

# Emotional atmosphere in third-graders' mathematics classroom – an analysis of pupils' drawings

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The aim of this study is to find out what kind of emotional atmosphere dominates in third-graders' mathematics lessons. The analysis is based on pupils' drawings. In total 133 drawings were analyzed by looking for content categories related to a holistic evaluation of emotional atmosphere during mathematics lesson. As a summary we can conclude that the emotional atmospheres in the mathematics lessons are mainly positive even though the differences between the classes are large. Furthermore, it can be said that asking pupils to do drawings is a good and many-sided method to collect data about the emotional atmosphere of a class.

The Finnish National Core Curriculum for Basic Education (NCCBE, 2004) describes the aims of teaching mathematics as well as the meaning of mathematics in a pupil's intellectual growth: The purpose of education is to offer opportunities to develop pupils' knowledge and skills in mathematics, and in addition it should guide pupils towards goal-directed activities and social interaction. The aim is, especially to support pupils' positive stance towards mathematics and studying it (NCCBE, 2004). According to earlier research, third-graders' attitude towards studying mathematics was fairly positive on average, the boys having a more positive attitude than the girls. The better the pupils were in mathematics, the more positive was their attitude (Huisman, 2006).

The National Core Curriculum for Basic Education (NCCBE, 2004) emphasizes the importance to create a learning environment having an open, encouraging, easygoing, and positive atmosphere, and that the responsibility to maintain this belongs to both the teacher and the pupils.

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The teacher has a central role in advancing the affective atmosphere and social interaction in their class. Harrison, Clarke and Ungerer (2007) summarize that a positive teacher-pupil relation advances both pupils' social accommodation and their orientation to school, and it is thus an important foundation for the pupils' academic career in future.

Also positive friendships seem to increase pupils' active school attendance. A pupil's advancement in school is connected to the factors that have an effect on social relations in the class like controlling emotions, liking school, eligibility as a mate, adjustment to school environment and self-control. In several studies, it has clearly been found, that there is a close connection between the atmosphere in the classroom and learning achievements as well as emotional and social experiences (e.g. Frenzel, Pekrun & Goetz, 2007; Evans, Harvey, Buckley & Yan, 2009).

The aim of this study is to find out what kind of emotional atmosphere dominates in third graders' mathematics lessons. For this purpose, we will use pupils' drawings as research data.

### *Dimensions to the emotional atmosphere in a classroom*

Evans et al. (2009) define three complementing components of classroom atmosphere: 1) academic, referring to pedagogical and curricular elements of the learning environment, 2) management, referring to discipline styles for maintaining order, and 3) emotional, the affective interactions within the classroom. In this study, we concentrate on the last component i.e. emotional atmosphere, which can be noticed e.g. as an emotional relation between the pupils and the teacher.

The emotional atmosphere within the classroom can be regarded either from the viewpoint of individuals in the class (psychological dimension) or from the viewpoint of a community (social dimension). While the individual perspective looks at the individual experiences in the class, the social perspective looks at the class more holistically with a focus on social interaction, communication and norms. Furthermore, a distinction can be made between two temporal aspects of affect: state and trait. State refers to the emotional atmosphere in a specific moment in the class while trait refers to more stable condition or property. These form a matrix shown in table 1 (Hannula, 2011).

At an individual's level the rapidly appearing and disappearing affective states are different emotions and emotional reactions (e.g. fear and joy), thoughts (e.g. "This task is difficult."), meanings (e.g. "I could do it."), and aims (e.g. I want to finish this task."). From this perspective, the state emotional atmosphere is the collection of such individual affective states in the class at any moment. On the other hand, more stable

Table 1. *Dimensions to the emotional atmosphere in a classroom (see Hannula, 2011)*

	Psychological dimension or the level of an individual	Social dimension or the level of a community (classroom)
Affective condition (state)	Emotions and emotional reactions Thoughts Meanings Goals	Social interaction Communication Atmosphere in a classroom (momentarily)
Affective property (trait)	Attitudes Beliefs Values Motivational orientations	Norms Social structures Atmosphere in a classroom

affective traits are related to attitudes (e.g. "I like mathematics."), beliefs (e.g. "Mathematics is difficult."), values (e.g. "Mathematics is important."), and motivational orientations (e.g.. "I want to understand."). The trait emotional atmosphere is the collection of such individual affective states in the class.

Different affective dimensions can be studied also using social level concepts at the level of community i.e. of a classroom. Rapidly changing affective states include, for instance, a social interaction connected to a certain situation, communication related to this, and the emotional atmosphere present in the classroom. As an example one can think about the situation when the homework is being checked in the beginning of a mathematics lesson. This situation can differ quite a lot in different classrooms. In one classroom pupils are working in pairs and the atmosphere – as seen through the emotional tone of communication – is jovial. In another classroom the teacher is walking around and s/he criticizes the pupils who have not done their homework. S/he also appoints certain pupils to present their solutions on the blackboard. The emotional tone of the social interaction, or the atmosphere, for this classroom is one of control and criticism.

When similar situations happen repeatedly in a classroom, students may form more stable affective traits typical to a certain classroom. Social norms (Cobb & Yackel, 1996), social structures and atmosphere in a classroom are such traits. Pupils will "learn" that during mathematics lessons homework is always checked in the same way, and a certain norm is developed. When also other parts of the mathematics lesson happen repeatedly in the same kind of atmosphere, the atmosphere may become general and include all mathematics lessons, possibly also lessons of other subjects.

### *Pupils' drawings as a research object*

Many researchers (e.g. Aronsson & Andersson, 1996; Murphy, Delli & Edwards, 2004) have used pupils' classroom drawings, and realized that they form rich data to reach children's conceptions on teaching. Drawings can be used, e.g. to find out latent emotional experiences (Kearney & Hyle, 2004). According to Harrison et al. (2007) drawings as indirect measurements tell more significantly about a pupil's accommodation to school than questionnaires and interviews. Also researchers in mathematics teaching (e.g. Tikkanen, 2008; Dahlgren & Sumpter, 2010) emphasize that one way to evaluate teaching are pupils' drawings about mathematics lesson. The drawings tell also about beliefs, attitudes and emotions related to mathematics. It has also been found that pupils begin, as early as in the second grade of elementary school, to form beliefs about good teaching (Murphy et al., 2004).

According to Blumer (1986) the meanings given by the pupils to various situations and things guide their actions, how they interpret different situations and what they include in their drawings. Giving meaning is a continuous process, which in this study takes place particularly in the social context of the mathematics lesson. Different pupils will find different meanings in the same situations. The meanings may have to do with physical objects, with social interaction, or with abstract things, such as the feelings that are elicited by teaching of mathematics. As a result of experiences gained from teaching, a pupil may evaluate themselves as poor and their classmate as good in mathematics.

### *The purpose of the study*

This article is linked to the comparative study between Finland and Chile 2010–2013, a research project (project #1135556) which is partly funded by the Academy of Finland. The purpose of the project is to study the development of pupils' mathematical understanding and problem-solving skills from the third grade to the fifth grade when open tasks are used in teaching at least once a month. The data in this article consist of drawings that were collected in the autumn of 2010 as part of the project's initial measurements. An earlier MAVI article, on teaching methods and communication in mathematics lessons, is based on the same drawings (Pehkonen, Ahtee, Laine & Tikkanen, 2012).

In this article, the meanings the drawer gives to the events in a mathematics lesson are regarded in the social context of the lesson. First, we are interested in each pupil's individual perception of their class and, secondly, we are interested in the collection of the individual perceptions in each classroom. The research problem is thus: "What kind of

emotional atmosphere in a mathematics lesson can be seen in third-graders' drawings?" The holistic emotional atmosphere of a class describes the situation as a whole that can be concluded from the facial expressions and communication in the drawing. Here two levels of the emotional atmosphere during a mathematics lesson can be distinguished: a general emotional atmosphere as described by all the pupils, and the emotional atmosphere in a certain classroom.

The research questions are as follows:

1. What kind of emotional atmosphere in a mathematics lesson can be seen in third-graders' drawings?
2. How does the emotional atmosphere differ between different classes?

## Method

### *Participants and data collection*

The third-graders (about 9 years old) came from nine classes taught by different teachers in five primary schools in the Helsinki metropolitan area. Some of the schools have used their teaching resources for dividing the classes for smaller groups in mathematics. That is why some classes have so few pupils.

The pupils drew a mathematics lesson scenario as their task in the beginning of the 2010 autumn term. All the pupils who were at school at that day did the drawing (about 85 % of the pupils). The task given to the pupils was:

Draw your teaching group, the teacher and the pupils in a mathematics lesson. Use speech bubbles and thought bubbles to describe conversation and thinking. Mark the pupil that represents you in the drawing by writing ME.

In total 133 pupils' drawings were analysed, out of which 71 were drawn by boys and 62 by girls. The words in the speech and thought bubbles enabled the study of communication between the teacher and pupils.

### *Data analysis*

According to the analyzing method used by Tikkanen (2008) in her dissertation, a drawing as an observational data can be divided into content categories. A content category means a phenomenon on which data are gathered. A content category is further specified into subcategories. In

this article, we are concentrating only on *the holistic evaluation of the emotional atmosphere in a classroom* which is based on all the pupils' and the teacher's moods seen in a drawing as well as on the pupils' speech and thought bubbles in the picture. The pupils' and the teacher's mood is determined on the form of the mouth (smiling, neutral, sad/angry, not visible). The nature of the speech and thought bubbles is classified into three subcategories: positive (e.g. "Mathematics is fun."), negative (e.g. "Mathematics is hard.") and neutral (e.g. "Four times four is sixteen."). The holistic evaluation of the emotional atmosphere in a classroom is thus based on five categories:

- 1) Positive (all persons smile and/or think positively, some part can be neutral).
- 2) Positive and negative (ambivalent), if at least one contradicting (positive or negative) facial or other expression is found in the drawing.
- 3) Negative (all persons are sad or angry or think negatively, some can be neutral).
- 4) Neutral, (all facial or other expressions are neutral).
- 5) Unidentifiable (when it is impossible to see any facial or other expressions).

In order to get an overview of the emotional atmosphere of the whole class we made a summary of the holistic evaluation of the individual pupils' drawings. In addition to analyzing individual pupils' views of the emotional atmosphere in their classroom we wanted to see how these individual views varied in different classrooms. It is important to notice that we were interested in the general atmosphere during mathematics lessons and not specific feelings toward mathematics activities.

Pupils' drawings varied a lot especially from the analyzing point of view. In many drawings only stick figures could be seen, in a few of them the hands started from the face, and in some cases pupils were just represented by their desks. However, some of the third-graders were very talented illustrators, and then the drawings contained many details.

To have an idea about the quality of pupils' drawings we calculated the number of the drawings in which facial expressions could be seen as well as the number of the drawings that contained speech and thought bubbles. In the drawings without any facial expression the classroom was e.g. drawn in such an angle that only the top of the persons' head could be seen. The total number of the drawings with facial expressions was

fairly small 42, i.e. only 32%. However, because the total number of the drawings containing speech and thought bubbles was 124 (93%), we were able to identify the holistic evaluation in almost all drawings.

The boys' and the girls' drawings differed significantly. Half of the girls drew pictures in which one could see the facial expressions compared to about 15% of the boys' drawings (Chi-square test, 4.42\*\*\*). No significant difference was found between the number of speech and thought bubbles drawn by the boys (401/71 = 5.6) and girls (313/62 = 5.0).

Three researchers classified the pupils' drawings first by themselves, and then, in the cases when the opinions differed (in about 10% of the drawings), the drawings were re-examined together. Problems in classification were mostly due to pupils' obscure drawings. The analysis of the drawings was qualitative, and it can be classified as inductive content analysis (Patton, 2002), as we were trying to describe the situation in the drawing without letting our own interpretations influence it. The drawings were analysed one content category at a time.

## Results

### *Emotional atmosphere in a mathematics lesson*

The emotional atmosphere in a mathematics lesson is taken as an entirety that consists of the pupils' and the teacher's facial expressions and their utterances or thoughts. It is classified using the scale: positive, ambivalent, negative, neutral, and unidentifiable. The result of the analysis is presented in table 2.

Table 2. Emotional atmosphere in a mathematics lesson in third-grade

	Positive	Ambivalent	Negative	Neutral	Unidentifiable
Total (133)	50 (38%)	44 (33%)	13 (10%)	20 (15%)	6 (5%)
Girls (62)	30 (48%) <sup>s</sup>	19 (31%)	5 (8%)	7 (11%)	1 (2%)
Boys (71)	20 (28%) <sup>s</sup>	25 (35%)	8 (11%)	13 (18%)	5 (7%)

Notes. <sup>s</sup> significance of the difference 2.41\* (chi-square test)

The mode of the emotional atmosphere in mathematics lessons was classified as positive in 50 (38%) of the drawings. A drawing classified as positive is presented in figure 1. The drawing is classified as positive because all the pupils as well as the teacher are smiling. Furthermore, both the teacher's and the pupils' speech or thought bubbles are either positive or neutral.



Figure 1. A positive emotional atmosphere (a boy's drawing)

In figure 1 the drawer (*minä*) is smiling and thinking that ("Rounding is easy."). The teacher is the tallest figure in the drawing. She is asking ("Does anyone need help?"). In the upper row starting from left a pupil asks ("Where is the pencil?"). The pupil sitting in the next desk says or thinks ("Jokerit [a Finnish hockey team] is the best."). The pupil standing near this desk says or thinks ("Hockey cards"). The pupil in the right corner says ("Pencil"). All these talks or thoughts were evaluated as neutral. In the bubbles of the pupils sitting in the lower row opposite to each other it is written ("Easy") and ("I need."). The latter pupil is probably answering the teacher's question but as they are smiling this remark



Figure 2. An example of an ambivalent emotional atmosphere (a girl's drawing)



was interpreted as neutral. The pupil in the lower corner says or thinks that ("Oilers [a Finnish floor ball team] is winning.")

The number of the pupils (44; 33%) who portrayed the emotional atmosphere in their mathematics lesson as ambivalent is almost the same as the number of pupils who described it as positive. An example of an ambivalent case is presented in figure 2. Although it is not possible to see the facial expressions, this picture was classified as ambivalent because there are both positive and negative expressions in the bubbles.

In figure 2 the drawer (*minä*) is sitting so that her face is not visible. She is thinking ("Easy"). The teacher is sitting behind her/his desk in the right side of the picture and looking at a book on her/his desk. In the group upper left hand corner the pupil thinks ("Boring"). In the drawer's group in the middle of the class the pupil diagonally opposite the drawer is thinking of a calculation and then s/he asks the teacher ("8 + 8 = ?, teacher"). The pupil next to her/him shouts ("Teacher! Here! Now!") The pupil in the group upper right hand corner is saying ("Hard") and the pupil in the group down right is thinking ("Easy").

A tenth of the pupils pictured the emotional atmosphere as negative i.e. they drew sad or angry faces and/or the speech bubbles contained negative (or neutral) thoughts. In figure 3 there is an example of a drawing showing a very negative emotional atmosphere.



Figure 3. An example of a negative emotional atmosphere (a boy's drawing)

The drawer (*minä*) is located in the left lower corner of the drawing and he shouts (“Teacher! Teacher! Teacher! Teacher! Teacher!”). The teacher is in the right lower corner and s/he says (“Don’t shout.”). S/he has a gun in her/his hand. The pupil above the teacher is thinking (“Oh no”). The pupil in the middle of the drawing is thinking (“Stupid X”), where X is one of the pupils in the class. The pupil in the right upper corner is shouting (“Teacher! Don’t shoot me!”), and the pupil on the left upper corner is saying (“Help, I am scared.”) All the facial expressions are quite wild, even teeth are shown.

In 15% of the drawings the emotional atmosphere was classified as neutral because the persons’ facial or other expressions were neither positive nor negative. Pupils and teachers were normally talking only about mathematical tasks like in figure 4.



Figure 4. An example of a neutral emotional atmosphere (a girl's drawing)

The teacher with her mouth like a line (neutral) is standing in front of the class. She asks (“How much is  $2 \times 2$ ?”) The drawer (*minä*) is standing in the second row on the left and is answering to the teacher’s question (“4”). The pupil on the drawer’s right hand side is thinking (“Is it 3?”). Pupils are like stick figures without faces. On the blackboard it is written “Let’s calculate!”.

As a summary we can conclude that the mode of the emotional atmosphere in mathematics lessons is positive in 50 cases (38%), with both the teacher and all the pupils smiling (or some of them neutral) and/or thinking positively/neutrally. A third of the pupils have drawn the emotional atmosphere in the classroom as ambivalent which means that in their drawings there is at least one person whose facial expression is sad or angry or who says (or thinks) something that is interpreted as

negative. The difference between positive and ambivalent sub-categories is not big, as the latter category contains also the drawings in which among many smiling pupils there is at least and perhaps only one pupil showing sad face. It can thus be said that in the third-graders' drawings the principal mood in mathematics lessons is positive. Girls' drawings are almost significantly more positive than boys' drawings (Chi-square test, 2.41\*)

### *Emotional atmosphere in different classrooms*

Next we are looking at classroom-specific emotional atmosphere in mathematics lesson found in the third-graders' drawings from the classes of nine different teachers, labeled A–I. We made a summary of the holistic evaluation of the individual pupils' drawings in order to get an overview of the emotional atmosphere of the whole class. The summary of emotional atmosphere in the different classrooms is presented in table 3.

*Table 3. Distribution of emotional atmosphere in mathematics lesson in the nine classrooms*

Classroom	Positive	Ambivalent	Negative	Neutral	Unidentifiable
A (15 pupils)	8 (53%)	4 (27%)	3 (20%)	0 (0%)	0 (0%)
B (14 pupils)	7 (50%)	1 (7%)	1 (7%)	3 (22%)	2 (14%)
C (19 pupils)	9 (47%)	7 (37%)	2 (11%)	0 (0%)	1 (5%)
D (18 pupils)	8 (44%)	6 (33%)	0 (0%)	2 (11%)	2 (11%)
E (16 pupils)	4 (25%)	2 (13%)	1 (6%)	9 (56%)	0 (0%)
F (17 pupils)	5 (29%)	4 (24%)	0 (0%)	8 (47%)	0 (0%)
G (17 pupils)	2 (12%)	5 (29%)	5 (29%)	4 (24%)	1 (6%)
H (11 pupils)	4 (36%)	5 (46%)	1 (9%)	1 (9%)	0 (0%)
I (6 pupils)	2 (33%)	4 (67%)	0 (0%)	0 (0%)	0 (0%)
Average (133 pupils)	49 (37%)	38 (29%)	13 (10%)	27 (1%)	6 (4%)

Even though the emotional atmosphere in mathematics lessons is mostly positive in the total data (see table 2), there are large differences among

the different classrooms. It is possible to look at the mode of the emotional atmosphere in every classroom (see table 3) but it is important to notice that this does not reveal the whole truth. The profiles of the emotional atmospheres vary widely also within the classrooms.

In four classrooms (A, B, C and D) the mode of the emotional atmosphere is positive. More than half of the pupils in classroom A presented the emotional atmosphere in the classroom as positive; on the other hand, classroom A has the second highest frequency of drawings that represent a negative atmosphere in the classroom. The atmosphere can therefore as whole be interpreted as ambivalent. The emotional atmosphere in classroom B can be interpreted particularly positive because only two pupils had drawn it negative or ambivalent. On the other hand, none of the drawings in classroom D were interpreted negative. Classroom C represents an average emotional atmosphere of the third graders' mathematics lesson.

In three classrooms (G, H and I) the mode of the emotional atmosphere in the pupils' drawings is ambivalent i.e. the pupils' drawings contain both positive and negative elements. In classroom I, none of the pupils described the emotional atmosphere as negative. On the other hand, in classroom G more than half of the pupils described in their drawings the atmosphere in mathematics lesson negative or ambivalent and only a small portion of the pupils described it positive. The emotional atmosphere in this classroom differs very clearly from the average emotional atmosphere in mathematics lesson.

In two classrooms (E and F) the mode of the emotional atmosphere can be interpreted as neutral i.e. about half of the pupils draw pictures which did not contain any negative or positive facial or other expressions.

## Conclusions

In the Finnish third-graders' drawings the mode value of the emotional atmosphere in mathematics lesson is positive. This matches also the result obtained in the connection of learning outcomes in mathematics in the beginning of the third grade (Huisman, 2006) namely that the third-graders' collective attitude towards studying mathematics was fairly positive. In this study the boys were found to have a more positive attitude than the girls. Whereas according to our study, the emotional atmosphere in mathematics lesson is more positive when described by the girls than by the boys (see table 1). However, this result does not totally forbid the possibility that boys in third grade react more positively towards mathematics than girls as found by Huisman (2006). It is

possible that, for example, girls' drawings also picture overall attitude toward school. However, it seems possible to obtain more information to this many-sided question with the aid of pupils' drawings (see e.g. Kearney & Hyle, 2004).

The most interesting result in this study is large differences between the emotional atmospheres in different classrooms. The Finnish National Core Curriculum for Basic Education (NCCBE, 2004) sets the aim to foster a positive atmosphere in all the classrooms. The teacher has a central role in constructing the emotional atmosphere in mathematics lessons (Evans et al., 2009; Harrison et al., 2007). The teachers' view of mathematics, their stance towards pupils, their pedagogical skills etc. affect the quality of interaction with pupils and thus also the emotional atmosphere. Especially, the emotional relationship between the teacher and the pupils, the teacher's awareness about pupils' feelings and the reasons for these, the teacher's skill to evaluate pupils' feelings and respond to them, the teacher's conception about the importance of different emotions in learning, and the teacher's emotional interpersonal guidelines affect the emotional atmosphere (Evans et al., 2009).

When evaluating a teacher's effect in this study one has to take into account that the third-graders made their drawings already in September 2010 when they had gone to school for only one month after the summer holiday. Pupils' conceptions on the emotional atmosphere in mathematics lesson have thus been affected mainly by the two former school years. On the other hand, a pupil's affective conditions and properties affect how they interpret different situations during mathematics lessons (Hannula, 2011). It would be interesting to study what the emotional atmosphere is like in the lessons of other subjects.

To some extent it was difficult to interpret pupils' drawings. The pupils were fairly young and therefore their drawing skills varied a lot. Some of the teachers had clearly let pupils to use more time to make their drawings and some of them had guided more carefully that some conditions had been fulfilled (e.g. that "ME" was clearly marked in the drawing). It will be interesting to see how the improvement in drawing skill will affect on the distribution of facial expressions.

As a summary, drawings seem to be a versatile way to collect information about emotional atmosphere in mathematics lessons (see also e.g. Harrison et al., 2007). The method offers also a single teacher a possibility to obtain and evaluate information how their pupils experience mathematics and mathematics lessons.

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