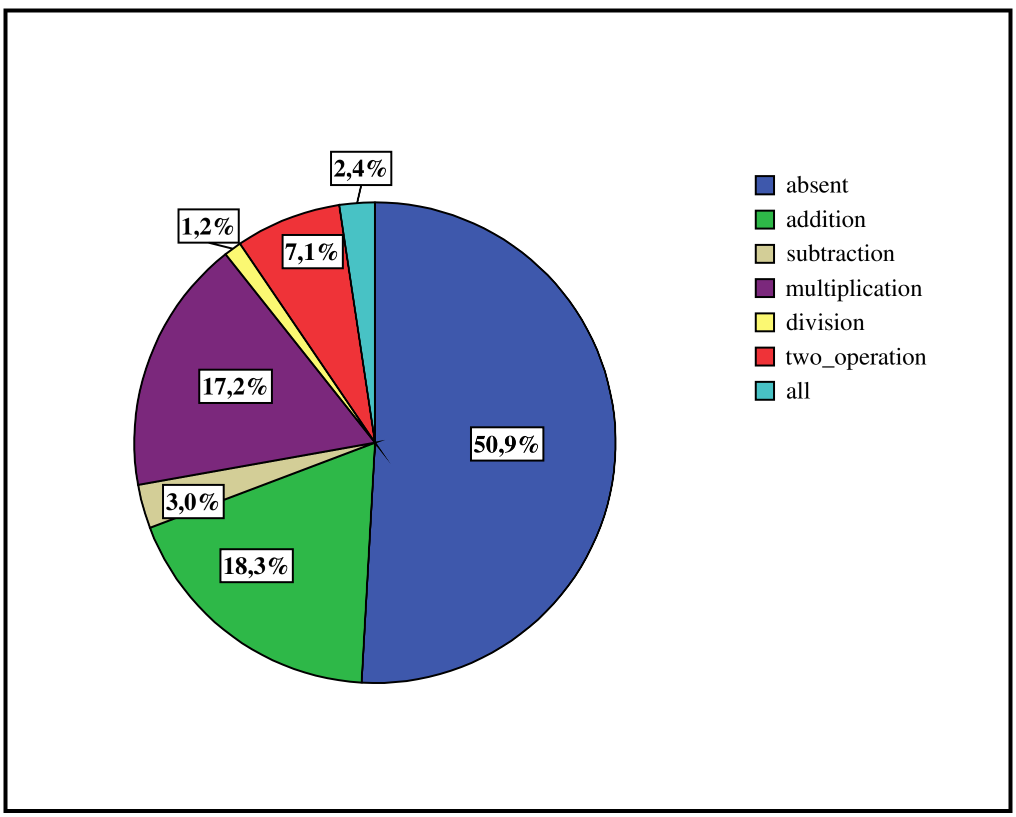


Figure 7.3. Percentages of the type of operations as an indicator of knowing mathematics

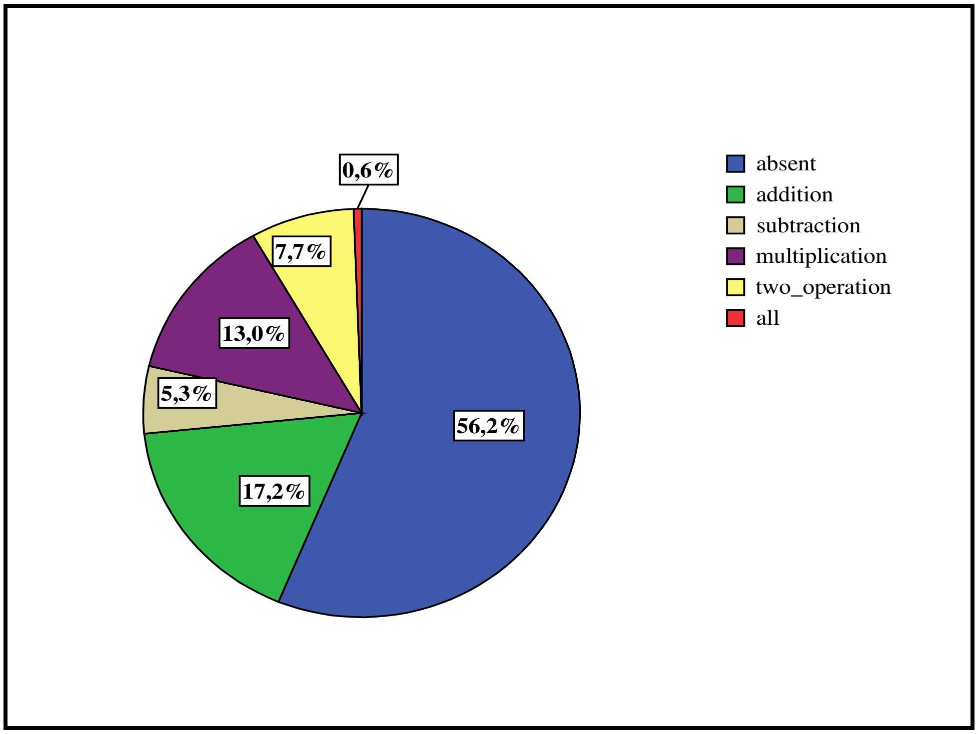


Figure 7.4. Percentages of the type of operations as an indicator of not knowing mathematics

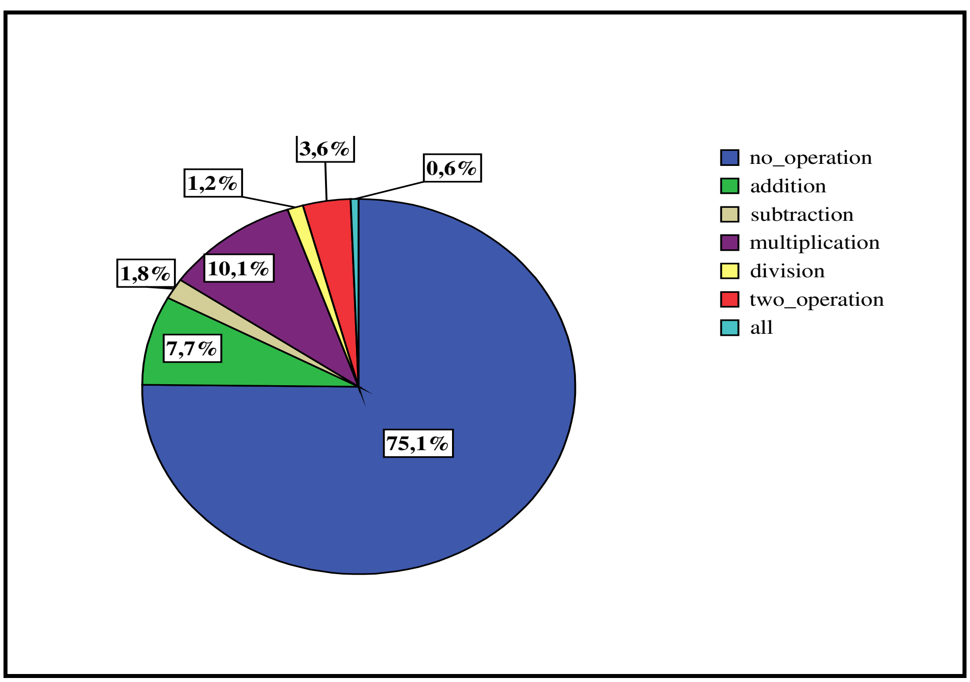


Figure 7.5. Percentages of the type of operations as an indicator of loving mathematics

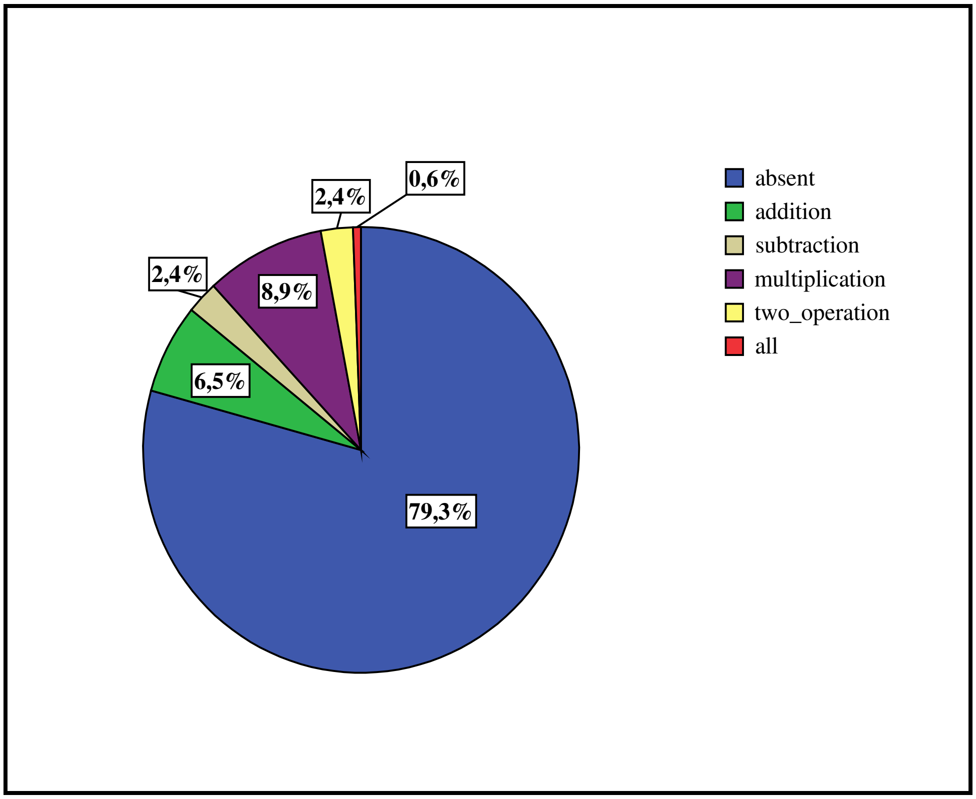


Figure 7.6. Percentages of the type of operations as an indicator of not loving mathematics

Research Question 3: Is there any tendency to include “the social settings” as an element of knowing/not knowing and loving/not loving mathematics?

Eight images were reflected as an indicator of “social settings” in this study. Table 7.6 indicates the percentages and frequencies of these images. The images as an indicator of “social settings” are male student, female student, peer, male teacher, female teacher, someone, father, and mother. The table shows that the most frequent image drawn by the sample is drawing a male student. The percentage of drawing a male student is 56.42 per cent in this table.

Table 7.6. Distribution of images as an indicator of “social settings”

Images Of "Social Settings"	Frequency	Percentage
Male Student	466	56.42
Female Student	194	23.49
Peer	55	6.66
Male Teacher	47	5.69
Female Teacher	37	4.48
Someone	16	1.94
Father	6	0.73
Mother	5	0.61
Total	826	100

Figure 7.7 is the pie graph of the images used as an indicator of “social settings”. It indicates the distribution of the percentages of these images.

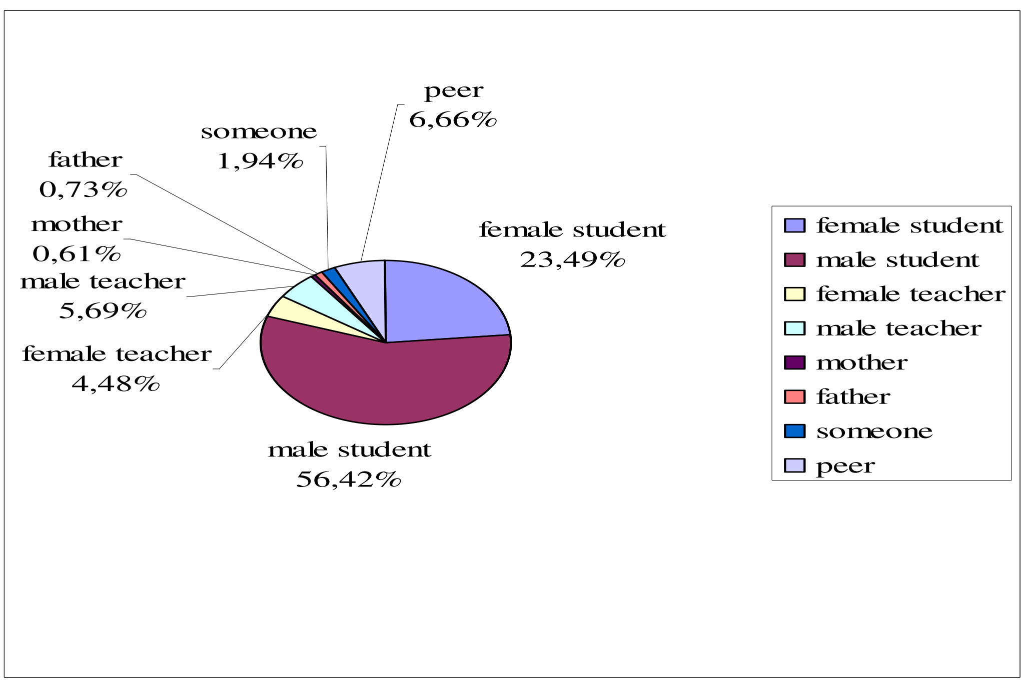


Figure 7.7. Percentages of images as an indicator of “social settings”

The students reflected the image of students, parents, peers, teachers, and someone. In fact some of them show the interactions between these images. So the Table 7.10 indicates the frequencies of drawing a student alone, drawing a student with teacher, drawing a student with parents, drawing a student with peers, drawing a student with peers and teacher, drawing a student with foreign, etc. As seen from the table, the frequency of drawing a student alone to reflect a student as an indicator knowing mathematics is 134. Moreover, the frequency of drawing a student alone to reflect student as not knowing mathematics is 135. Also, the frequency of drawing a student alone to reflect student as loving mathematics is 128. Lastly the frequency of drawing a student alone to reflect student as an indicator of not loving mathematics. As seen from the Table 7.7 the frequencies of reflecting student alone as an indicator of knowing/not knowing/loving/ not loving mathematics are higher than the interactions such as student+teacher, student+parent, etc. Therefore the students have a tendency to draw a student alone for all their drawings of a student as knowing/not knowing/loving/not loving mathematics.

Table 7.7. Frequency distribution of the interactions of images as an indicator of "social settings"

	Indicator of knowing math	Indicator of not knowing math	Indicator of loving math	Indicator of not loving math
No one	3	3	7	8
Student alone	134	135	128	128
Student + teacher	12	12	13	13
Student + parent	1	0	5	3
Student + peer	6	3	8	8
Student + peer + teacher	9	10	5	6
Student + someone	2	3	1	2
Student + teacher + someone	1	2	1	1
Someone	1	1	1	0
Total	169	169	169	169

Cross tabulations and Chi-square analysis are used as a technique to analyze the images of the drawn student for gender. The following figures indicate the frequencies and the chi-square analysis of male and female samples for the drawing of a female/male student who knows/not know/loves/not love mathematics.

Figure 7.8 shows the frequencies drawing a female student and a male student as knowing mathematics with respect to sample gender. The figure includes the frequency of drawing a female student as knowing mathematics by female and male samples and the frequency of drawing a male student as knowing mathematics by female and male samples. According to Figure 7.8, female students have a tendency to draw a female student as knowing mathematics. The frequency (f=42) of drawing a female student as knowing mathematics by female sample is higher than the frequency (f=28) of drawing a male student as knowing mathematics by female student. Moreover the frequency (f=82) of drawing a male student as knowing mathematics by male sample is higher than the frequency (f=15) of drawing of a female student as knowing mathematics by male sample. So female students have a tendency to depict a female student as knowing mathematics and male students have a tendency to depict a male student as knowing mathematics.

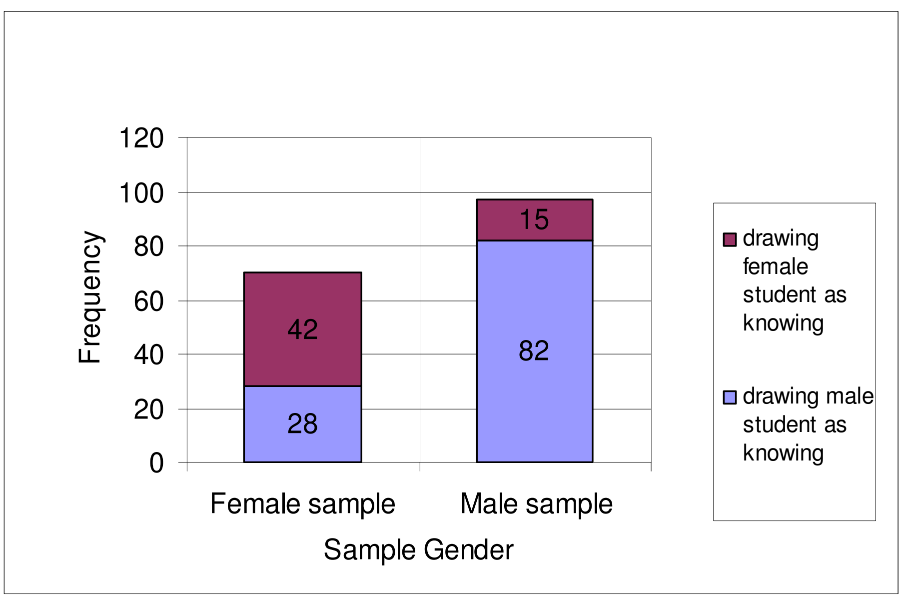


Figure 7.8. Frequencies of reflecting male /female student as an indicator of knowing mathematics by female/male samples

The Pearson chi-square test indicates that there is a significant association between the sample gender and drawing a female student as knowing mathematics because the significance level is less than .001 (χ^2=33.977, df=1, p<.001). Also there is a significant association between the sample gender and drawing a male student as knowing mathematics because the significance level is less than .001 (χ^2=37.894, df=1, p<.001).

Figure 7.9 shows the frequencies and percentages of drawing a female student and a male student as not knowing mathematics with respect to sample gender.. The figure includes the frequency and percentage of drawing a female student as not knowing mathematics by female and male samples and the frequency and percentage of drawing a male student as not knowing mathematics by female and male samples. According to Figure 7.9, the frequency and percentage(f=42) of drawing a male student as not knowing mathematics by female sample is higher than the frequency (f=28) of the drawing of a female student as not knowing mathematics by female student. Moreover the frequency (f=82) of drawing a male student as not knowing mathematics by male sample is higher than the frequency (f=13) of the drawing of a female student as not knowing mathematics by male sample. So female students have a tendency to depict a male student as not knowing mathematics and male students have a tendency to depict a male student as not knowing mathematics.

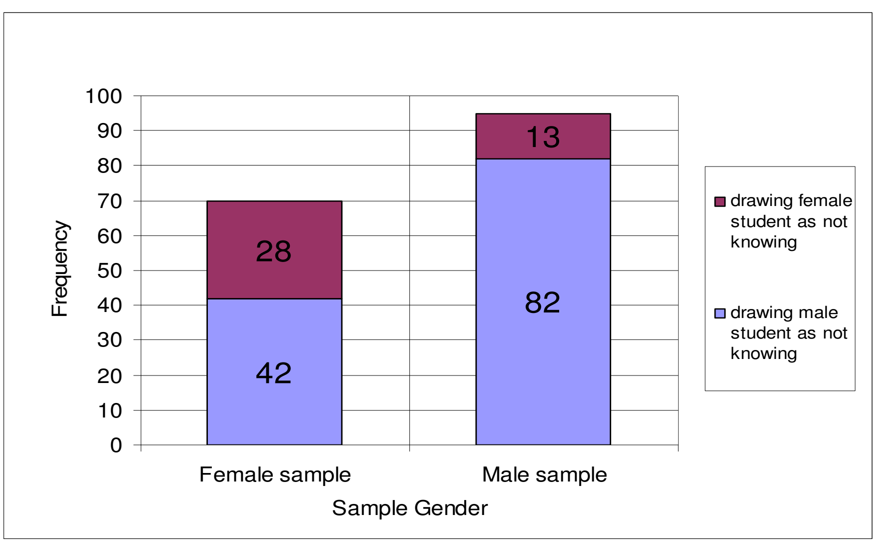


Figure 7.9. Frequencies of reflecting male /female student as an indicator of not knowing mathematics by female/male samples

There is a significant association between the gender and drawing a female student as not knowing mathematics because the significance level is less than .001 (X^2=14.609, df=1, p<.001). Moreover there is a significant association between the gender and drawing a male student as not knowing mathematics at .001 level (χ^2=14.522, df=1, p<.001).

Figure 7.10 shows the frequencies of the sample drawings of a female student and a male student as loving mathematics with respect to sample gender. The figure includes the frequencies of the sample drawings of a female student as loving mathematics and the frequencies of drawing a male student as loving mathematics. According to Figure 7.10, the frequency of drawing a female student as loving mathematics by female sample is 36 and the frequency of the drawing of a male student as loving mathematics by female student is 34. Also, the frequency (f=81) of drawing a male student as loving mathematics by male sample is higher than the frequency (f=13) of the drawing of a female student as loving mathematics by male sample. So female students have a tendency to depict both female and male student as loving mathematics but again here male students have a tendency to depict a male student as loving mathematics.

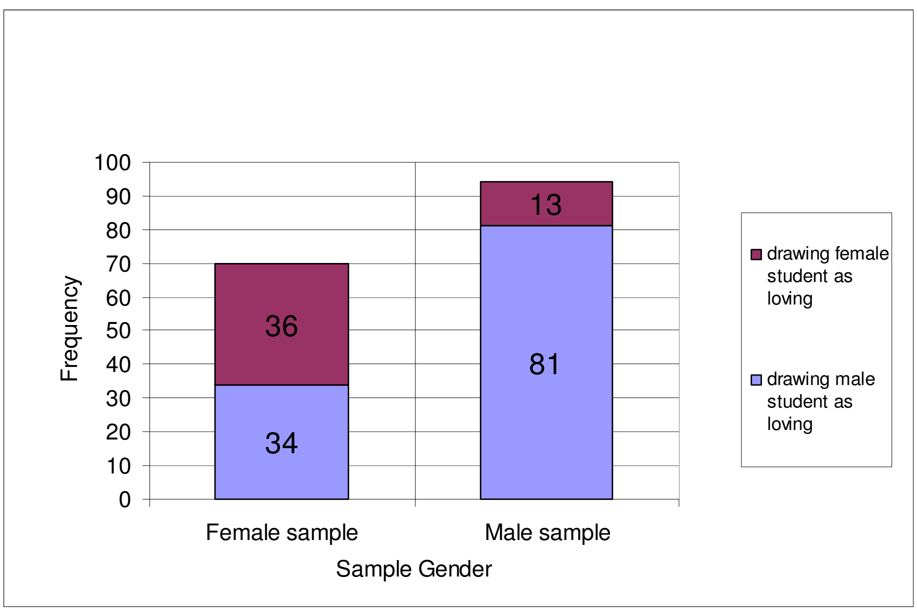


Figure 7.10. Frequencies of reflecting male /female student as an indicator of loving mathematics by female/male samples

The Pearson chi-square test indicate that there is a significant association between the gender and drawing a female student as loving mathematics at .001 level (χ^2=6.886, df=1, $p<.001$) and there is a significant association between the gender and drawing a male student as loving mathematics at .001 level (χ^2=26.297, df=1, $p<.001$).

Figure 7.11 shows the frequencies of the sample drawings of a female student and a male student as not loving mathematics with respect to sample gender. The figure includes the frequencies of the sample drawings of a female student as not loving mathematics and the frequencies of drawing a male student as not loving mathematics. According to Figure 7.11, the frequency (f=44) of drawing a male student as not loving mathematics by female sample is higher than the frequency (f=26) of the drawing of a female student as not loving mathematics by female student. Moreover the frequency (f=73) of drawing a male student as not knowing mathematics by male sample is higher than the frequency (f=21) of drawing a female student as not loving mathematics by male sample. So female students have a tendency to depict a male student as not loving mathematics and male students have a tendency to depict a male student as not loving mathematics

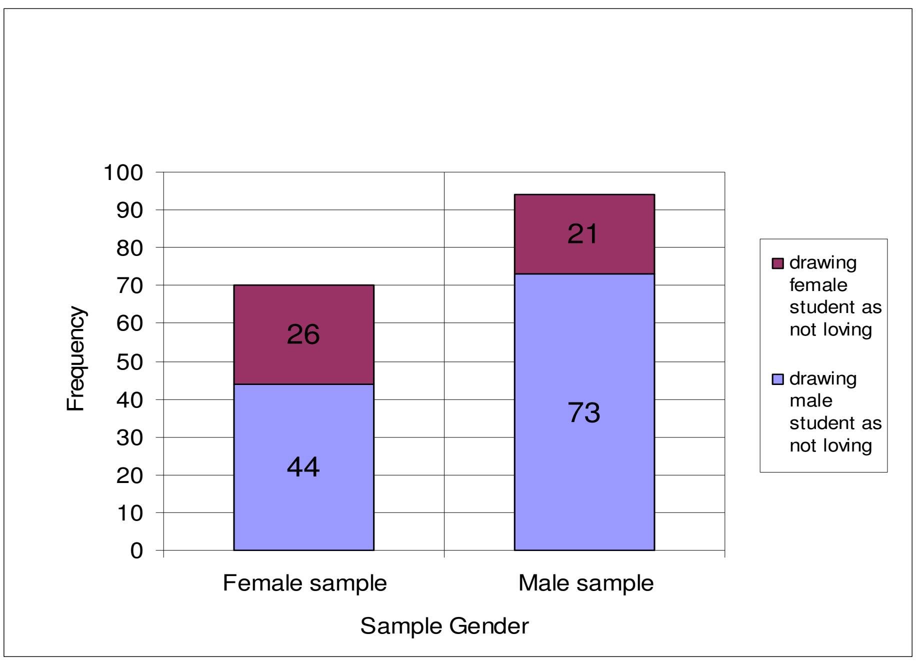


Figure 7.11. Frequencies of reflecting male /female student as an indicator of not loving mathematics by female/male samples

There is a significant association between the gender and drawing a female student as not loving mathematics at .05 (χ^2=4.304, df=1, p≤.05) and there is a significant association between the gender and drawing a male student as not loving mathematics at .05 level (χ^2=3.882, df=1, p≤.05).

Research Question 4: Is there a tendency to include "the physical settings" as an element of knowing/not knowing and loving/not loving mathematics?

Ten images were used as an indicator of "physical settings". Table 7.8 indicates the frequencies of each image. The images used as an indicator of "physical settings" are classroom, desk, chair, home, teacher table, street, bank/market/grocer, school garden, library, and laboratory. The table shows that the most frequent (f=212)image drawn by the sample is drawing classroom. The table also indicates the distribution of frequencies of the reflected images of physical settings as an indicator of knowing/not knowing/loving/not loving mathematics.

Table 7.8. Frequency distribution of images as an indicator of "physical settings"

	Indicator of knowing math	Indicator of not knowing math	Indicator of loving math	Indicator of not loving math	Total
classroom	62	62	47	41	212
desk	46	39	41	36	162
chair	32	30	22	19	103
home	4	4	10	10	28
teacher table	9	9	4	5	27
street	2	4	3	6	15
bank/grocer/market	4	4	0	1	9
school garden	1	0	1	3	5
library	0	0	2	1	3
laboratory	1	0	0	0	1
Total	161	152	130	122	565

Figure 7.12 is the pie graph of the images used as an indicator of "physical settings". It indicates the percentages of the reflected images of "physical settings" by the sample.

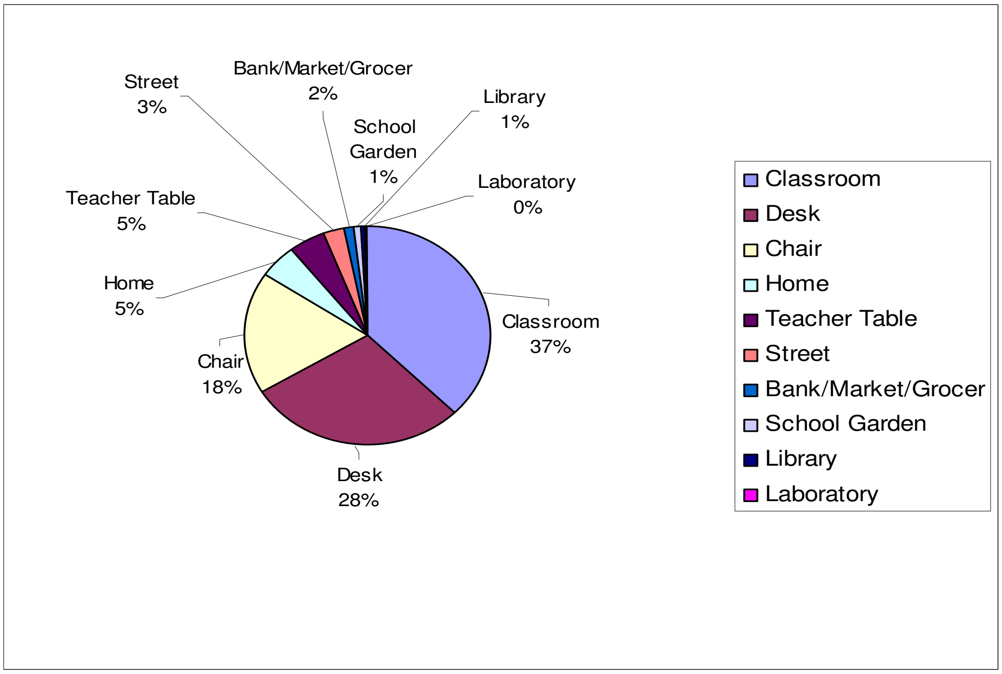


Figure 7.12. Percentages of reflected images as an indicator of "physical settings"

Research Question 5: Is there a tendency to include "the instructional media" as an element of loving/not loving and knowing/not knowing mathematics?

Thirteen images were categorized as "instructional media". Table 7.9 indicates the frequencies of each image reflected as an indicator of knowing/not knowing/loving/ not loving mathematics in this category. The images of "physical settings" are blackboard, desk, notebook, chair, chalk, pencil, rubber, board rubber, teacher table, math book, book, exam paper, and magazine. The table shows that the most frequent (f=187) image reflected by the sample is the blackboard. The table also indicates the distribution of frequencies of the reflected images of instructional media as an indicator of knowing/not knowing/loving/not loving mathematics.

Table 7.9. Frequency distribution of images as an indicator of “instructional media”

	Indicator of knowing math	Indicator of not knowing math	Indicator of loving math	Indicator of not loving math	Total
blackboard	54	54	42	37	187
notebook	40	32	37	19	128
chalk	29	27	10	11	77
pencil	22	17	20	11	70
rubber	10	7	11	6	34
board rubber	11	13	6	4	34
math book	5	4	8	5	22
book	6	2	4	3	15
magazine	1	2	1	1	5
Total	178	158	139	97	572

Figure 7.13 is the pie graph of the images of “instructional media”. It indicates the percentages of the images of “instructional media” drawn by the sample.

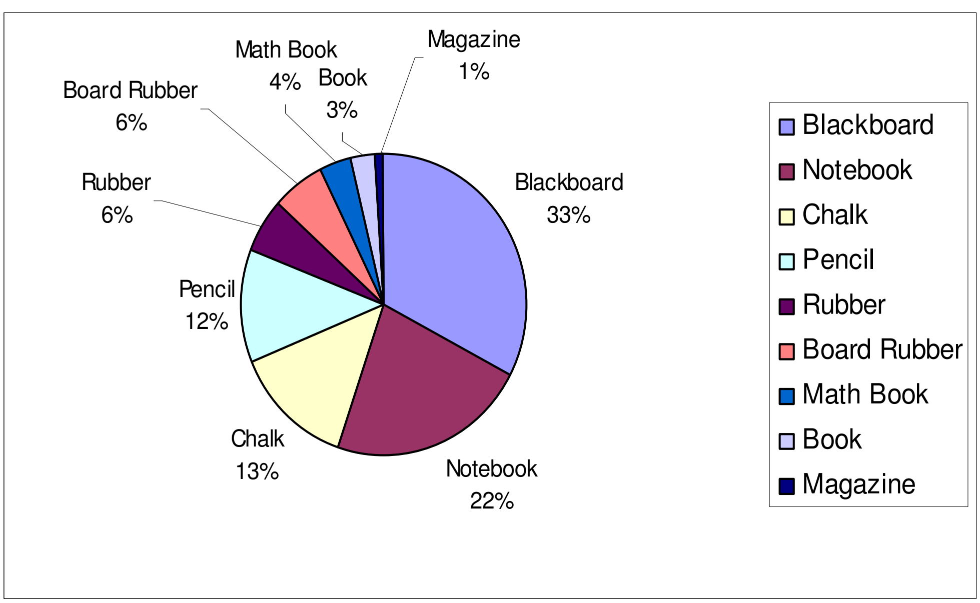


Figure 7.13. Percentages of reflected images as an indicator of “instructional media”

Research Question 6: Is there any tendency to include “methods/procedures” as an element of knowing/not knowing and loving/not loving mathematics?

Three images were used as an indicator of “instructional procedures”. Table 7.10 indicates the frequency and percentages of each image. The images of “instructional procedures” are exam mark, exam paper and report card. Table 7.16 shows that the most frequent (f=14) image used by the sample for this table is exam mark. However as seen from the Table 7.1 the frequencies and the percentages of exam mark (f=14, 0.38 per cent), exam paper (f=7, 0.19 per cent) and report card (f=4, 0.10 per cent) is not high. Therefore students do not have a tendency to include “instructional procedures” as an element of knowing/not knowing/loving/not loving mathematics.

Table 7.10. Distribution of images as an indicator of “instructional procedures”

Images Of “Instructional Procedures”	Frequency	Percentage
Exam Mark	14	56
Exam Paper	7	28
Report Card	4	16
Total	25	100

Research Question 7: Is there a tendency to include “the teacher” as an element of knowing/not knowing and loving/not loving mathematics?

Table 7.11 is a part from the Table 7.1 to indicate the frequency and percentage distribution of male and female teacher. As seen from the table the frequency of drawing a male teacher is 47 and the percentage of drawing a male teacher is 1.47 per cent. Also the frequency of drawing a female teacher is 37 and the percentage of drawing a female teacher is 1.15 per cent. Without considering the gender, in total the frequency of drawing a teacher is 84 and the percentage of drawing a teacher is 2.62 per cent. Comparing to the images from the Table 7.1, “male student”, “operations”, “female student”, “blackboard”, “notebook”, etc. the frequency and the percentage of drawing a teacher is not high.

Table 7.11. Distribution of the first nineteen images

	Images	Frequency	Percentage
1	Male Student	466	14,54
2	Smile	377	11,76
3	Talking Balloon	372	11,61
4	Operations	237	7,39
5	Explanation	226	7,05
6	Classroom	212	6,61
7	Female Student	194	6,05
8	Blackboard	187	5,83
9	Desk	162	5,05
10	Notebook	128	3,99
11	Name Of The Drawn Student	112	3,49
12	Chair	103	3,21
13	Sadness	102	3,18
14	Chalk	77	2,40
15	Pencil	70	2,18
16	Question Mark	54	1,68
17	Male Teacher	47	1,47
18	Peer	42	1,31
19	Female Teacher	37	1,15
	Total	3205	100,00

Although the frequency of drawing student is not high, when we examined the drawings of sample with the image of teacher, the position of the teacher is generally near the blackboard, near the teacher table or sitting down on the teacher table. Also, she/he is far away from the students. Moreover students generally depicted teachers as saying "Aferin-Well done", "Doğru-True", "Yanlış-False", etc. The examples of these drawings were shown in Appendix E.

Research Question 8: Can students discriminate between cognitive (knowing and not knowing) aspect of mathematics and affective (loving and not loving) aspect of mathematics?

Table 7.12 indicates the frequency distribution of cognitive (knowing and not knowing) and affective (loving and not loving) aspects of mathematics in the original pictures with respect to the perceived cognitive and affective aspects of mathematics by the judges. According to the table, 39 judges perceived cognitive aspects of mathematics as cognitive and 49 judges perceived cognitive aspects as affective. However, 31 judges perceived affective aspects as cognitive and 53 judges perceived affective aspects in the original picture as affective.

Table 7.12. Frequency distribution of intended aspects in the original pictures vs. perceived aspects by the judges

		Perceived aspects		Total
		Cognitive	Affective	
Original picture	Cognitive	39	46	85
	Affective	31	53	84
Total		70	99	169

The Pearson chi-square test indicate that there is no significant association between the intended aspects of mathematics in the original pictures and the perceived aspects of mathematics by the judges because the significance level is .2 (χ^2=1.403, df=1, p≤.2).

Therefore the students do not have a tendency to discriminate between cognitive aspect of mathematics (knowing and not knowing mathematics) and affective aspects of mathematics (loving and not loving mathematics).

Research Question 9: Can students discriminate between positive standing (knowing and loving) and negative (not knowing and not loving mathematics) standing in mathematics?

Table 7.13 indicates the frequency distribution of the intended positive standings (knowing and loving) and negative standings (not knowing and not loving) of mathematics in the original pictures with respect to the perceived standings by the judges. According to the table, 65 judges perceived positive standings of mathematics in the original picture as positive and 19 judges perceived positive standings of mathematics as negative. Moreover, 34 judges perceived negative standings of mathematics in the original picture as positive, and 51 judges perceived negative standings of mathematics in the original picture as negative.

Table 7.13. Frequency distribution of intended standings in the original pictures vs. perceived standings by the judges

		Perceived standings		Total
		Positive	Negative	
Original picture	Positive	65	19	84
	Negative	34	51	85
Total		99	70	169

The Pearson chi-square test indicate that there is a significant association between the intended standings in the original picture and perceived standings by the judges because the significance level is less than .001. (χ^2=24.331, df=1, p<.001).

Therefore the students have a tendency to discriminate between positive (knowing and loving) standing in mathematics and negative (not knowing and not loving) standing in mathematics.

Research Question 10: Can students make finer discriminations among knowing mathematics, not knowing mathematics, loving mathematics, and not loving mathematics?

Table 7.14 indicates the distribution of the frequency and the percentages of drawing a student as knowing mathematics with the symbol of smiling (lips up ) and not drawing a student as knowing mathematics with the symbol of smiling. As seen from the table the frequency of drawing a student as knowing mathematics with the symbol of smiling is 114 and the percentage of drawing a student as knowing mathematics with the symbol of smiling is 67.5 per cent. Figure 7.14 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as knowing mathematics with the symbol of smiling.

Table 7.14. Absence or presence of “smiles” as an indicator of knowing mathematics

	Frequency	Percentage
Absent	55	32.5
Present	114	67.5
Total	169	100.0

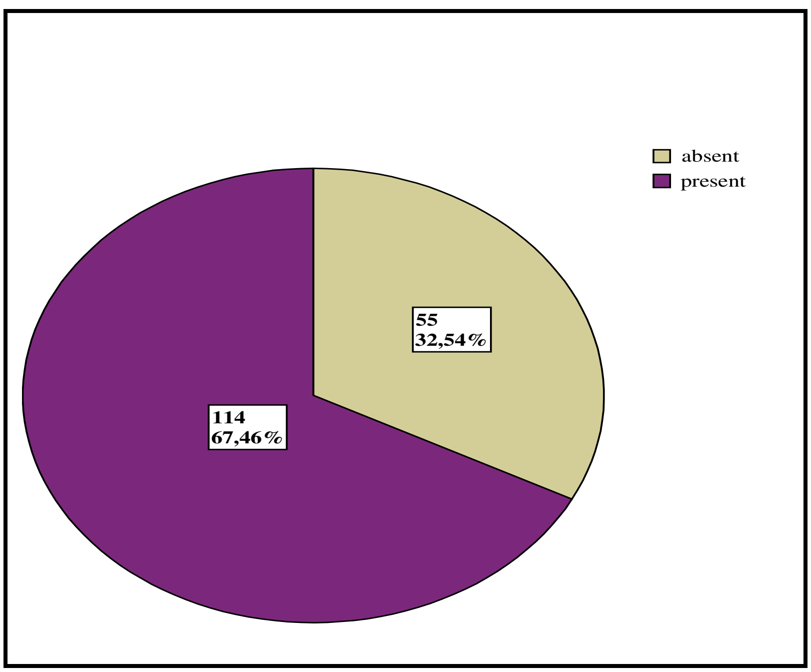


Figure 7.14. Absence or presence of “smiles” as an indicator of knowing mathematics

Table 7.15 indicates the distribution of the frequency and the percentages of drawing a student as not knowing mathematics with the symbol of smiling (lips concave up ☺) and not drawing a student as not knowing mathematics with the symbol of smiling. As seen from the table the frequency of drawing a student as not knowing mathematics with the symbol of smiling is 70 and the percentage of drawing a student as not knowing mathematics with the symbol of smiling is 41.4 per cent. Figure 7.15 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as not knowing mathematics with the symbol of smiling.

Table 7.15. Absence or presence of “smiles” as an indicator of not knowing mathematics

	Frequency	Percentage
Absent	99	58.6
Present	70	41.4
Total	169	100.0

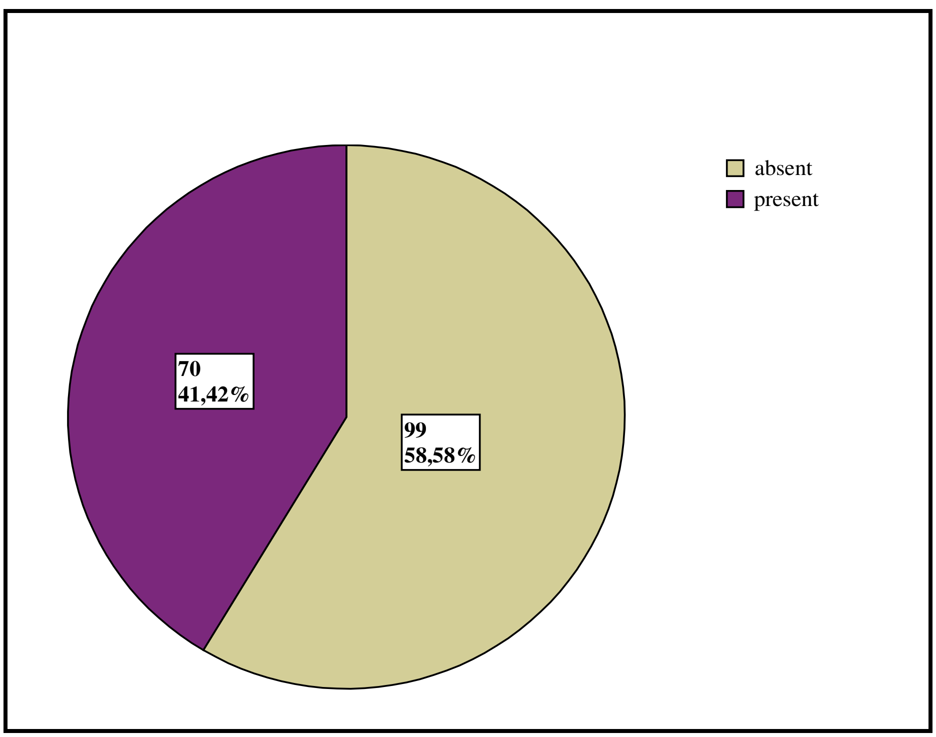


Figure 7.15. Absence or presence of “smiles” as an indicator of not knowing mathematics

Table 7.16 indicates the distribution of the frequency and the percentages of drawing a student as loving mathematics with the symbol of smiling (lips up ☺) and not drawing a student as loving mathematics with the symbol of smiling. As seen from the table the frequency of drawing a student as loving mathematics with the symbol of smiling is 120 and the percentage of drawing a student as loving mathematics with the symbol of smiling is 71,0 per cent. Figure 7.16 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as loving mathematics with the symbol of smiling.

Table 7.16. Absence or presence of “smiles” as an indicator of loving mathematics

	Frequency	Percentage
Absent	49	29.0
Present	120	71.0
Total	169	100.0

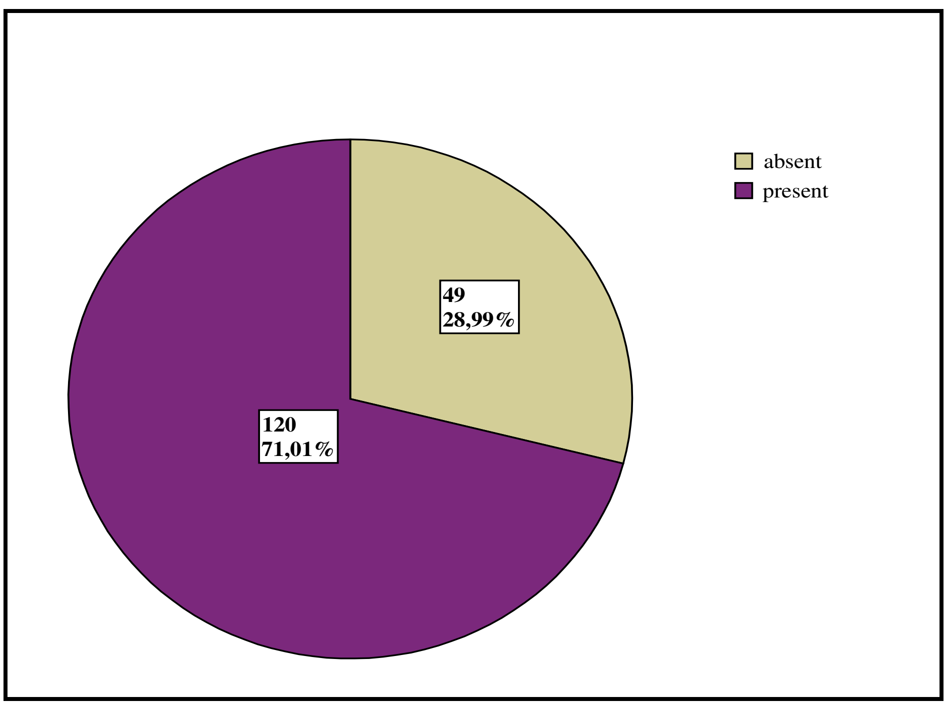


Figure 7.16. Absence or presence of “smiles” as an indicator of loving mathematics

Table 7.17 indicates the distribution of the frequency and the percentages of drawing a student as not loving mathematics with the symbol of smiling (lips up ) and not drawing a student as not loving mathematics with the symbol of smiling. As seen from the table the frequency of drawing a student as not loving mathematics with the symbol of smiling is 73 and the percentage of drawing a student as not loving mathematics with the symbol of smiling is 43,2 per cent. Figure 7.17 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as not loving mathematics with the symbol of smiling.

Table 7.17. Absence or presence of “smiles” as an indicator of not loving mathematics

	Frequency	Percentage
Absent	96	56.8
Present	73	43.2
Total	169	100.0

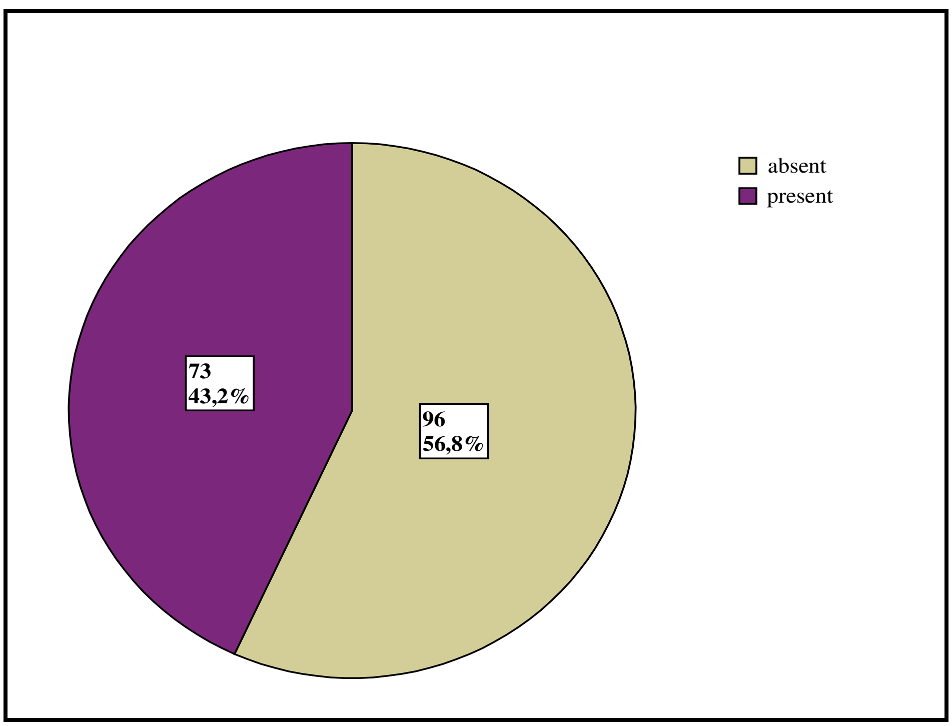


Figure 7.17. Absence or presence of “smiles” as an indicator of not loving mathematics

As seen from the tables and from the figures, the students depicted students as knowing and loving with the symbol of smiling with high frequencies and percentages.

No students draw a student as knowing mathematics with the symbols of being sad. Table 7.24 indicates the distribution of the frequency and the percentages of drawing a student as not knowing mathematics with symbols of being sad (lips down and tears) and not drawing a student as not knowing mathematics with symbols of being sad. As seen from the table the frequency of drawing a student as not knowing mathematics with the symbols of being sad is 50 and the percentage is 29.6 per cent. Figure 7.18 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as not knowing mathematics with symbols of being sad

Table 7.18. Absence or presence of “sadness” as an indicator of not knowing mathematics

	Frequency	Percentage
Absent	119	70.4
Present	50	29.6
Total	169	100.0

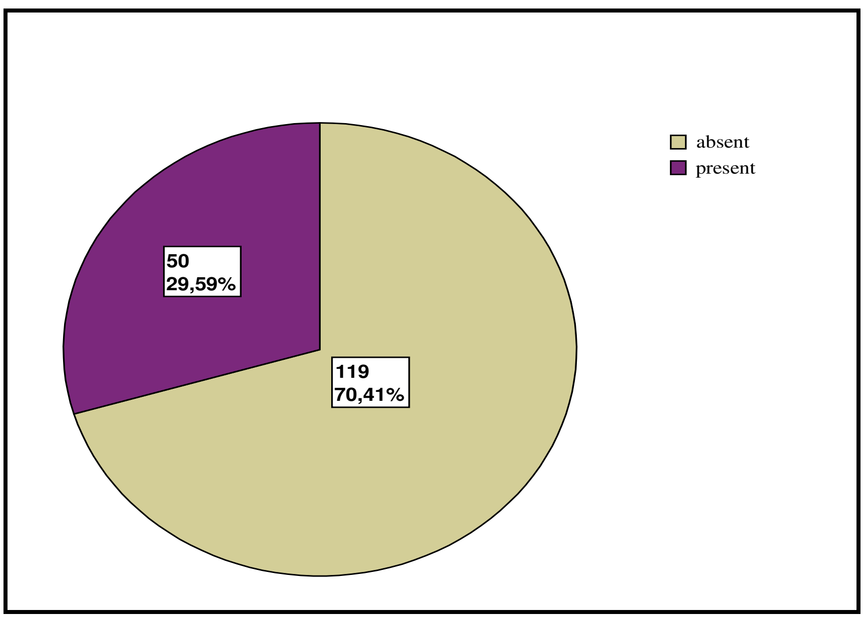


Figure 7.18. Absence or presence of “sadness” as an indicator of not knowing mathematics

Table 7.19 indicates the distribution of the frequency and the percentages of drawing a student as loving mathematics with symbols of being sad (lips down  and tears) and not drawing a student as loving mathematics with symbols of being sad. As seen from the table the frequency of drawing a student as loving mathematics with the symbols of being sad is only 1. Figure 7.19 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as loving mathematics with symbols of being sad

Table 7.19. Absence or presence of “sadness” as an indicator of loving mathematics

	Frequency	Percentage
Absent	168	99.4
Present	1	0.6
Total	169	100.0

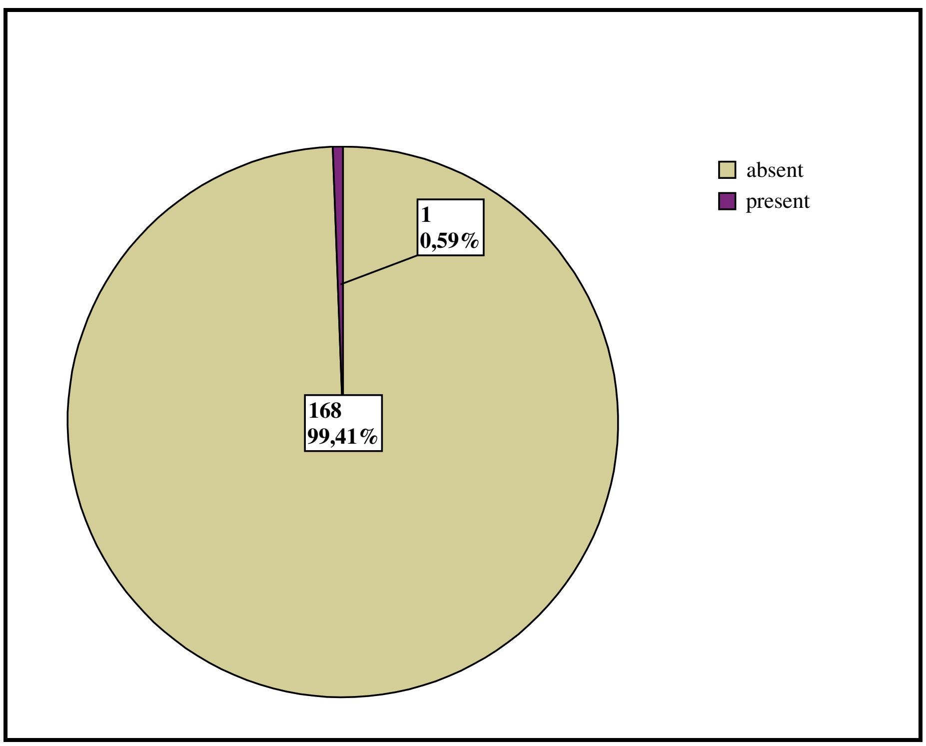


Figure 7.19. Absence or presence of “sadness” as an indicator of loving mathematics

Table 7.20 indicates the distribution of the frequency and the percentages of drawing a student as not loving mathematics with symbols of being sad (lips down and tears) and not drawing a student as not loving mathematics with symbols of being sad. As seen from the table the frequency of drawing a student as loving mathematics with the symbols of being sad is 51 and the percentage is 30.2. Figure 7.20 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as not loving mathematics with symbols of being sad

Table 7.20. Absence or presence of "sadness" as an indicator of not loving mathematics

	Frequency	Percentage
Absent	118	69.8
Present	51	30.2
Total	169	100.0

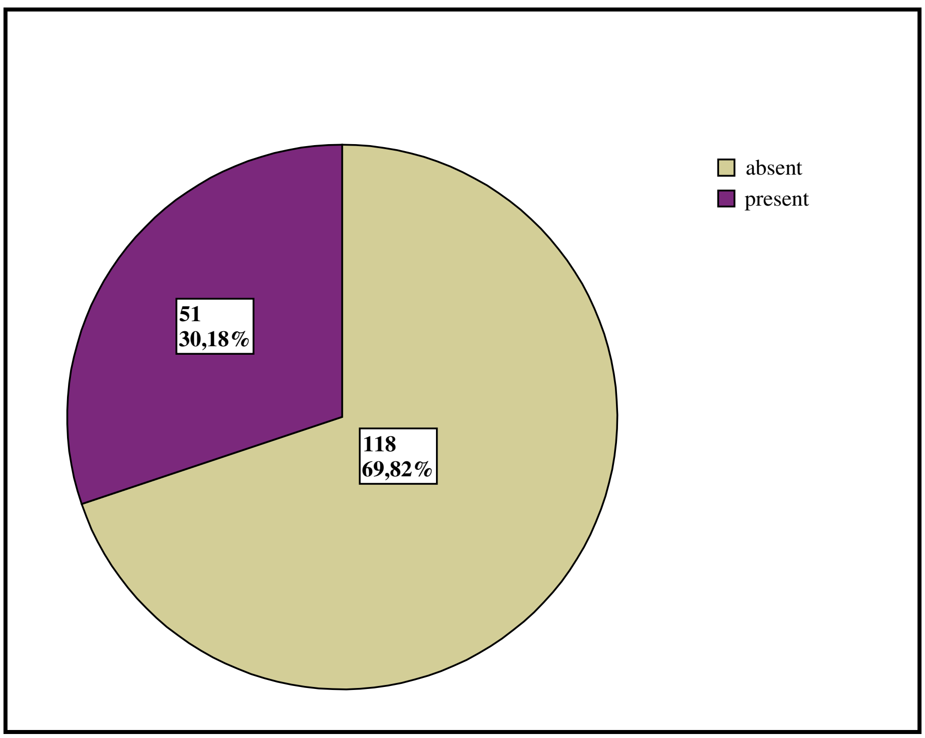


Figure 7.20. Absence or presence of "sadness" as an indicator of not loving mathematics

The tables and the figures indicate that no students have a tendency to draw a student as knowing mathematics with the symbols of being sad. Only one student is drawn by the sample as loving mathematics with the symbol of being sad. Interestingly, comparing to the frequencies of drawing a student as knowing and loving mathematics with the symbols of being sad, the frequencies of drawing a student as not knowing and as not loving mathematics with the symbols of being sad are higher than two of them.

No students draw a student as knowing mathematics with the symbol of question mark. Table 7.21 indicates the distribution of the frequency and the percentages of drawing a student as not knowing mathematics with the symbol of question mark and not drawing a student as not knowing mathematics with symbol of question mark. As seen from the table the frequency of drawing a student as not knowing mathematics with the symbol of question mark is 44 and the percentage is 26. Figure 7.21 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as not knowing mathematics with the symbol of question mark.

Table 7.21. Absence or presence of “question mark” as an indicator of not knowing mathematics

	Frequency	Percentage
Absent	125	74
Present	44	26
Total	169	100.0

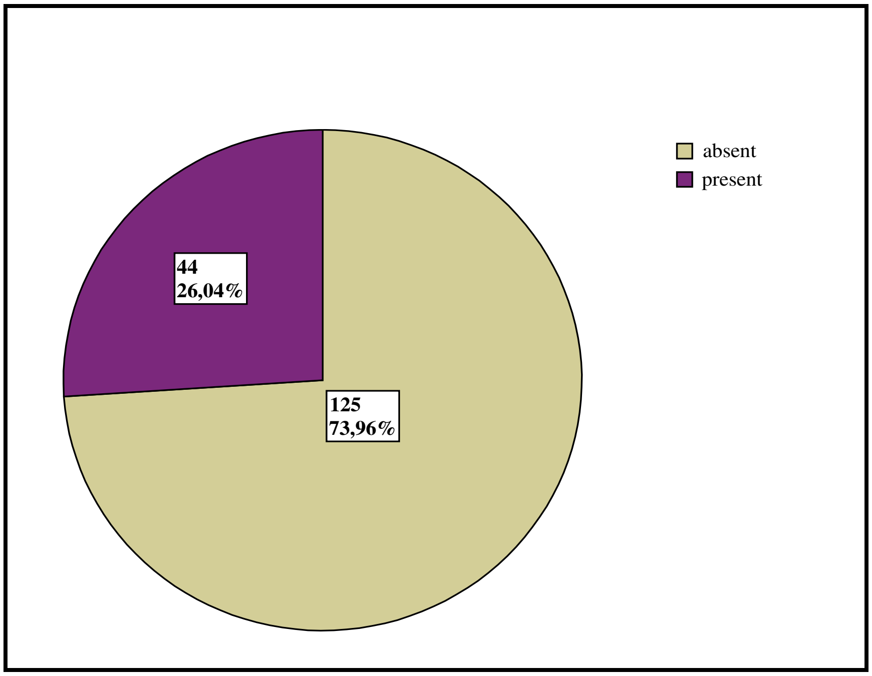


Figure 7.21. Absence or presence of "question mark" as an indicator of not knowing mathematics

Table 7.22 indicates the distribution of the frequency and the percentages of drawing a student as loving mathematics with the symbol of question mark and not drawing a student as loving mathematics with symbol of question mark. As seen from the table the frequency of drawing a student as not knowing mathematics with the symbol of question mark is only 2. Figure 7.22 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as loving mathematics with the symbol of question mark.

Table 7.22. Absence or presence of "question mark" as an indicator of loving mathematics

	Frequency	Percentage
Absent	167	98.8
Present	2	1.2
Total	169	100.0

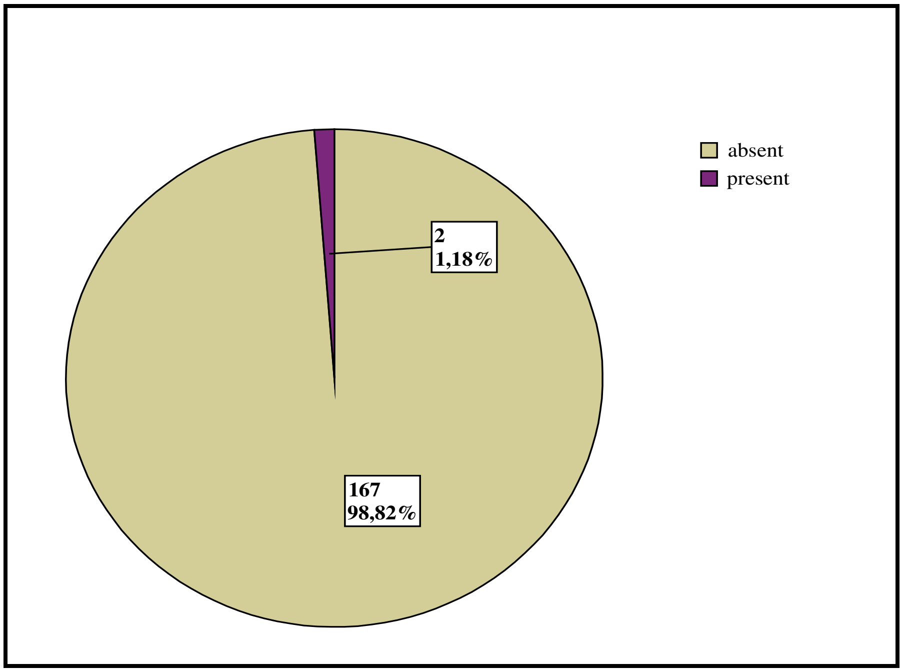


Figure 7.22. Absence or presence of “question mark” as an indicator of loving mathematics

Table 7.23 indicates the distribution of the frequency and the percentages of drawing a student as not loving mathematics with the symbol of question mark and not drawing a student as not loving mathematics with symbol of question mark. As seen from the table the frequency of drawing a student as not knowing mathematics with the symbol of question mark is only 8. Figure 7.23 also shows the pie graph of the frequency and the percentage distribution of drawing and not drawing a student as not loving mathematics with the symbol of question mark.

Table 7.23. Absence or presence of “question mark” as an indicator of not loving mathematics

	Frequency	Percentage
Absent	161	95.3
Present	8	4.7
Total	169	100.0

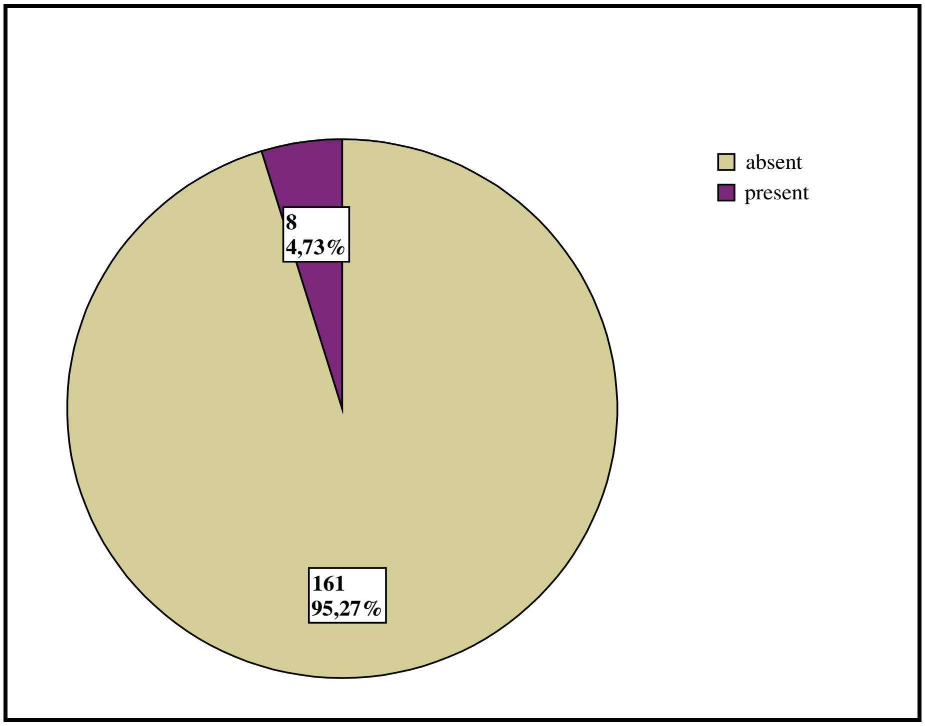


Figure 7.23. Absence or presence of “question mark” as an indicator of not loving mathematics

The comparison of the tables and the figures shows that the frequency of reflecting question mark as an indicator of not knowing mathematics is higher than the frequencies of reflecting question mark as an indicator of knowing, loving and not loving mathematics.

8. DISCUSSION

The purpose of the present study is to examine the images drawn by the students to reflect their perceptions of knowing/ not knowing and loving/not loving mathematics. So this study used students' drawings as a method of inquiry in order to give students a chance to reflect their perceptions of knowing/not knowing and loving/not loving mathematics. Within this framework, Baykal's (1978) "system view of instructional process" was utilized to describe and explain the images used by the students. Based on the system view some of the images were described as an indicator of major components of the instructional system which are "objectives", "social settings", "physical settings", "instructional media", "instructional procedure", and "teacher". In fact the illustrative examples of Baykal (1994-1995) in Table 2.2 were utilized. Then operations, mathematics symbols, mathematics problems, and geometric shapes were described as the indicator of "the objectives". Male student, female student, peer, male teacher, female teacher, someone, father, and mother were described as the indicator of the "social settings". Classroom, home, street, bank-market-grocer, school garden, library, laboratory, desk, chair and teacher table were the images which were described as the indicator of "physical settings"; and blackboard, notebook, chalk, pencil, rubber, board rubber, math book, book, and magazine were described as the indicator of "instructional media". Then exam paper, exam mark, and report card were described as the indicator of "instructional procedures". The teacher is described as another component of the instructional system although it is included in the social settings because according to Baykal (1978) teacher has ablitiy and skills to manage all components of the instructional system so it should be considered as a component of the system. However, there were some images with high frequencies and not described with the system view then they described as finer discriminations which were "smiles", "sadness", and "question mark".

Before describing the images according to system view, each image used by the students were scored by the researcher. Since the studies with drawings were subjective, reliability study is the most fundemantal part of this study. So a second scorer scored the images independently. Then Pearson correlation was computed in order to assess rater consistency in scoring student drawings. Results indicated that the two scorers were significantly consistent in scoring student drawings. The coefficient of correlation among the scorers was .971 which is statistically significant at the .001 level. Moreover the studies of Fieros *et al.* (1996) indicated that student drawings can be scored by multiple raters with a high degree of reliability (Gülek, 1999). Therefore in this study the images scored from student drawings provide a high level of confidence in the interpretation of the related findings.

Validity study was done in order to assess whether the students can reflect their perceptions of knowing/ not knowing/ loving/ not loving mathematics through drawings. Therefore; verbal, symbolic and mathematical explanations of randomly selected 169 drawings (one from each sample's four drawimgs) were cleared. Then they given to the peers of the judges. Differently, the judges were selected from the peers of the sample. The judges did not have any idea about this study and they were at the same grade level with the sample. The judges stated their standings about the student in the picture as a student who knows/not know/loves/not love mathematics. Then Pearson chi-square tests indicated that the association between the intended standings in the original picture and the perceived standings by the judges is significant at .001 level (χ^2=28,924, df=9, p<.001). These findings suggest that students can reflect their perceptions of knowing/not knowing and loving/not loving mathematics by using drawings.

The results of the study indicates that students reflect "the objectives" through operations (f=237), and they have a tendency to use operations as an indicator of knowing (f=83) and not knowing (f=74) mathematics. In literature it is indicated that the public image of mathematics is that "mathematics is computation" (Lim, 1999). Similarly the students have the image that knowing and not knowing mathematics is related with operations. Another result of this study indicates that students tend to use operations with right answers as an indicator of knowing mathematics (f=75). In fact it is stated in the literature that "the goal of doing mathematics is to obtain the right answer", and "it is always important to get the answer exactly right" are some public images of mathematics (Lim, 1999). Also in literature knowing mathematics is defined as being able to get the right answer (Everbody Counts, 1989). So this study supported these findings. Another interesting result related with operations is that the students have a tendency to reflect operations with no answers as an indicator of not knowing mathematics (f=50), although it is expected that not knowing mathematics will be reflected with the wrong answers (f=24) of the operations since students tend to reflect knowing mathematics with the right answers of the operations. The last result related with the operations is that “addition” and “multiplication” are the operations which frequently reflected by the students.

The findings related with “social settings” indicate that students tend to reflect the image of male student frequently (f=466). However, it is indicated in literature that most of the children’s drawings showed more female than male figures (Rock and Shaw, 2000). In fact this study does not support this finding. Another result of the study is that male students have a tendency to draw a male student to reflect knowing/not knowing/loving/not loving mathematics, however female students tend to reflect knowing mathematics with female student, and reflect not knowing and not loving mathematics with male students. Moreover female students use both male and female student equally to reflect loving mathematics. So it can be said that according to male students; they know mathematics, they do not know mathematics, they love mathematics, and they do not love mathematics. However, female students have the perception that female students know mathematics, male students do not know mathematics and do not love mathematics, and also both male and female students love mathematics. It is also mentioned in literature that the public image of mathematics is that “men are better in mathematics than women” (Lim, 1999). In this study the drawings of male samples supported this public image, but the drawings of female samples do not supported it since they reflected that female students know mathematics. Moreover it is indicated that female’s attitudes toward mathematics tend to be different from males’, that females tend to be less confident than males in their abilities to do mathematics and stated a stereotype of females as less mathematically capable and less mathematically oriented than males. As mentioned in this study the drawings of female sample indicates that females tend to reflect female students as knowing mathematics (Steele, 2003). However male have a strict perception in reflecting knowing, not knowing, loving, and not loving mathematics with the image of male student, the strictness is not seen in female drawings, in fact they confused because they both reflect loving and not loving mathematics with the image of male student. As mentioned previously, the reason will be the attitudes of females as being less confident in their abilities of doing mathematics than males’.

According to Baykal (1978) the most seen interaction between the social settings is student-student, teacher-student, and student-parent. So it is expected to see reflections of these interactions in the drawings but the results indicated that students tend to draw a student alone, in other words with no interaction with the other indicators of “social settings” to reflect their perceptions of knowing/ not knowing/loving/not loving mathematics. So, it can be said that the students individualized knowing, not knowing, loving, and not loving mathematics.

The teacher is another component of the instructional system. As mentioned above the frequency of reflecting teacher-student interaction is not high. Moreover the frequency of using teacher figures in the drawings were not high. However, there were some interesting reflections from the drawings. For example, the drawings included the figure of teachers (see Appendix E) as standing near the blackboard, sitting down on the teacher table, being far away from the student(s), and saying “true”, “false”, “bravo”, “listen me children”, “why didn’t you study”, “please study your lesson”. In literature, it is indicated that pupils drew mathematicians as teachers who use violence, or threats of violence on their pupils (Picker and Berry 2000). However, there is no such a finding about drawing a teacher as using violence or threats, in this study.

In literature the study with children’s drawings indicated that “virtually all the young children’s pictures showed classroom scenes, often with displays of numbers, calendars, number lines, and such tools as pencils, papers, chalkboards, and erasers” (Rock and Shaw, 2000, p. 553). Similarly, the students reflected physical settings frequently with the image of classroom (f=212) and reflect instructional media with blackboard (f=187) in this study. Therefore, it can be said that students tend to reflect knowing, not knowing, loving, and not loving mathematics as taking place in the classroom. In fact, in literature it is mentioned that “knowing mathematics is having pupils construct mathematical knowledge in the classroom” (Floden, *et.al.*, 1990). Moreover, Dawson (1995) stated that students learn the love of mathematics in their classes. Thus the study supported the mentioned findings in the literature.

The frequency of the images that were used to reflect the "instructional procedures" is not high (f=25). Students do not tend to reflect the "instructional procedures" as an element of knowing, not knowing, loving, and not loving mathematics.

There are also some interesting pictures shown at Appendix F. The first four drawings are the drawings of a male student from the sixth grade (see Figure F.1.). In his drawings, he used four different monsters and he depicted a blackboard as an indicator of knowing mathematics and reflected a blackboard, a pencil, and a notebook as an indicator of loving mathematics. He reflected a toy and a as an indicator of not loving mathematics and reflecting the monster alone as an indicator of not knowing mathematics. Another interesting drawing was from a male student at the sixth grade (see Figure F.2). As seen he tries to use same student for all his four drawings and differentiates each of them. For example he reflected some pieces and a student as an indicator of knowing and not knowing mathematics and he allowed the students who knows mathematics to construct a usefull washing machine for daily life from these pieces, however did not allowed the student who does not know mathematics to use the pieces to construct something useful and he explained that "Matematik bilmeyen öğrenci istediği şeyi yapamaz- The student who does not mathematics will not do anything he/she wants". Moreover as mentioned in the results part of the study, the student also use the shapes of lips as an indicator of loving and not loving mathematics.

All in all, as mentioned previously system view of Baykal (1978) is utilized in this study and some images were described and explained according to this view. However, the results indicates that the students do not tend to reflect knowing, not knowing, loving, and not loving mathematics with the images of all major components of the instructional system. According to Baykal (1978) the components of the instructional system complement each other in a dynamic association and none of the components by themselves can be an alternative to the whole system. So it can be said that the students do not have a system view in reflecting knowing, not knowing, loving, and not loving mathematics. In fact, as mentioned they individualized it.

8.1. Limitations of the Study & Recommendations for Further Researches

The present study is limited with the number of the sample and selection of the sample. The subjects were selected from a state school in Istanbul and random sampling could not be achieved for practical reasons. Therefore, for further researches the number of the sample will be more than 169 and sample will be selected from both the state schools and private schools.

Another limitation of the study is that there is no restriction during drawing studies of the sample. So some students used verbal explanations instead of using drawings. Therefore the studies of the 20 students could not be used for this study. Moreover if the study of students restricted to use only drawings, the drawings would include more images than sixty images. So for further studies, the researchers will restrict students to use only drawings. However one advantage of not restricting students with using only drawings was that no students give up their studies by saying “I don’t want to draw”, or “I cannot draw”, or “My drawing is bad”, in other words they can understand that the researcher do not want them to depict a wonderful picture. So most of the students were relaxed during the study.

The study is also limited with the time preparing a scoring sheet to score the images reflected by the students. However, for further studies a proposed spread sheet for data entry was developed.

Lastly, studying with four drawings of each student was another limitation of the study because the students will confuse during their drawing study and the statistical analysis (not mentioned in results) indicated that the students have a tendency to use more images for their first drawings than the remaining three drawings. In other words students depicted their first drawings in more detailed. Moreover scoring and analysis of the four drawings were not easy since you had to do each study four times for each sample.

APPENDIX A: PROPOSED SPREAD SHEET FOR DATA ENTRY

Table A.1. Proposed data matrix for the classification of the images

Students	Name	Surname	Gender	Grade	Image 1	Image 2	Image 3	Image 4	Image 5	Image 6	Image 7	Image 8	Image 9	Image 10	Image 11			,,,,,,,,,,	Image K
1																			
2																			
3																			
...																			
N																			

- Let the rows indicate the subjects in the study
- Let the columns indicate the images observed
- Set as many columns as necessary to specify the characteristics of the subjects (i,e, name, gender, grade, school etc,)
- Insert the category label as described below into the cells where rows and columns intersect, You can leave the cell blank if the specified image is absent,
    - A. If the image indicates an objective
    - B. If the image indicates a social setting (except teacher)
    - C. If the image indicates a physical setting
    - D. If the image indicates an instructional media
    - E. If the image indicates an instructional procedure
    - F. If the image indicates a teacher
    - G. Something which can be specified as one of the above.

Table A.2. A hypothetical example how to use the data matrix proposed

Students	Name	Surname	Gender	Grade	Operations	Blackboard	Home	mother	Father	computer	laboratory	Teacher	classroom	Exam mark	Question mark	Sadness
1	Ayşe	Güneş	F	5	A	D	C	B	B			F	C	E		G
2	Fatma	Ay	F	7		D				D		F	C	E	G	
3	Ali	Yıldız	M	4	A	D	C	B		D	C					G

B: INFORMATION ABOUT SCHOOLS
(Orbay and Piyalepaşa Primary School)

Table B.1 indicates the addresses of the schools at Beyoğlu in Istanbul and is took from: http://www.beyoglu-bld.gov.tr/2-4-2-okullar.htm

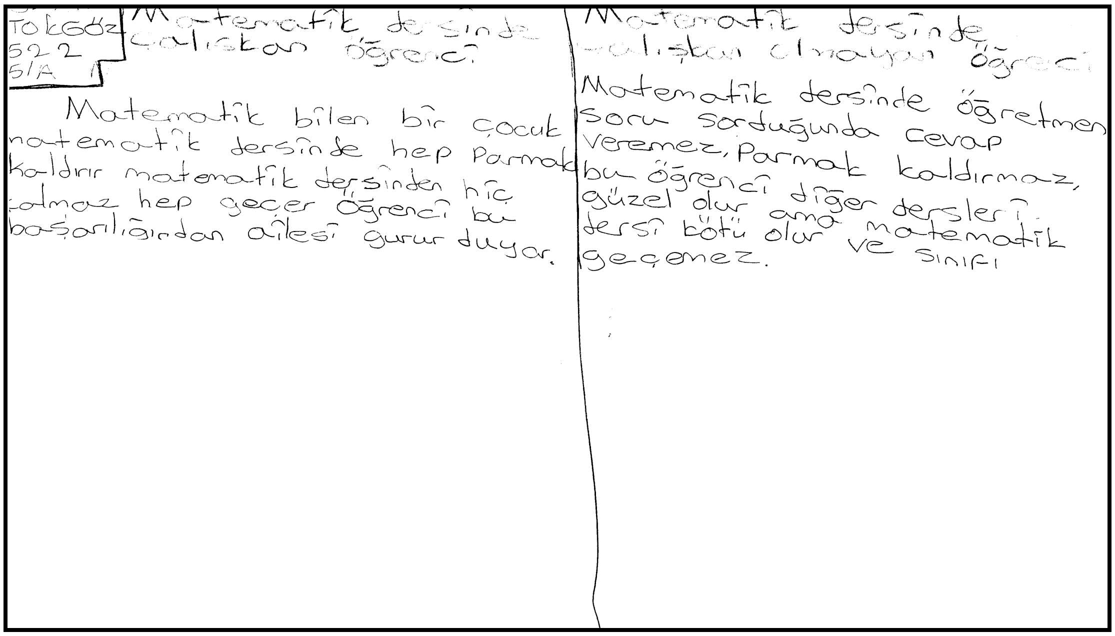
Table B.1. The addresses of the schools in Beyoğlu

SIRA NO	OKUL ADI	ADRESİ
1	AHMET EMİN YALMAN İLKÖĞRETİM OKULU	YAHYA KAHYA MAH.BAHRİYE CD.NO:84 KASIMPAŞA
2	AYŞE EGE KIZ MESLEK LİSESİ	BEDRETTİN MAH.AYNİALİBABA SK.NO:2
3	BEYOĞLU TİC. VE ANADOLU TİCARET MESLEK LİSESİ	BEDRETTİN MAH.TEKKE SK.NO:1 ŞİŞHANE
4	İHSAN ŞERİF İLKÖĞRETİM OKULU	BESTE SK.NO:1HASKÖY
5	İTO ANADOLU MESLEK VE TERZİLİK MESLEK LİSESİ	MEŞRUTİYET CD.NO:114
6	BEYOĞLU ANADOLU LİSESİ	İSTİKLAL CAD.NURİ ZİYA SK.NO:2 BEYOĞLU
7	REFİA ÖVÜNÇ KIZ TEKNİKOLGUNLAŞMA ENSTİTÜSÜ	İSTİKLAL CAD.48BEYOĞLU
8	BEYOĞLU TEKNİK LİSE VEENDÜSTRİ MESLEK LİSESİ	REFİK SAYDAM CD.KUYTU SK.NO:3 TEPEBAŞI
9	BEYOĞLU FINDIKLI LİSESİ	ÖMERAVNİ MAH.BEYTÜLMALCI YOK.10 KABATAŞ
10	CEMAL ARTÜZ İLKÖĞRETİM OKULU	SANDALCI KERİM SK.NO:8SÜTLÜCE
11	CEZAYİRLİ GAZİ HASAN PAŞA İLKÖĞRETİM OKULU	BÜLENT DEMİR CD.NO:3KASIMPAŞA
12	CİHANGİR İLKÖĞRETİM OKULU	KILIÇ ALİ PAŞA MAH.KUMRULU SOK.NO:12/20 CİHANGİR
13	CİHANGİR PRATİK KIZ SANAT OKULU	CİHANGİR YOKUŞU NO:24BEYOĞLU
14	DR.TEVFİK SAĞLAM İLKÖĞRETİM OKULU	REFİK SAYDAM CD.NO:2ŞİŞHANE
15	ESEYAN ERMENİ İLKÖĞRETİM OKULU	MEŞELİK SK. NO:34TAKSİM
16	ESEYEN ERMENİ LİSESİ	MEŞELİK SK. NO:34TAKSİM
17	ÖZEL SAINT PULCHERİE FRANSIZ KIZ ORTAOKULU	ÇUKURÇEŞME SK.NO:7

18	FİRUZAĞA İLKÖĞRETİM OKULU	TÜRKGÜCÜ CD.NO:263FİRUZAĞA
19	GALATASARAY İLKÖĞRETİMOKULU	İSTİKLAL CAD.263GALATASARAY
20	GALATASARAY LİSESİ	İSTİKLAL CAD.263GALATASARAY
21	ÇIRAKLIK EĞİTİM VE HALK EĞİTİM MERKEZİ	ZİNCİRLİKUYU CD.BÖREKÇİBAYRAM SK. NO:201 KASIMPAŞA
22	HASKÖY LİSESİ	PİRİPAŞA MAH.KUMBARHANE CD.NO:30 BEYOĞLU
23	HASKÖY İLKÖĞRETİM OKULU	OKMEYDANI CD.NO:20HASKÖY
24	HALICIOĞLU İŞİTME ENG.OKULU	ÇIKSALIN TOKAÇ SOK.,NO:22/1HALICIOĞLU
25	HÜVİYET EKİR İLKOKULU	IRMAK CAD.NO:84BEYOĞLU
26	HOCA İSHAK İLKÖĞRETİM OKULU	TURŞUCUHÜSEYİN SK.NO:23HALICIOĞLU
27	İSTİKLAL İLKÖĞRETİM OKULU	İSTİKLAL MAH.ALİKABULİ SK.NO:22
28	ÖZEL İTALYAN LİSESİ	TOMTOM KAPTAN SK.NO:11-13 BEYOĞLU
29	ÖZEL ALMAN LİSESİ	ŞAHKULU BOSTANI SK.NO:20TÜNEL
30	ÖZEL OPERA GÜZEL SANATLAR LİSESİ	
31	KABATAŞ TİCARET MESLEK LİSESİ	MUHTAR LEYLAILDIR SOK.KABATAŞ
32	KADIMEHMET İLKÖĞRETİM OKULU	DENİZ HASTANESİ ARKA SOK.1 KASIMPAŞA
33	KASIMPAŞA ÇOK PROGRAMLI LİSESİ	BEDRETTİN MAH.AYNI ALİ BABA SK.NO:2 KASIMPAŞA
34	KAPTANPAŞA İLKÖĞRETİM OKULU	ZİNCİRLİKUYU CD.BÖREKÇİ BAYRAM SK.201 KASIMPAŞA
35	ÖZEL GETRONAGAN ERMENİ LİSESİ	SAKIZCILAR CAD. NO:9KARAKÖY
36	KARAKÖY RUM İLKOKULU	KARAKÖY
37	ÖZEL MAVİ HALİÇ LİSESİ	HASKÖY CAD.NO:114HALICIOĞLU
38	ÖZEL MERKEZ RUM LİSESİ	AĞAHAMAM MAÇ SK.40BEYOĞLU
39	ÖZEL MERKEZ RUM İLKOKULU	AĞAHAMAM MAÇ SK.40BEYOĞLU
40	MUALLİM CEVDETİLKÖĞRETİM OKULU	PEŞTEMALCİ SK.NO:11ÇIKSALIN TOKAÇ SOK.,NO:22/1
41	NAMIK KEMAL İLKÖĞRETİM OKULU	ÖMERAVNİ MAH.SELİMHATUNCAMİ SK.2 FINDIKLI
42	ŞEHİT ÖĞRETMEN NEŞE ALTEN İLKÖĞRETİM OKULU	MİMAR SİNAN CAD.ÇAMLIKALTI SK. ÖRNEKTEPE
43	OKÇU MUSA İLKÖĞRETİM OKULU	KULE SK.NO:65-67KULUDİBİ
44	**ORBAY İLKÖĞRETİM OKULU**	**ZİNCİRLİKUYU CD.AĞAÇKÖPRÜ SK.8 KASIMPAŞA**
45	ÖZEL TARHAN LİSESİ	KUMBARACI YOKUŞUTERCÜMAN ÇIKMAZI 1 TÜNEL

46	ÖZEL TARHAN İLKÖĞRETİMOKULU	KUMBARACI YOKUŞUTERCÜMAN ÇIKMAZI 1 TÜNEL
47	**PİYALEPAŞA İLKÖĞRETİM OKULU**	**KADIMEHMET CAD.NO:11KASIMPAŞA**
48	PİRİREİS İLKÖĞRETİMOKULU	HACIAHMET MAH. PİRHÜSAMETTİN SOK.NO:35 KASIMPAŞA
49	PİRİPAŞA İLKÖĞRETİM OKULU	F.SULTAN CAD.OKUL SK.2BEYOĞLU
50	ÖZEL SAINT BENOIT FRANSIZ LİSESİ	KEMERALTI CAD.NO:35KARAKÖY
51	SANK GEORG. AVUSTURYA LİSESİ	KARTÇINAR SK.NO:2-10KARAKÖY
52	SURURİ İLKÖĞRETİMOKULU	BAHRİYE CAD.KERAMET SK.19KASIMPAŞA
53	TAKSİM İLKÖĞRETİM OKULU	BÜYÜKPARMAKKAPI TEL SK.31BEYOĞLU
54	İSTANBUL ATATÜRK LİSESİ	K.MUSTAFA ÇELEBİ MAH.KUYU SK.NO:9 TAKSİM/BEYOĞLU
55	TAKSİM TİCARET MESLEK LİSESİ	BÜYÜKPARMAKKAPI TEL SK.31BEYOĞLU
56	ÖZEL ZOĞRAFYAN RUM ERKEK LİS.	TURNACIBAŞI SK.NO:27BEYOĞLU
57	ÖZEL ZAPYON RUMİLKÖĞRETİM OKULU	MEŞELİK SK. NO:17BEYOĞLU
58	ÖZEL ZAPYON RUM LİSESİ	MEŞELİK SK. NO:17BEYOĞLU
59	İ.T.O.KADINLAR ÇEŞMESİ İLKÖĞRETİM OKULU	PİYALEPAŞA CAD.8KASIMPAŞA
60	ÖZEL TUDEM AKŞAM ANADOLU OTELCİLİK VE TURİZM MESLEK LİSESİ	
61	ÖĞRETMEN EVİ VE AKŞAMSANAT OKULU	MEŞRUTİYET CD.NO:232
62	ÖZEL MAVİ HALİÇ İLKÖĞRETİM OKULU	HASKÖY CAD.NO:114HALICIOĞLU
63	ÖZEL AYAKOSTANTİN RUM İLKOKULU	

APPENDIX C: EXAMPLES OF THE STUDIES THAT WERE NOT STUDIED SINCE THEY INCLUDES VERBAL EXPLANATIONS INSTEAD OF DRAWINGS



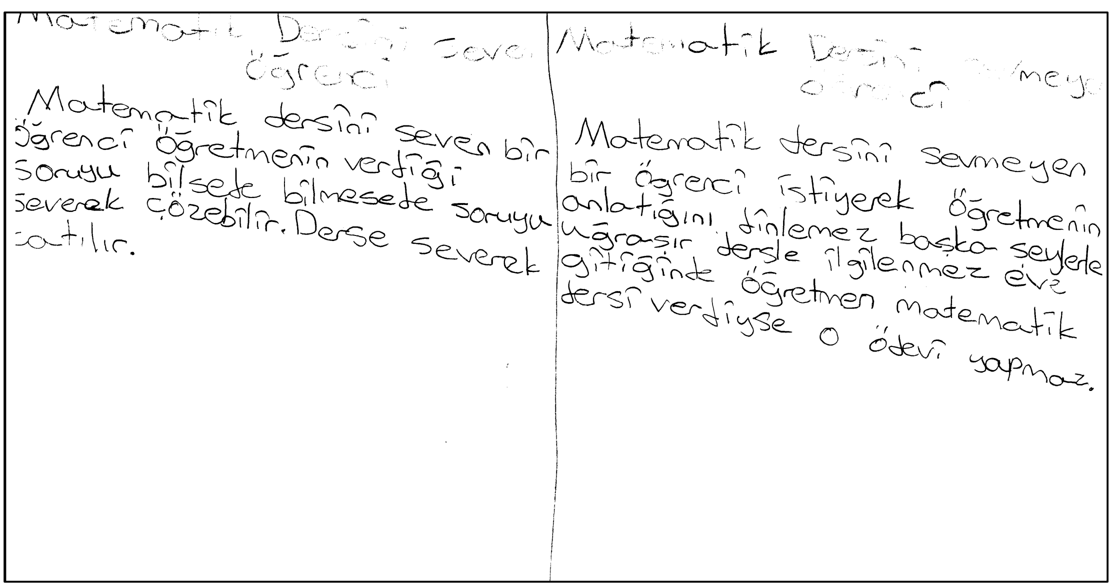


Figure C.1. Female student, 5th grade, drawings of a student who knows/not know/loves/not love mathematics

Matematiği sevmeyen öğrenci bakkalda parayı yalnış sayar. Derslerde konuşur, sıkılır.

Matematik seven bir öğrenci her yerde başarılıdır.

Öğretmenin sorduğu sorulara doğru cevap verir. Derslerde sıkılmaz, konuşmaz. Öğretmenini can kulağı ile dinler.

Figure C.2. Male student, 5th grade, drawings of a student who loves/not love mathematics

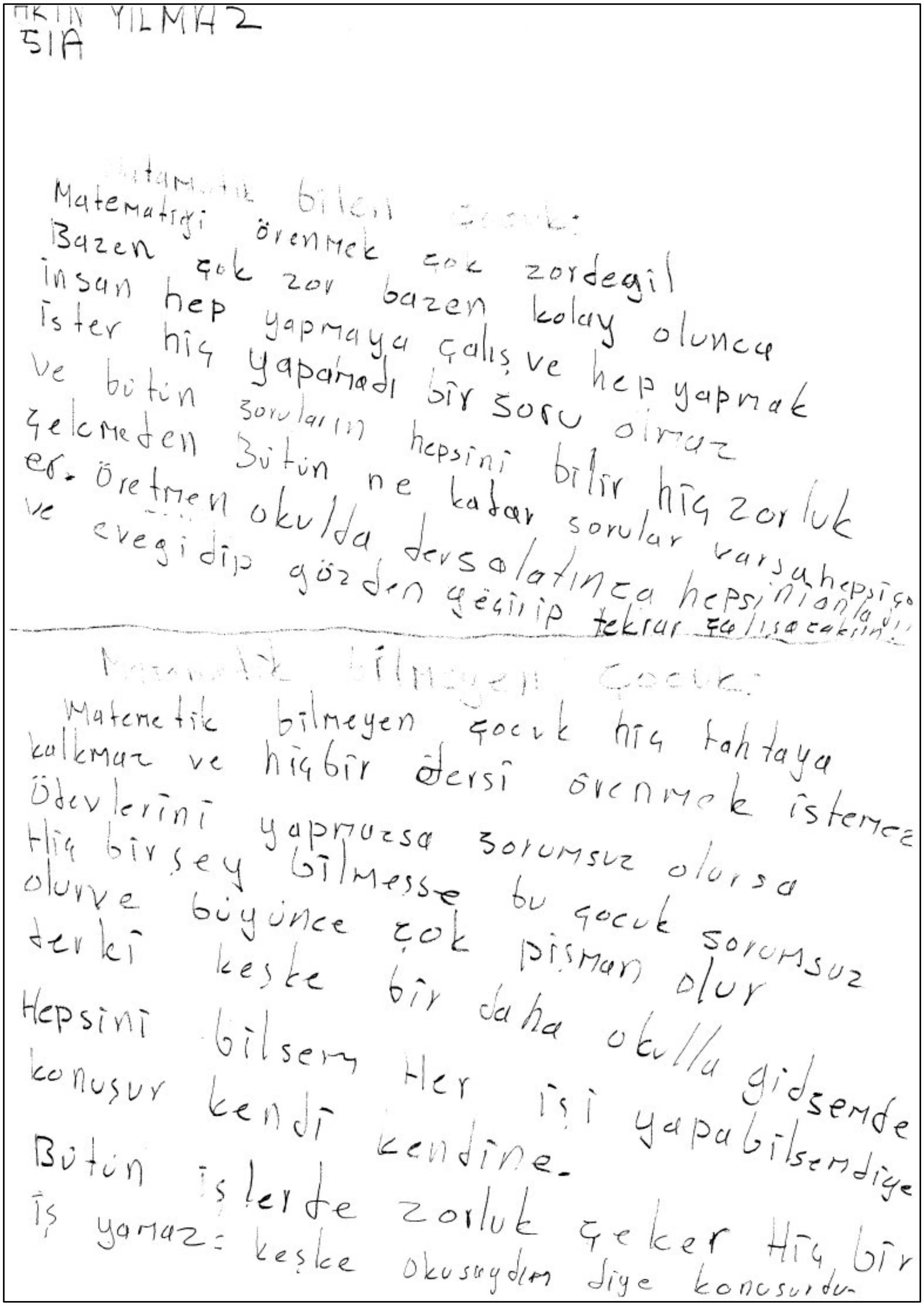


Figure C.3. Male student, 5th grade, drawings of a student who knows/not know mathematics

APPENDIX D: EXAMPLES FROM STUDENTS' DRAWINGS

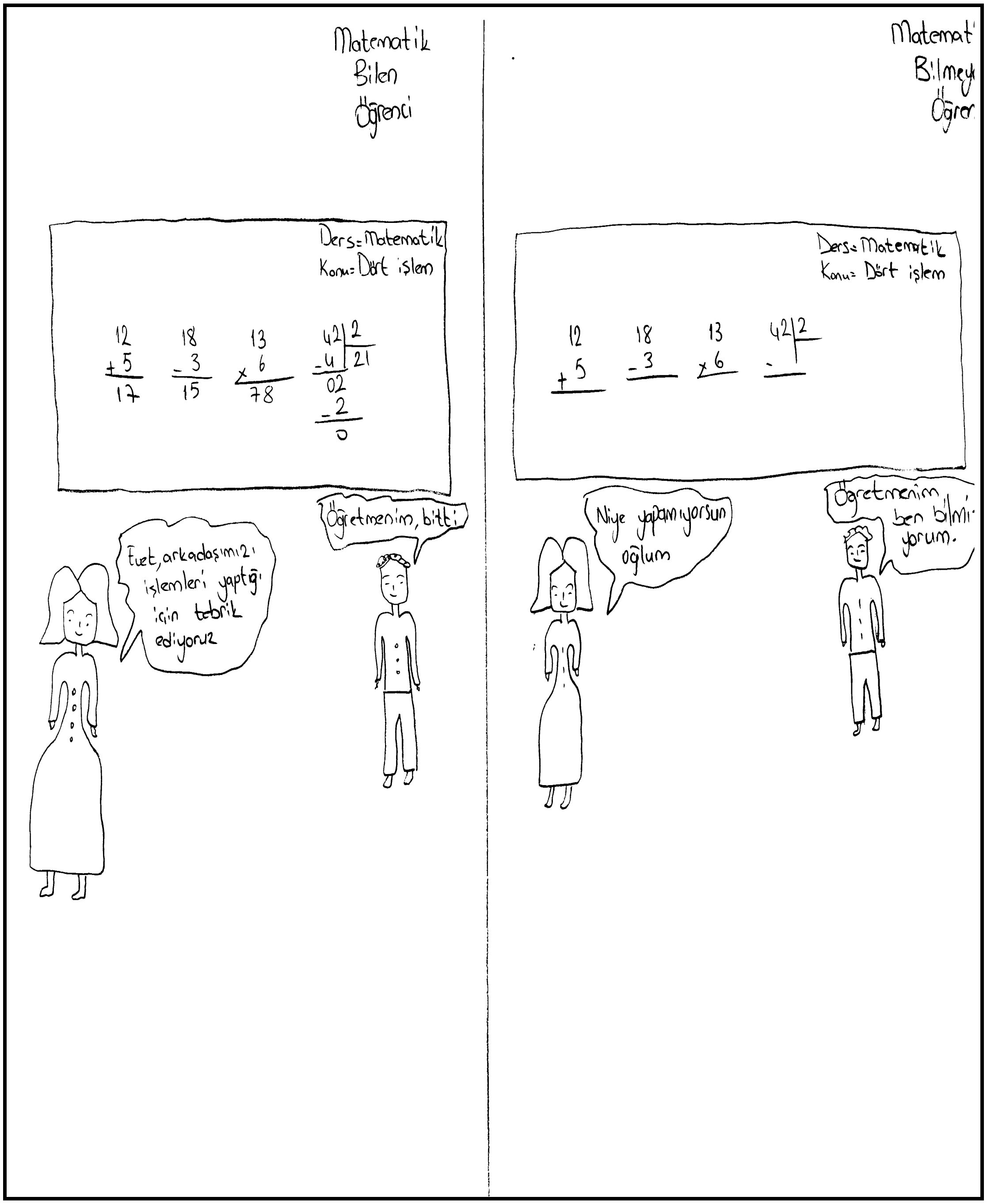
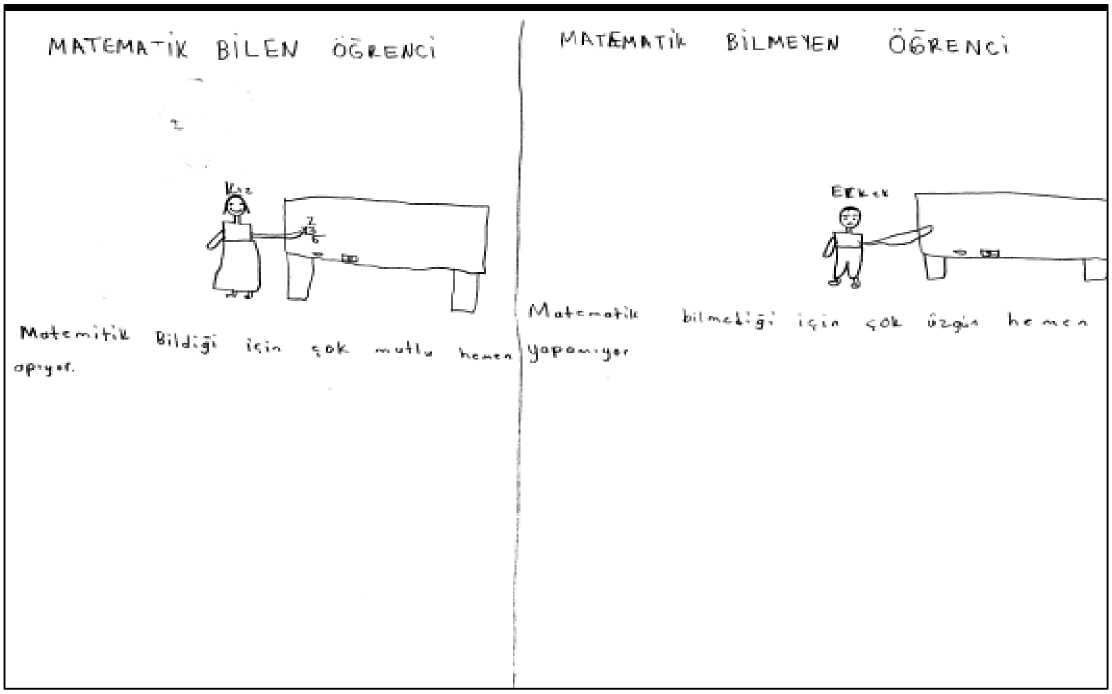


Figure D.1. Female student, 7th grade, drawings of a student who knows/not know mathematics

Figure D.2. Male student, 8th grade, drawings of a student who knows/not know/loves/not love mathematics

Figure D.3. Female student, 3rd grade, drawings of a student who knows/not know mathematics



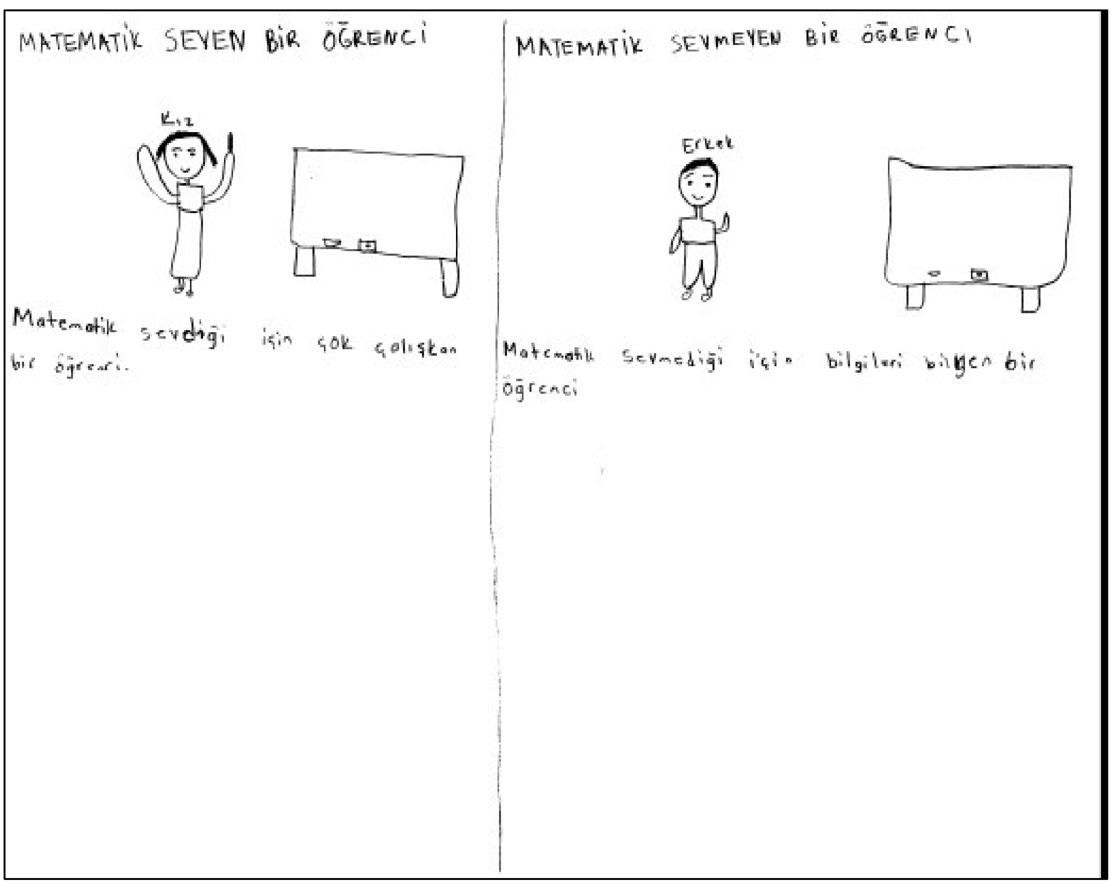


Figure D.4. Female student, 3rd grade, drawings of a student who knows/not know/loves/not love mathematics

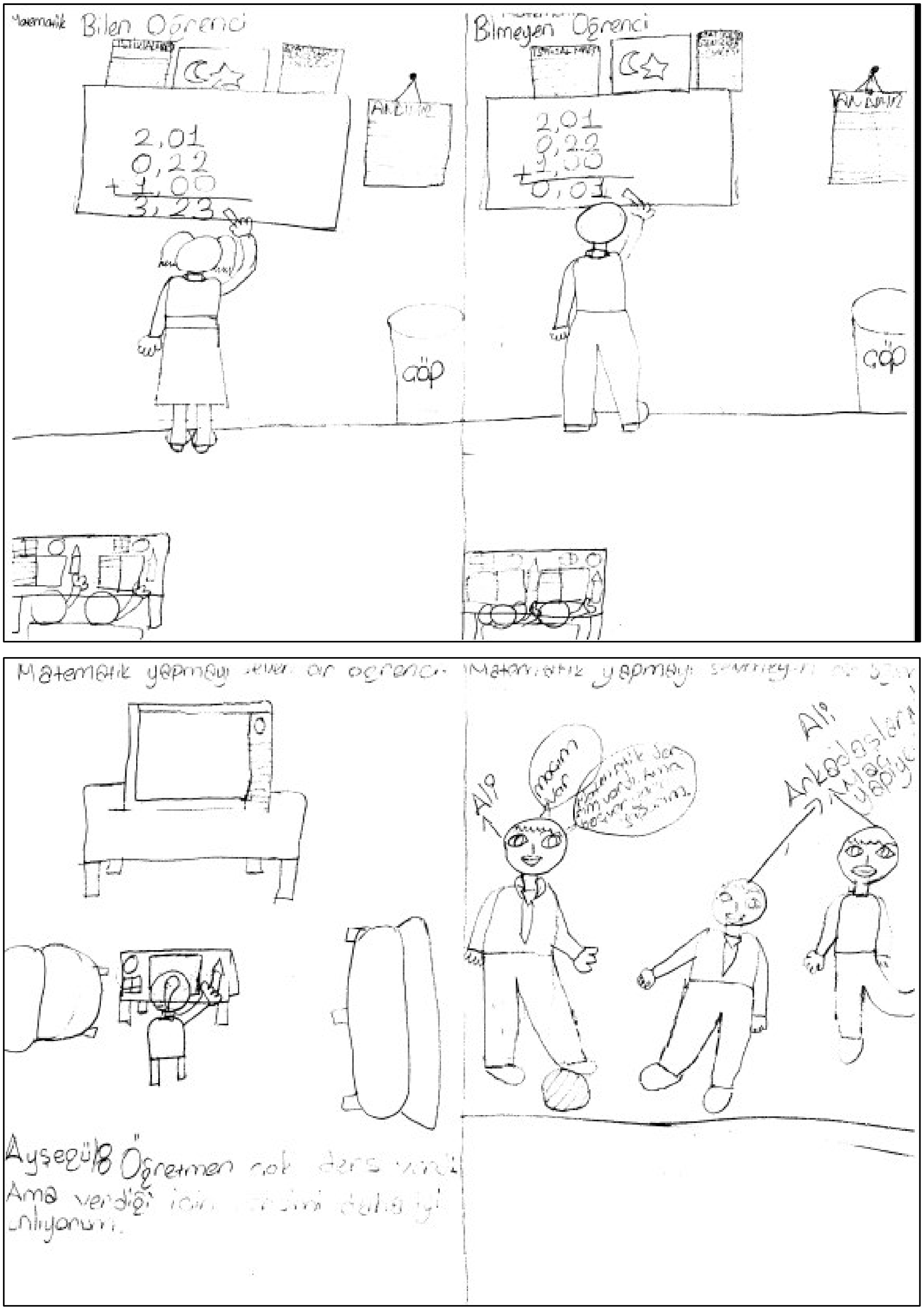


Figure D.5. Female student, 6th grade, drawings of a student who knows/not know/loves/not love mathematics

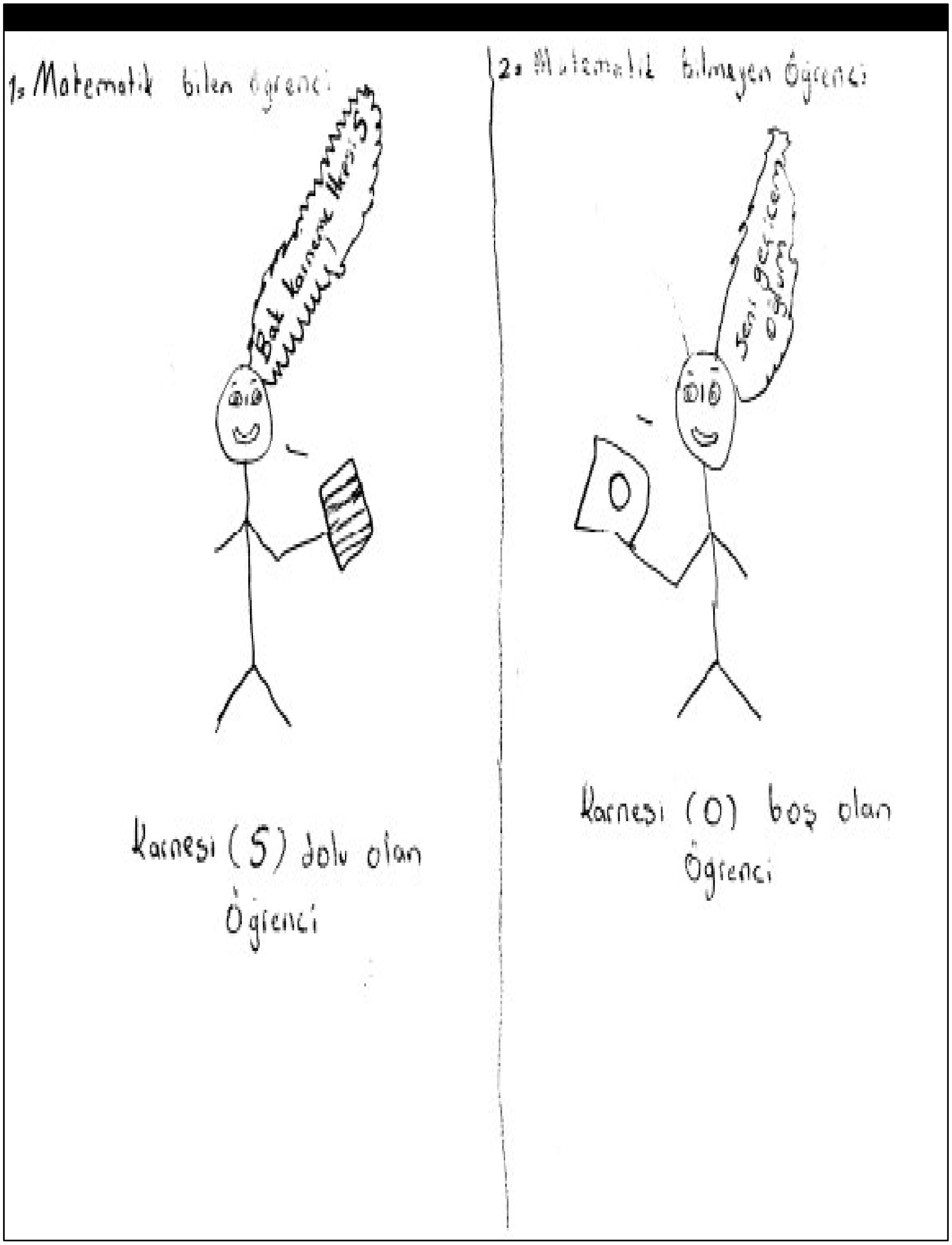


Figure D.6. Male student, 6th grade, drawings of a student who knows/not know mathematics

Figure D.7. Male student, 5th grade, drawings of a student who knows/not know/loves/not love mathematics

Figure D.8. Male student, 5th grade, drawings of a student who knows/not know/loves/not love mathematics

APPENDIX E: EXAMPLES FROM STUDENTS' DRAWINGS THAT INCLUDES THE IMAGE OF TEACHER

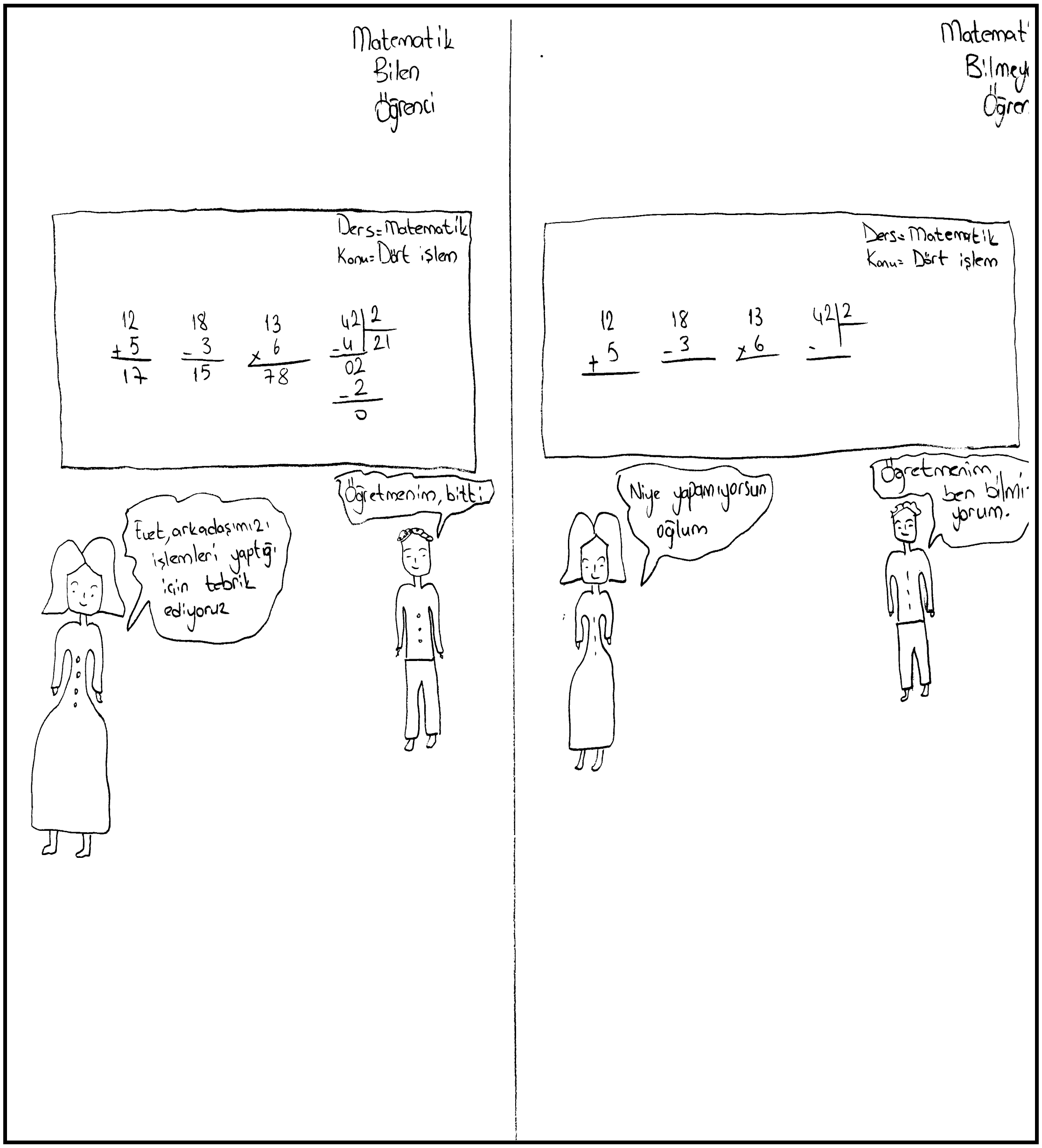


Figure E.1. Female student, 7th grade, drawings of a student who knows/not know mathematics

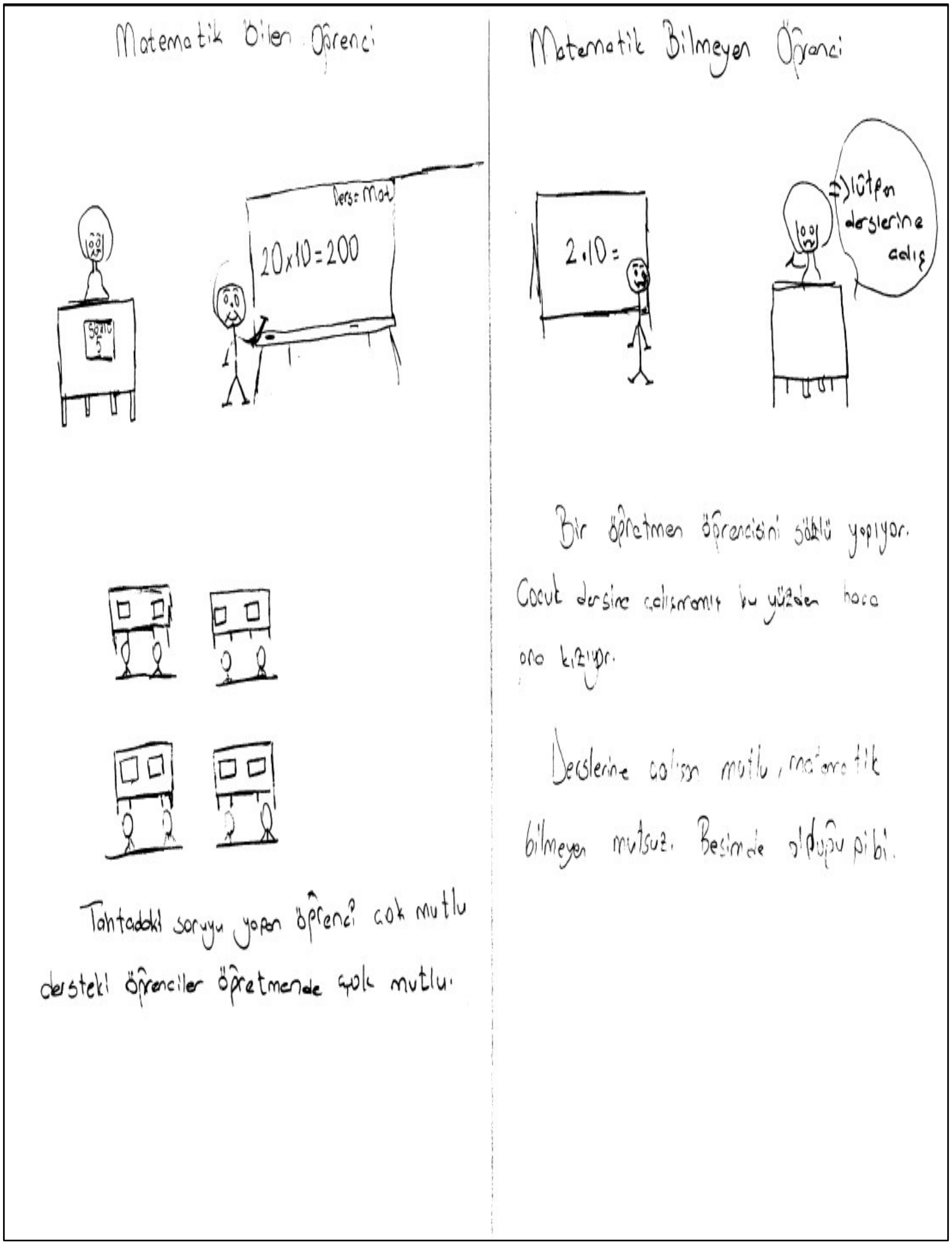


Figure E.2. Female student, 7th grade, drawings of a student who knows/not know mathematics

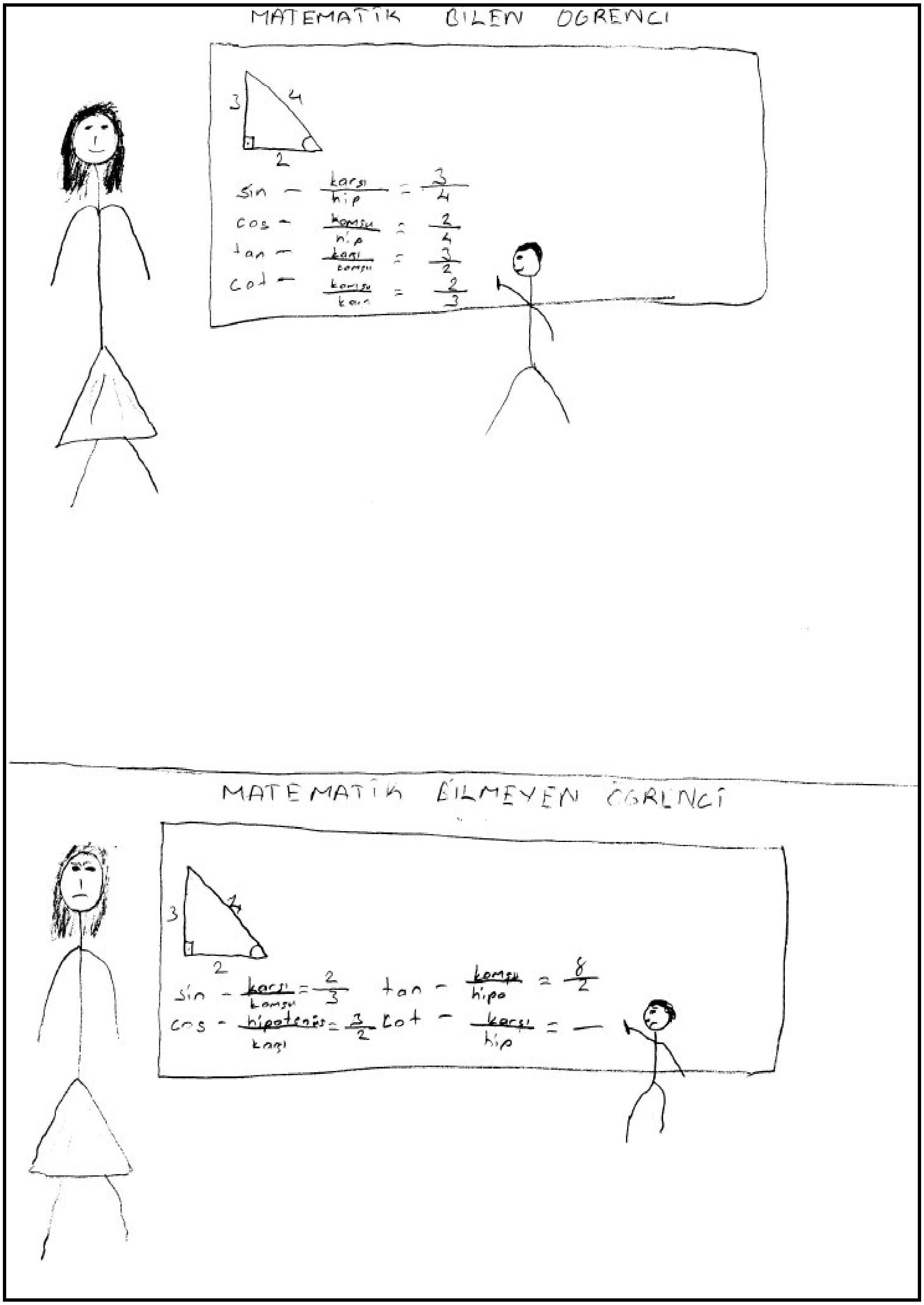


Figure E.3. Male student, 8th grade, drawings of a student who knows/not know mathematics

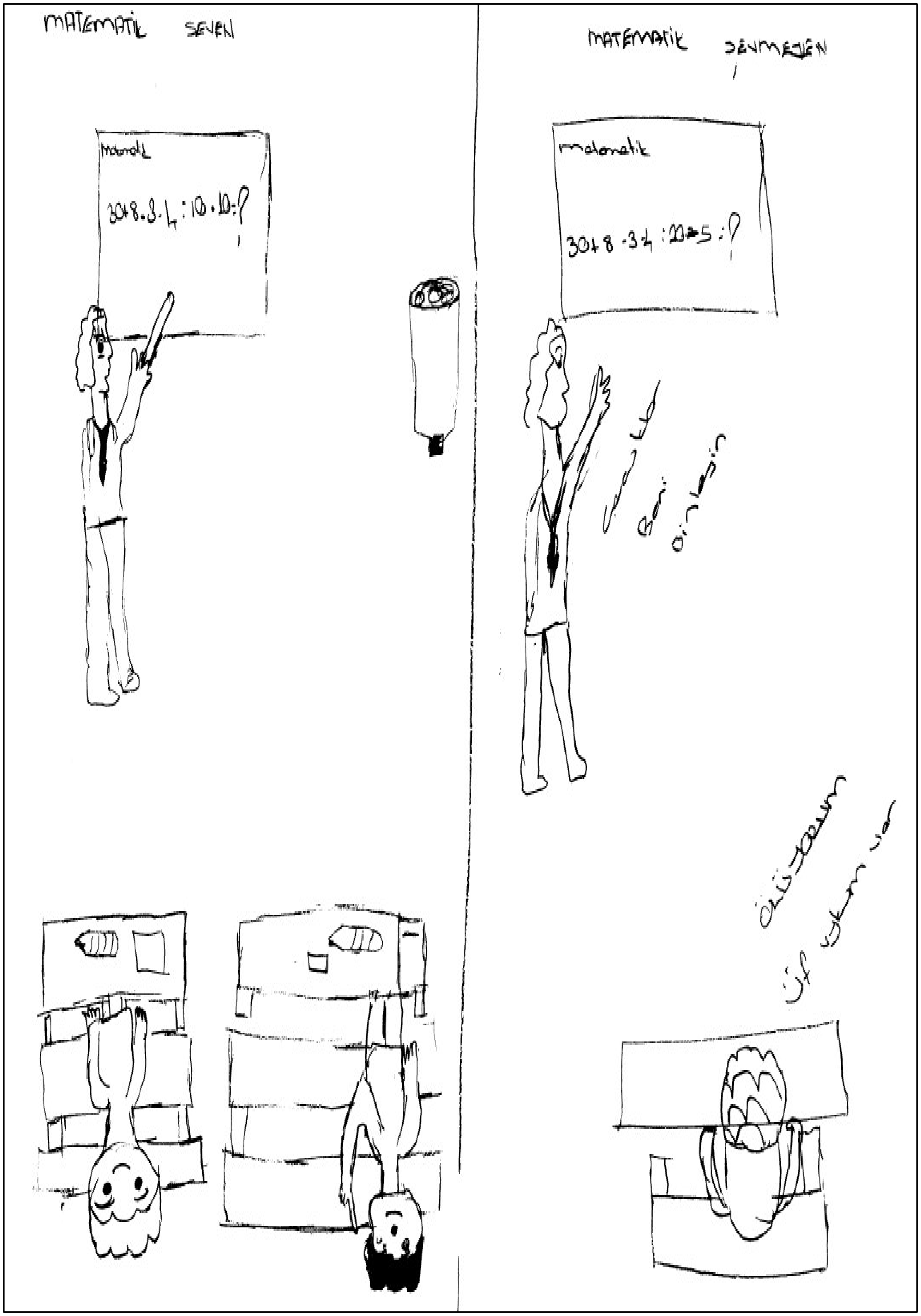


Figure E.4. Female student, 8th grade, drawings of a student who loves/not love mathematics

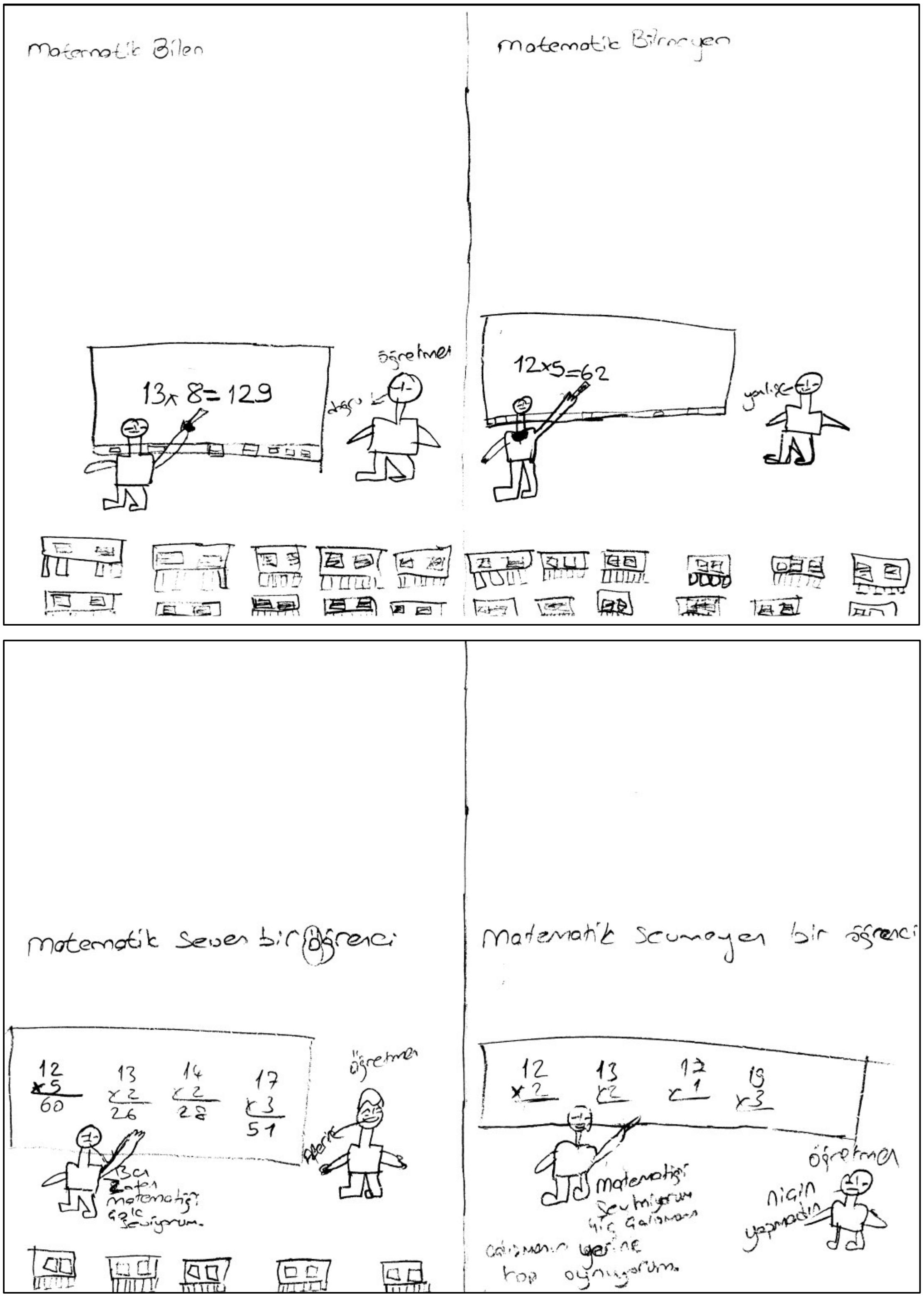


Figure E.5. Male student, 6th grade, drawings of a student who knows/not know/loves/not love mathematics

APPENDIX F: EXAMPLES FROM INTERESTING DRAWINGS

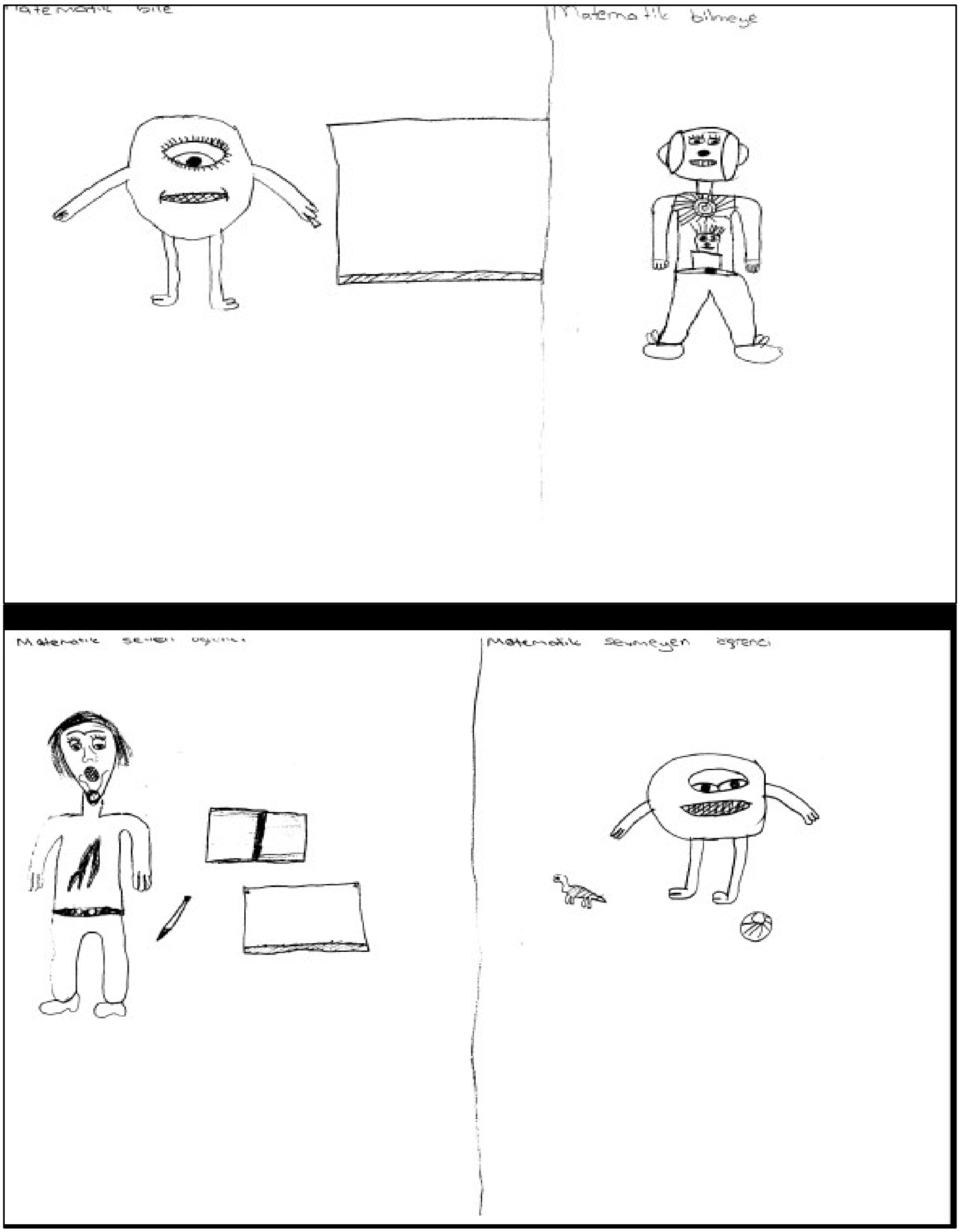


Figure F.1. Male student, 6th grade, drawings of a student who knows/not know/loves/not love mathematics

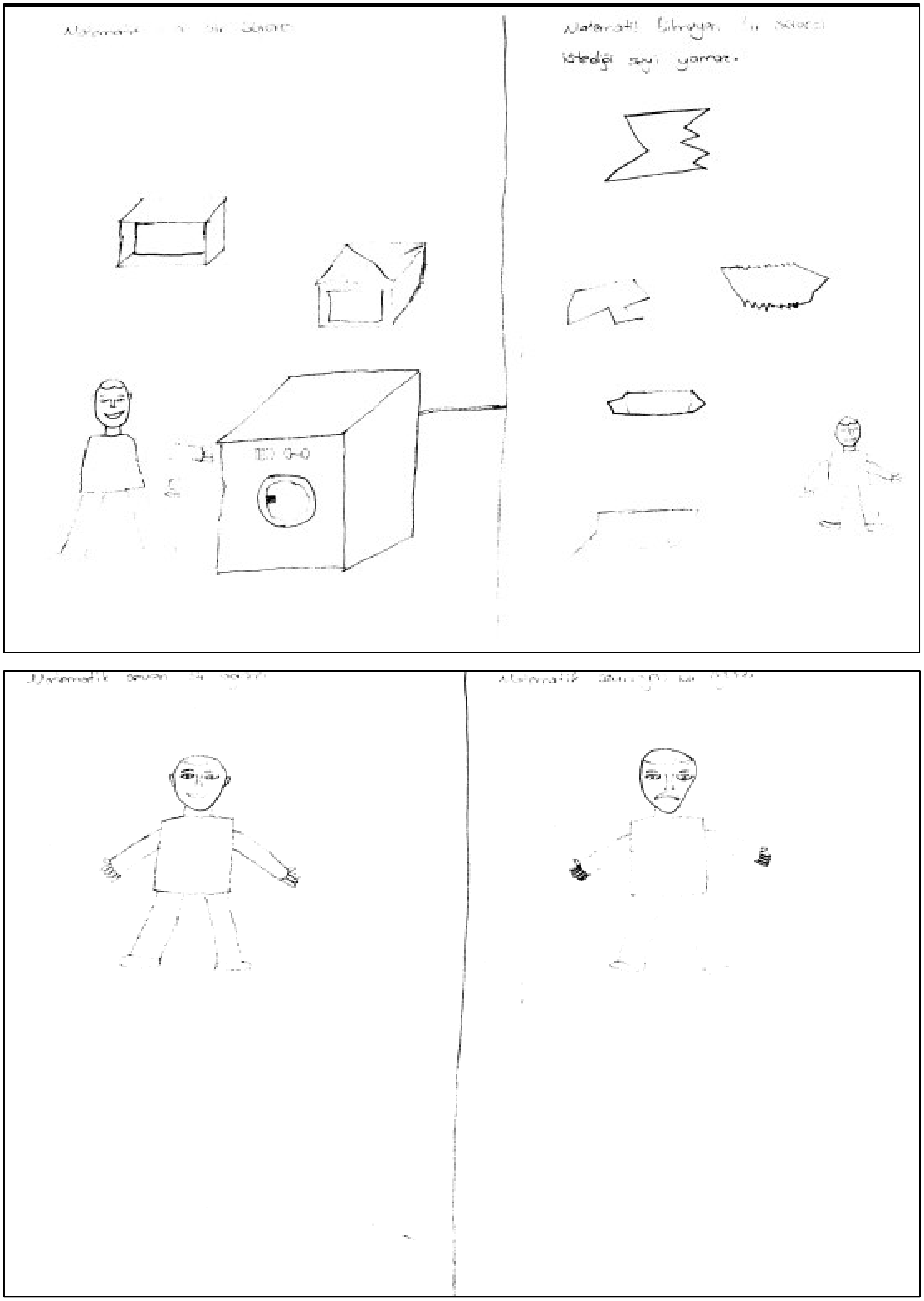


Figure F.2. Male student, 6th grade, drawings of a student who knows/not know/loves/not love mathematics

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