Exploring daily emotions of a mathematics teacher in classroom: Case of Christian

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There is not much research on emotions of mathematics teachers further than the wide research on mathematics anxiety of mathematics teachers and pre-service teachers in elementary school. With the aim of the starts filling this gap this research pursues the aim of identifies the daily emotions in classroom of a high school mathematics teacher. Data was gathered through audiotaped self-reports where the participant reported his emotional experiences during 13 mathematics classes. The data analysis show that the participant experimented diverse emotions such as satisfaction, disappointment, appreciation, happy-for, sorry-for, reproach and anger. The triggering situations for the cognitive appraisals are about the achievement of the planned activities for the lessons. The belief of the participant on the "good attitude" of students –perceived as students "collaboration", "independence" and "participation"–supports the appraisals.

Keywords: Teachers' emotions, cognitive appraisal, self-reports of experience,

Teachers' emotions in mathematics education

In the field of mathematics education, most of the research on teachers' emotions focuses on mathematics pre-service elementary teachers. There is also some research on elementary teachers. Mathematics anxiety—"a set of negative emotions about a state of discomfort, occurring in response to situations involving mathematical tasks" (Bekdemir, 2010) — is the most widely emotional phenomenon studied in pre-service elementary school (e.g. Bursal & Paznokas, 2006; Di Martino, Coppola, Mollo, Pacelli, & Sabena, 2013; Di Martino & Sabena, 2011; Hodgen & Askew, 2007). These investigations show that "mathematics anxiety is a common phenomenon among pre-service elementary school teachers in many countries and it can seriously interfere with students becoming good mathematics teachers" (Hannula, Liljedahl, Kaasila, & Rösken, 2007, p. 153). For example, , Harper and Daane (1998) found that mathematics anxiety persists in prospective elementary school teachers, enrolled in a U.S. midsized south-eastern university, and that often, the anxiety was originated in elementary school. Causes for these students' mathematics anxiety included an emphasis on right answers and the right method, fear of making mistakes, insufficient time, word problems and problem solving.

Some other research focused in the study of specific emotions in elementary school teachers (Bibby, 2002; Di Martino et al., 2013). For example, Bibby (2002) found the presence of shame [a reaction to other people's criticisms and an emotional response to knowing and doing mathematics] related with epistemological beliefs about the nature of mathematics: absolutist/product conceptions of mathematics provide ideal opportunities for experiencing shame. Bibby found statements relating

to the fear or anticipation of judgement against those standards they felt they had to measure up: "These comments feature notions of trust, lack of trust and self-doubt, doubt, all of which indicate a fear of shame: a fear of (imagined or real) criticism, ridicule or rejection by others" (Bibby, 2002, p. 710)..

The research of teachers' emotions in mathematics education outlined here shows the strong presence of negative affect towards mathematics on elementary education teachers. There is a consensus among researchers that the main cause of all negative emotions is that most elementary and pre-service elementary teachers are not specialists in mathematics and often had negative experiences with mathematics as mathematics students in elementary or middle school (Coppola, Martino, Pacelli, & Sabena, 2012; Di Martino et al., 2013; Hodgen & Askew, 2007; Philipp, 2007). The appearance of mathematics anxiety in the first years of school is linked with the way in which mathematics is presented to pupils, with the teacher playing a central. Under these negative affective circumstances it is generally recognized that changes in mathematics education is a difficult and sometimes painful process (Hannula et al., 2007; Hodgen & Askew, 2007).

The previous review shows that most of what we know on teachers' emotions from different scholar levels is almost limited to mathematics anxiety. The intention of this research is to start filling these gaps by following the aim to identify the daily emotions experimented by a high school mathematics teacher in classroom.

Theory of cognitive structure of emotions

The theory of cognitive structure of emotions Ortony, Clore, & Collins, 1988)—known as "OCC theory" for the initials of the surnames of the authors—is an appraisal theory structured as a three-branch typology, corresponding to three kinds of stimuli: consequences of events, actions of agents, and aspects of objects. Each kind of stimulus is appraised with respect to one central criterion, called the central appraisal variable. An individual judges: (1) the desirability of an event, that is, the congruence of its consequences with the individual's goals (an event is pleasant if it helps the individual to reach his goal, and unpleasant if it prevents him from achieving his goal), (2) the approbation of an action, that is, its conformity to norms and standards, and (3) the attraction of an object, that is, the correspondence of its aspects with the individual's likes. In terms of the distinction between reactions to events, agents, and objects, we have three basic classes of emotions: "being pleased vs. displeased (reaction to events), approving vs. disapproving (reactions to agents) and liking vs. disliking (reactions to objects)" (Ortony, Clore, & Collins, 1988).

OCC theory describes a hierarchy that classifies 22 emotion types. The hierarchy contains three branches, namely emotions concerning consequences of events, actions of agents, and aspects of objects. Additionally, some branches combine to form a group of compound emotions, namely emotions concerning consequences of events caused by actions of agents. OCC theory provides specifications for each emotion type with three elements: (1) The type specification provides, in a concise sentence, the situations or events that elicit an emotion of the type in question, (2) a list of tokens is provided, showing which emotion words can be classified as belonging to the emotion type in question.

For example, 'frighten', 'scared', and 'terrified' are all types of fear (of course, 'fear' is also a type of fear): (1) TYPE SPECIFICATION: (displeased about) the prospect of an undesirable event and (2) TOKENS: apprehensive, anxious, cowering, dread, fear, fright, nervous, petrified, scared, terrified, timid, worried, etc. In Table 1 we summarized the type specifications of all 22 emotion types.

Appraisals in terms of	Group of emotions	Types of emotions (sample name)
GOALS	Fortunes-of-others	Pleased about an event desirable for someone else (happy-for)
		Pleased about an event undesirable for someone else (gloating)
		Displeased about an event desirable for someone else (resentment, envy)
		Displeased about an event undesirable for someone else (sorry-for)
	Prospect-based	Pleased about the prospect of a desirable event (hope)
		Pleased about the confirmation of the prospect of a desirable event (satisfaction, joy)
		Pleased about the disconfirmation of the prospect of an undesirable event (relief)
		Displeased about the disconfirmation of the prospect of a desirable event (disappointment, frustration)
		Displeased about the prospect of an undesirable event (fear, worry)
		Displeased about the confirmation of the prospect of an undesirable event (fears-confirmed)
NORMS	Attribution	Approving of one's own praiseworthy action (pride)
		Approving of someone else's praiseworthy action (appreciation, admiration)
		Disapproving of one's own blameworthy action (self-reproach, shame)
		Disapproving of someone else's blameworthy action (reproach, rejection)
NORMA/ ATTITUDE	Well-being/ Attribution	Approving of someone else's praiseworthy action and pleased about a desirable event (gratitude=admiration + joy)
		Disapproving of someone else's blameworthy action and displeased about an undesirable event (anger = reproach + distress)
		Approving of one's own praiseworthy action and pleased about a desirable event (gratification=pride+ joy)
		Disapproving of one's own blameworthy action and displeased about an undesirable event (remorse = shame + distress)

Table 1: Emotion types according to the OCC theory (an extract)

Research question

Considering the above theoretical considerations, in this research we have chosen to identify the *emotional experiences* (the individuals' explicit positive or negative appraisals of the triggering

situations) of a high school mathematics teacher. Thus, the research question arising from the aim of our investigation —identify the daily emotions experimented by a high school mathematics teacher in classroom— is: What are the daily individual emotional experiences of a high school mathematics teacher in classroom?

Methodology

Participant and Context

Christian, our participant and fourth author of this paper, was 35 years old by the time of the data gathering. He studied Communication and Electronic Engineering and has a master degree in mathematics education. From 2010, he ventures into mathematics teaching gaining 5 years of experience in teaching at the university and at a technical high school. High school where Cristian works is part of the national high school Mexican system, which has a dual system: it prepares students for university studies but is also engaged with those who need to enter the labour market and require a technical certificate.

Data gathering

The source of data was the daily self-informs of Christian's experiences in his high school Integral Calculus course. The diary methods "involve intensive, repeated self-reports that aim to capture events, reflections, moods, pains, or interactions near the time they occur" (Iida, Shrout, Laurenceau, & Bolger, 2012, p. 277). Christian's self-reports of experiences in class followed an event-based protocol (Iida et al., 2012). The focal experience of the participant that triggered the data collection is the emotional experience of teaching a mathematics class. After each of the 13 lessons (from October 14 to December 4, 2015) of his Integral Calculus course Christian send an audio with a smartphone to the second author of this paper via WhatsApp™ with his answers to the questions: (1) Name and date of the report, (2) What course does this report attend?, (3) What mathematics topics did you work at class today?, (4) How did you design your class?, (5) How were your students intended to learn?, (6) What emotions and feelings did you experiment today at class?, (7) Tell us about the positive experiences you lived today at mathematics class, why were they positive experiences? and (8) Tell us about the negative experiences you lived today at mathematics class, why were they negative experiences? Questions 3, 4 and 5 were designed to understand Christian's expectations and goals in each class. Questions 6, 7 and 8 were designed to know the experimented emotions of Christian in each class. The running time of the self-reports of Christian were among 1:40 y 2:54 minutes.

Data analysis

The data was completely transcribed and repeatedly read for several times. Christian did not participate in the analysis of the data but agreed that the final report adjusted in general to his experience in class. He did not propose any significant change in the interpretation made by the first three authors but made some observations on the interpretations of some fragments of his self-reports and interviews. He also suggested new elements to detail the context of the research.

Following OCC theory, we considered two aspects to identify the type of emotion: (1) ***Concise phrases that express the triggering situations*** of the emotional experiences. We highlight them

with ***italic bold***, and (2) *emotional words or phrases* that express the emotional experience from the participants words or phrases that indicate the appraisal of the triggering situations. We highlight these words or phrases in *italics*. Rn (n from 1 to 13) denotes the number of the participant's report.

For the analysis we only consider excerpts that express emotional experiences; this means that it must contain at least one explicit positive or negative appraisal of the triggering situation. We interpret the positive or negative valence according to the question reported by Christian (the valence is negative if it corresponds to questions 8 and it is positive for question 7). For example, in:

> **Christian-R2:** [The emotions and feelings I experimented in class were] Being *happy* because ***the students managed to structure answers to different doubts of their classmates*** {satisfaction-appreciation}. [The *positive experience* I lived was] ***the interest of the students in helping their classmates*** {appreciation} [I consider this experience as positive] ***because of the reflected attitude during the class, it was to help them*** {happy for-appreciation}.

We interpret "the students managed to solve doubts" as a triggering situation ('the students managed to solve doubts') of a satisfaction type of emotion (Pleased about the confirmation of the prospect of a desirable event). We interpret "the interest of the students to help their classmates" as a triggering situation ('the students help their classmates') of an appreciation type of emotion (Approving of someone else's praiseworthy action). Sometimes in the same emotional experience we identify two types of trigger situations and two types of emotions. In "being happy because the students managed to structure answers to different doubts of their classmates" we interpret as a triggering situation ('the students managed to solve doubts') of a satisfaction type of emotion and a triggering situation ('the students help their classmates') of an appreciation type of emotion.

We build a table with all emotional experiences for each report. The second and third author of this paper identified the triggering situations and the types of emotions for each self-report on separate analysis but using the same table based on the 22 types of emotions proposed the theory of cognitive structure of emotions. They worked the consensus of the triggering situations and the types of emotions with the participation of the first author of this paper. Table 2 shows an example of these analyses.

Emotional experience	Type of emotion	Triggering situation
Being *happy* because ***the students managed to structure answers to different doubts of their classmates***	Satisfaction	The students managed to solve doubts
	Appreciation	The students help their classmates
[*Positive experience*] *the interest of the students **to help their classmates***	Appreciation	The students help their classmates
[*Positive experience*] ***because of the reflected attitude during the class, it was to help them***	Happy for	The students have a positive attitude in class
	Appreciation	The students help

		each other
[*Happiness and joy*]**when I realize they answered the doubts**	Satisfaction	The students solve their doubts
[*Happiness and joy*] **because of the participation and enthusiasm of the students**	Satisfaction	The students participate in class
	Appreciation	The students show enthusiasm in class
[*Positive experience*]**because of the interest showed by the students helping their classmates to solve their doubts, letting them to move on** and understand the integration techniques	Satisfaction/	Students solve doubts
	Appreciation	Students help their classmates
	Happy for	Students understood the integral techniques
[*What I learn in class today*] I consider that the **help received from their classmates, in the sense that they shared different knowledge** about the integration technique studied and this allowed their classmates to advance on the topics of the class.	Appreciation	Students help each other
	Happy for	Students make progress in the topics

Table 2. Types of emotion and triggering situations of R2 (an extract)

Results

We identified 95 emotional experiences from 7 different types corresponding to 4 groups of emotions (Table 3). We found that Christian experimented emotions of satisfaction, disappointment, appreciation, happy-for, sorry-for, reproach and anger triggered by the cognitive appraisal of 6 types of triggering situations: (1) on the achievement of the planned activity, (2) on the students' participation, (3) on the students' collaboration, (4) on the students' attitude, (5) on the students' independence, and (6) on the students' learning and understanding. During the data analysis, we identified the importance of Christian's the notion of "students' (good) attitude". We asked Christian specifically about his. We found that the supports the appraisals is the his belief about the "good attitude" of students— perceived by Christian as students' "collaboration", "independence" and "participation"— is a necessary condition to achieve participant's goals in class and for the students to learn.

Christian's most common experimented emotions were satisfaction (F=36), appreciation (F=26) and disappointment (F=16). These emotions represent 82% of his emotional experiences. More than half of the emotional experiences are *Satisfaction* (pleased about the confirmation of the prospect of a desirable event) and *disappointment* (displeased about the disconfirmation of the prospect of a desirable event). This means that they are the result of the appraisal of situations in terms of the

goals Christian expressed for his lessons. On the other, *appreciation* (approving of someone else's praiseworthy action) represent more than a fourth of the emotional experiences. This highlights the important role Christian attributes to his students' behavior ("good attitude", "participation" and "independence") to achieve their goals.

Types of emotion	*Total*	*F*	Triggering situations
Satisfaction	36	21	Students solve exercises
		6	Students participate in class
		4	Students solve doubts
		2	Students propose methods
		2	Students understand
		1	Students must be independent while solving
Appreciation	26	10	Students help their classmates
		6	Students participate in class
		5	Students are independent in solving processes
		4	Students must have good attitude
		1	Students solve doubts
Disappointment	16	8	Students do not do the planned activity.
		3	Students cannot enter the correct results in the platform
		3	Students do not participate in class.
		2	Students do not understand.

Note: *F* denotes the amount of times we identified the triggering situation.

Table 3. Types of emotion and triggering situation (the most frequent)

Discussion

Table 4 presents the types of triggering situations. As we said before, Christian considers the "good attitude" of a student in terms of "independence", "participation" and "collaboration". Therefore, we include all the triggering situations expressed in these terms in only one type of triggering situation named "students' attitude". In this way, we obtained that most of the triggering situations (95%) are divided in two types: (1) Students' attitude (52%) and (2) achievement of the planned activity (43%). This means that the success of an activity depends on his students' attitude above all.

Our results are consistent with those investigations that focused on teachers' emotions based on appraisal theories (e.g. Frenzel, 2014; Schutz, 2014). We believe that this consistency results from the hypothesis that emotions are the result of cognitive appraisals about what happens in class, realized in terms of goals. Our research shows that the appraisal of students' behavior, conceptualized as "good attitude", is the main triggering situation of Christian's emotional experiences. This is also highlighted in the Frenzel's (2014) "reciprocal model on causes and effects

of teacher emotions". We propose the thesis that the emotional experiences of other mathematics teachers could mostly be triggered by the mathematics behavior of their students.

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