The Eurasia Proceedings of
Educational & Social Sciences (EPESS)
ISSN: 2587-1730

The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2014

Volume 1, Pages 427-434

ICEMST 2014: International Conference on Education in Mathematics, Science & Technology

ASSESSING THE CLIMATE FOR CREATIVITY IN MATHEMATIC'S LESSONS

Alexandre Tolentino de Carvalho
Universidade de Brasília

ABSTRACT: In relationships established at school, it creates an psychological climate in this environment that can both promote the development of the creative potential of individuals, as may hinder it. However, in the literature consulted, lacks empirical studies that address the constituent factors of the classroom climate for creativity in mathematics and there are no validated instruments to measure statistically this climate. This article describes an empirical-analytic study realized with 324 students from public and private schools in the age range from 9 to 14 years devoted to understanding the factors present in the formation of the classroom climate for creativity in mathematic's lessons. Shows the Scale of Climate for Creativity in Mathematics lessons, instrument resulting from this study that serves as a tool for teachers, managers, researchers and students can assess strengths and weaknesses involved in the constitution of the favorable climate to creativity in mathematic's lessons.

Key words: Creativity in mathematics, mathematics education, classroom climate for creativity

INTRODUCTION

It seems consensus among researchers in mathematics education that math abilities are not worked in their completeness and, apparently, logical scholastic abilities, linked to convergent thinking, receive priority in lesson plans at the expense of abilities that require more time and more attention from the teacher in the direction both to research, to plan, to elaborate and to monitor the development of these classroom. As a result, the attitudes of students with mathematical knowledge become more automated and less reflective.

For example, we can take the studies of Haylock (1997) who noticed that there is a tendency among students of content-universe fixation (i.e., their thoughts about a problem are restricted to a variety of inadequate or inappropriate elements) and algorithmic fixation (in which they adhere to a routine or stereotyped response, even when it becomes inefficient or inappropriate for the problem at question). Then Haylock proposes that overcoming this rigidity of thought may be relevant a aspect for the mathematical problem solving.

Also in this sense, Valdés (2010) identifies that many teachers, guided by a purely formal conception of the nature of mathematics, consider that this school discipline should devote themselves to develop ways of thinking linked to logical thinking. When referring to logical thinking, the author try to define those forms of reasoning developed by the teacher in which he prioritizes convergent thinking, ways of acting "associated with formal thought" (Valdés 2010, p. 8) and comprising inductive, deductive and analogy reasoning. However, the author points out that having a well-developed logical thinking is insufficient for solving mathematical problems that require abilities that go beyond logical thought, i.e., that require a "high dose of imagination, fantasy and creativity" (p. 6).

Logically, these authors are referring to the development of creative skills in math classes, one facet of school mathematics that has been neglected when the teacher prioritizes the indiscriminate use of formulas, algorithms and hard thinking in which you teach, you learn and reproduces only forms of mathematical problem solving. Krutetskii (1978) already demonstrated that mathematics developed in the school presented problems that required students both the domain of logic, i.e., essential algorithms for solving mathematical problems of most, as the domain of creative skills necessary for solving problems which could not be resolved by means of algorithms. However, at present, we still find kinds of problems at schools which, according to Piggott (2007), restrict themselves to address a context that is very familiar to the student, almost always portraying a mathematical concept they have just learned and that nothing brings of challenging, they are given clear clues about the knowledge to be applied to its resolution.

- Selection and peer-review under responsibility of the Organizing Committee of the conference

*Corresponding author: Alexandre Tolentino de Carvalhoe-mail: Alexandre.tolenca@gmail.com

There is not doubt among researchers that the development of the creative potential of students need to be part of the agenda of mathematics abilities to be developed at school space. Fleith (2010) states that one of the environment most investigated in research related to creativity is the school. Being an environment made up of people who are related to each other and relate to mathematical knowledge, is eventually developed a climate in this environment that can both promote the development of creative potential that each individual carries, as the can serve as a barrier that prevents creativity to flourish in this space. As remembered by the author, "the cultural environment has a strong influence on creativity by supporting or inhibiting the development of creative effort" (Fleith 2011, p. 3).

Fernandes (2008) recalls out that in the classroom "converge personalities, motivations and capacities very disparate, not being, therefore, easy to create and nurture relationships of affection, affection and friendship, if there is a good climate of acceptance for differences and mutual respect "(p. 16). Therefore, to study how it organizes the climate of the classroom and, specifically, studying the climate for creativity in mathematics lessons, it is necessary to focus both on the environment as in the people who relate that environment. However, much of the research focuses on identifying talented individuals through application testing and individualized description of the individual's role components of the school room for the creativity to emerge in math classes. In the literature consulted, there aren't empirical studies that specifically address the environmental factors that influence the development of creative abilities in mathematics, nor were found statistically validated instruments to measure climate specifically in mathematics lessons.

Taking into account the importance of undertaking research related to climate for creativity in mathematics classrooms and the lack of studies and measurement instruments of this climate specific in this area of education, this paper is devoted to describe a study conducted in the years 2013 and 2014 with students in the age range 9 to 14 years in search of analyzing the factors and dimensions involved in shaping the climate of the classroom for creativity in mathematics lessons and to present, alternatively for measuring these factors, the Scale Climate for Creativity in Mathematics Lessons, instrument resulting from these studies.

To build an understanding of the climate for creativity in mathematics classes were consulted 5 major areas involving literature on climate of the classroom (Brunet, 1992 and Fernandes, 2008; Rodrigues Garran, 2004; Ĉagran & Schmidt, 2006), Climate for creativity in the classroom (Alencar, 2007; Amabile et al, 1996;. Fleith & Alencar, 2005) and climate in mathematics lessons covering psychological climate in mathematics lessons (Haladyna, Shaughnessy & Shaughnessy, 1983) and social representations in mathematics. (Ramos, 2004). The consultation of literature also encompassed studies on creativity (Alencar & Fleith, 2003; Amabile, 1983; Csikszentmihalyi, 1996; Lubart, 2007; Simonton, 1988; Sternbert, 1991) and on creativity in mathematics (Balka, 1974; Gontijo, 2007; Hadamard, 2009/1963; Hashimoto, 1997; Haylock, 1987, 1997; Kattou 2012; Krutetskii, 1976; Poincaré, 1908). For the sake of synthesis, we won't address the contributions of all these scholars. However, we point out some basic points essential to understanding how we conceive understandings of the climate for creativity in mathematics lessons.

We can also point out the contributions of Brunet (1992) as included in the first area of knowledge, i.e., studies on climate of the classroom. He defends that "organizational climate is the perceptions of school actors in relation to existing practices in a such organization" (in Santos 2010, p. 42). He pointed three variables as determinants of the constitution of the climate of the classroom: (a) the structure: are the physical characteristics of the organization described, for example, in school curricula; (b) the organizational process: the way how one performs the management of human resources, for example, the way in which conflicts are resolved, the policy of rewards and the way in which it organizes educational project; (c) behavioral variables: modes of individual and group organizations. The results of these dimensions are: for the individual is reflected in the level of satisfaction on their income and quality of life; for the group is the cohesion, morale and results; and the organization is educational performance, efficacy, adaptation and evolution.

Fernandes (2008) remind out that a large number of authors defend that the interactions between teacher and students are crucial to the constitution of the atmosphere of the classroom. However, this interaction is seen as essentially asymmetrical depending mostly of the actions of the teacher and to a lesser extent the action of the students. This fact is due to the teacher's rigid posture which expects students to adapt to their way of teaching. In this optical, it becomes clear the important role of the teacher who constitutes a determinant in the process of drafting the climate of the classroom. However, it must be focus that the teacher's role is crucial, but not sufficient, since both the student "devout" as "resigned" and still "revolted" (Amado, 2001, cited in Fernandes, 2008, p . 14) form part of these interactions not always acting passively.

In the second area of the literature, we analyzed the contributions about climate of classroom for creativity. A current and important work related to climate for creativity in classroom can be attributed to Fleith (2010). The author presents the scale Climate for Creativity in the Classroom (Fleith & Alencar, 2005) constructed to assess the climate for creativity in the classroom and validated through factor analysis, where he uses a sample of students in 3rd and 4th-graders (currently 4th and 5th year of primary school). Items are answered through a frequency range of five points, ranging from never to always and are distributed into five factors: support from teacher to student's expression of ideas (consists of 5 items that relate to the support provided by the teacher to which the student can to express your opinion); perception of the student with respect to creativity (contains 4 items related to the image that the student creates about his performance on with regard to creativity); student interest in learning (consists of 6 items that shows the student engagement with the learning process); learner autonomy (displays 4 items corresponding to a personality trait associated with creativity); stimuli from the teacher to the student's production of ideas: composed of 3 items related to attitude of acceptance and encouragement from teachers to the ideas developed by the students. Fleith (2010) observes that the factors this scale lend themselves to evaluate both teacher behaviors that are conducive to the expression of student creativity, as the student characteristics related to creativity.

The discussion about climate in Mathematics lessons, i.e., the third area of literature consulted, was conducted with the use of elements present in studies searching to understand the psychological climate in this area of knowledge and in studies related to social representation in Mathematics. Articulated themselves those elements using up the contributions from each of these studies in order to build an understanding of the climate in mathematics lessons and consequently walked to the conclusion about the climate for creativity in mathematics lessons.

Haladyna, Shaughnessy and Shaughnessy (1983) developed a study wherein elaborated a hypothetical model in which the factors teacher quality, socio-psychological climate of the classroom and climate of the management/organization of the classroom were used to measure attitude toward mathematics of students in the 4th, 7th and 9th grades. Authors define attitude towards mathematics as a general emotional disposition for the school subject of mathematics, valued for to be a important result to the school itself, often by being positive slant and slightly related to the success and power increase tendency to elect mathematics as a career possibility in this field. Therefore, the authors focused on the analysis of endogenous factors to the classroom, postulating that "the development of attitudes toward mathematics is likely to be influenced by the teacher and the learning environment (sometimes referred to as climate variables in classroom) "(p. 20).

Another source of study of which one can get elements to be understanding about climate in mathematics lessons can be found in research on social representations in mathematics. Ramos (2004) developed a study that shows concern for the lack of success in this discipline wherein students, besides having poor results in tests and examinations held during their school career, also shows disinterest with discipline. Another concern raised by the author concerns the fact that, despite technological advances facilitate the tasks of calculations, in conceptual terms, the requirements have become increasingly mathematicized requiring a set of mathematical abilities that go beyond the activities of calculations and pass more by "making decisions, by defining strategies to follow to solve a problem, by a critical perspective in face to the results obtained which allow completed by her reasonableness, or not, by the interpretation of graphs and tables, etc." (Ramos, 2004, p. 71).

The author has in these concerns the motivating issues that led her to analyze social representations in the mathematics building an analysis model consists of four dimensions that interpenetrate: affective (relationship of students with the discipline at the level of affection including the importance given to success in mathematics, the affective relationship with mathematics, perception of abilities with mathematics and the image of a good student with Mathematics), social (aspects that concern to the social environment in which students are inserted such as the importance given by parents to success in mathematics, the importance given by friends to succeed in mathematics and the relationship of the group of friends with Mathematics), academic (school experiences of students such as vision relative at the ease of getting good results in Mathematics and relationship with the teacher) and instrumental (including expectations and convictions about the benefits arising from mathematical knowledge as view of the usefulness of school mathematics).
Ramos resorted at the contributions of Durkheim (1968), Moscovici (1976) and Bourdieu (1972) to substantiate the perspective of social representations used in the research he has done. There by, this perspective of social representations understands that "individuals, not being a mere receptacle of images, when interpret, organize

and relate what comes to them from abroad, are themselves to be responsible for new creations" (Ramos, 2004, p . 72). The author continue admiting which also in the Mathematics the individual is not restricted to passively internalize the information, it modifies and creates new representations. Based on these considerations, the author defines social representations as "symbolic tools that give meaning to the information that comes to us coming from social reality, organizing her and using her as a guide to action" (Ramos, 2004, p. 74).

The researchers who are dedicated to studying creativity in the systemic approach show the importance of the environment for the development of creativity and constitute the fourth research area used for understanding the climate for creativity in mathematics lessons. Amabile (1983) reveals the importance of the influences of the social environment for the development of motivation, attitudes and abilities. Csikszentmihalyi (1988) develops all a definition about the social and cultural means where creativity occurs may inhibit or stimulate the creative activity of the individual. Sternberg and Lubart (1991) is referring to the environmental context as an important factor for the development of creativity favoring the generation of new ideas, encouraging and supporting the generation of creative products and evaluating the creative product. Simonton (1988) assesses creativity as a social phenomenon which should be studied through investigation the influences of social, political and cultural variables and which cannot be understood outside of the social context in which it occurs.

The fifth and final area of knowledge consulted refers to creativity in mathematics which we have already addressed in the beginning of this introduction. In addition to these points raised, we can mention, for example, Hashimoto (1997) which highlights the importance of to foment the creativity in mathematics in school spaces through activities that give opportunity for students have different ways of thinking about a problem to be solved. As previously mentioned, were not found correspondence which concerned to the studies related climate to creativity in mathematics classes. In this logic, looking up theoretical contributions in the contributions discussed earlier to advance in the definitions about climate for creativity in mathematics classes and for the preparation and validation of an appropriate instrument for studies on the subject. For this purpose, it is necessary a articulation retaking key information previously addressed.

First, one can assume the climate for creativity in mathematics classes submerged in emotional-affective structure, starting from the conception of which the school is a meeting place for kids with knowledge. In the case of mathematics, inspired by Krutetskii (1976), the lessons are the moments of meeting the child with school mathematics and with creativity in mathematics, a meeting that takes place in deep interaction between student-student, student-teacher and student-knowledge (in the plural because comes up scholastic abilities and creative abilities in mathematics). Starting from the contributions discussed above, it is assumed that in the climate for creativity in mathematics, the physical involvement and the structure (like the way which the teacher organizes the space, time and school materials and objects of knowledge to be developed in the planning of the lessons) indicate the resources that contribute to the creation of the enabling environment for creativity. The objectives and the organizational process relate to mode how the mathematics teacher organizes the educational process. The characteristics of the teachers and students, i.e., the behavioral variables relate to the interrelationships that occur in the environment of classroom and ways of behaving before knowledge. Are variables that will determine the way in which the climate of the classroom will enhance the development of creative abilities of students.

The constituent contributions of our study allows us to conclude further that the creation of a climate for creativity in mathematics classes, the perceptions of students about mathematical knowledge are constituted by factors of a social nature in which it give personal relationships, of affective nature wherein the student is related to mathematical knowledge and constitute representations about the degree of importance of the school as environment creativity, of instrumental nature in which the student builds expectations as to such future knowledge, and ultimately of academic nature in which the teacher as an organizer of school space, becomes primarily responsible for managing lessons.

When in the present study is presented the term "Climate for Creativity in Mathematics Lessons", it refers to the confluence of several factors of psychological, social, environmental and structural order that determine the perceptions of the students about the value that is attributed to creative activity in mathematics classrooms and therefore interfere in the itself creative activity of the mathematical subject , considering that these perceptions are converted into bases for the action of the individual perceiver.

These contributions substantiated and resulted in a scale that attempts to assess the perception of students in the 5th grade of elementary school about the climate for creativity in mathematics classes, focusing, therefore, on the environmental factors that influence the development of the creative potential of subject respondents to the instrument. Lubart emphasizes that "the environment evaluates creativity through social judgment" (2007, p.18). Pasquali (2010) reminds us that "assess seems to be a fatality of the human being in relation to its environment, including here, the physical environment and the social" (p.11). Therefore, among the constant human need to evaluate the facts around and considering the importance of social judgments in the constitution of individual perceptions, this scale is based as a useful tool in finding possible negative influences on the incorporation process the perception of the student as the institutionalized medium in which it develops its creative potential.

METHODS

The investigations were guided by an empirical-analytical study preceded by consulting the literature described above, the procedure needed to account to develop and validate a reliable and valid instrument. This sense 53 items were developed initially trying to reflect the aspects mentioned above, structured in a Likert 4-point scale ranging from 1 value, corresponding to the never option, to value 4, related to the always option. The language of the items was constructed by means of affirmatives phrases to ensure comprehension of the respondents seeking also maintain a standardized wording in order to facilitate the reading of sentences and emphasize the fact that participants should evaluate what occurs only in classes mathematics. Still, in order to aid the understanding of participants adapting the instrument to the age of respondents, we sought, through graphics, to represent the values assigned on the scale. Thus, the graphics capabilities represent the gradation extending a figure of a shell of ice cream relating to the value "NEVER", passing a figure of one ball of ice cream relating to the value "A FEW TIMES", another figure of two balls of ice cream concerning the value "OFTENTIMES" and reaching the figure of three balls of ice cream relating to the value "ALWAYS", as shown below:

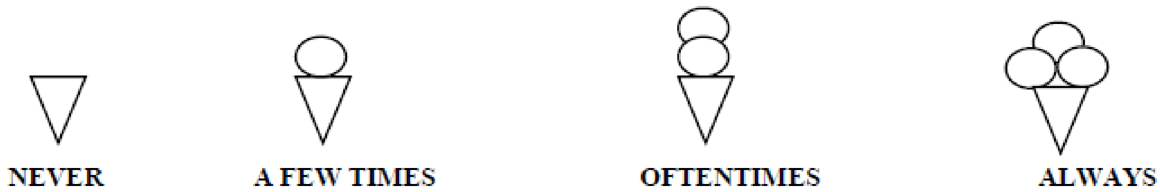

Figure 1 - Graphic Resource of the Scale of Climate for Creativity in Mathematics Lessons

The validation of this instrument took place at three different times required for the scale could actually measure what it is intended of form effective, appropriate and reliable. For that, it was initially consulted a group of experts, after a group of students and finally, we used statistical tools. We present below a brief detail of this process:

a) The initial analysis was performed by the judgment of a panel of three experts. The role of these experts was constituted in to judge the items as to their purpose of measuring students' perception regarding the climate for creativity in mathematics classes, ie, respond to the questionnaire: the items are able to measure this perception? Items that were considered adequate (although they have been suggested amendments) by at least two experts were included in the version that was subsequently submitted to analysis of the students. After this analysis, changes of terms and suggestions for new items were suggested, getting the version for semantic analysis comprised 55 items in total.

b) After the evaluation of experts, we proceeded to the semantic analysis, when five collaborators, students in the 5th grade of elementary school to a public school, provided elements for assessing the adequacy vocabulary items to the corresponding age group. According to Pasquali (1999), the items must be formulated with an appropriate language (criterion of clarity) so that they are understood by all members of the population (criterion of credibility). In this analysis step, students showed understanding of vocabulary and no change was realized.

c) And finally, after the semantic validation, the instrument was administered to a sample of 324 students following the recommendation of Gorsuch (1983) that indicates the application in a sample which represents a proportion of 5 students for each item constant on the scale or a total of at least 200 individuals. Of these students, 200 were enrolled in public schools and 124 in private schools. The reliability of the instrument constituted by factor analysis, at which time it was found their internal structure and extraction of factors was performed. Using the statistical package SPSS version 20.0, conducted an exploratory analysis of data collected in the application of the preliminary version of the scale, proceeding then to the statistical analysis of these data. With the principal components exploratory analysis, we sought to describe and explore the main features of the results and we investigate the presence, in the data collected, of statistical assumptions to demonstrate the possibility of factorability of the instrument.

RESULTS and FINDINGS

Then we discuss the main results of this empirical research so that, later, we analyze the implications of these results for mathematics education. When performed the extraction of principal components we observed the factorability of the matrix and the possibility of existence of factors. Were pointed favorable index indicative of factorability of the matrix. First, it was pointed the index of sampling adequacy KMO OF 0.801 indicating factorable matrix and optimal adjustment of the sample size given that the literature shows that values above 0.80 are considered great. The analysis of the correlation matrix Anti-image showed diagonal values greater than 0.5 and low values in the rest of matrix which suggests its factorability. The Test of Bartlett's Sphericity ruled out the possibility that the correlation matrix represents an identity matrix (a situation in which the diagonal elements are equal to 1 and the remaining coefficients of the array equal to zero) indicating significant values and a significance level small. Were not found extreme values (0 and 1) in the table of values commonalities, a fact that rules out the existence of problems in factorability matrix.

Darting of the Principal Component Analysis, we estimated the initial number of 19 factors with reference to the Kaiser criterion where the eigenvalue of each factor must be equal to or greater than 1. Taking into account the large number of factors extracted by this criterion, we started to analyze the variance explained by the factor must be at least 3%, which suggested the extraction of 6 factors. Inspection of the Scree Plot graph also suggested the existence of six factors. However, the sixth factor was eliminated by having low reliability index (Cronbach's alpha) and contain only 3 items that did not have a factor loading greater than 0.30 on the other factors. Three items belonging to the other five factors were eliminated for not presenting a theoretical sense to justify the presence of that item in the factor to which it was allocated. This way, after the analyzes, the matrix gave birth to the scale consisted of 45 items arranged in five factors that explain 33.07% of total variance. The scale called Scale Climate for Creativity in Mathematic's Lessons was constituted as follows:

Compounding Factor 1, we have 11 items that relate to the relationship of the student with mathematics developed in the classroom, where he can express representation that makes this area of knowledge, demonstrating the level of pleasure and performance in this discipline as well as assess their level of creativity in mathematics. In this sense, Gnedenko (1982) shows that students will be creative in mathematics if he likes to math, something that rarely happens in the classroom. So, Factor 1 was named Student's Relationship with Mathematics, with Cronbach alpha index of 0.862. As an example, we mention the items: "The math classes are among my favorite classes" and "I find it easy to learn mathematics."

Factor 2 consists of 16 items and was titled Pedagogical Organization and Creativity in Mathematics. Showed a Cronbach alpha of 0.762 and concerns the perception of students as how the teacher organizes, plans and develops their math classes and how he inserts the development of mathematical creativity of the student in this educational organization. So, covers items that look for evaluate the availability of materials and physical spaces in the development of lessons and variability of pedagogical actions that can stimulate the development of creative strategies for solving mathematical problems. The way the teacher organizes her classes also reflect on how students perceive the usefulness of the knowledge constructed in school will have in your life. Exemplifying this factor we have the items: "The mathematic's lessons take place at various locations of the school (library, gymnasium, garden, patio, etc.)" and "In mathematics classrooms I am encouraged to invent problems."

Factor 3 was named Relationship with Mathematics by to embrace 7 items that relate to the student's perception about the image that colleagues pass of the mathematics and the level of creativity developed in this discipline. then, items seek to evaluate the perception of students about what their peers think about the taste of discipline and the way they evaluate their levels of creativity. The Cronbach alpha index was 0, 731. Items "My colleagues like of mathematics classes" and "My colleagues are creative in Mathematics classes" exemplify this factor.
Factor 4 was comprised of 7 items related to the level of support that the teacher dispenses the production and communication of ideas by the student. The factor was named Teacher's Support at the Production and

Communication of Ideas. In this factor, it discusses the evaluation of the student regarding the perception that has on how the teacher plays its role of stimulating production and communication of ideas during math classes, teacher's action that can stimulate the development of the creative potential of students, insofar as these find space to enhance the quantitative and qualitative development of ideas. The index Cronbach alpha was 0.664. The following items are included in this factor: "In mathematics lessons the teacher allows me to ask questions when I have doubts" and "In mathematics lessons the teacher gives me time enough to think about a problem that I have to answer."

The last factor, titled Interaction of Students in Search of Mathematics Strategies, consists of 4 items that look for evaluate the way in which interactions among students in the classroom during the resolution of mathematical activities. As well evidenced by Schoenfeld (2013) learning environments are highly interactive, and ideas that individuals construct are often built and refined in collaboration with others (p.20). This form, this factor is concerned with how to measure how the interactions between students favor the establishment and communication of mathematical strategies, since the joint actions of the students may favor the emergence of creative strategies. The index Cronbach alpha was 0.507. Exemplifying this factor we have the following items: "My colleagues like to do math activities with me" and "My colleagues ask me to help them with math activities."

CONCLUSION

The results suggest that the full development of math abilities in the classroom pass compulsorily by the confluence of several factors if the aim is to educate students proficient in math. Of course this is not a purely mathematical logic, but mainly a mathematical which enables the individual to the full development of their potential, including here the ability to be able to understand their processes of mathematical thinking and problem solving abilities that require more than simple algorithmic procedures.

Based on this concept, the development of the scale grounded in the literature that supports such a view of mathematics education and validated by a rigorous statistical process scale allows us to have at hand a valuable tool with regard to the assessment of the climate of the classroom. Teachers, administrators, researchers, and students themselves can assess the strengths and weaknesses that support for the constitution of the atmosphere that can promote or inhibit the development of the creative potential that each student carries.

RECOMMENDATIONS

The full version of the Scale of Climate for Creativity in Mathematics is designed to be preferentially applied to students enrolled in the 5th grade of elementary school in public and private, educational grade in which students components of the sample of validation instrument schools were enrolled. However, studies can be oriented so as to extend the range for use in other elementary grades. Furthermore, it is recommended further studies in order to improve the scale, both increasing the sample as conducting studies in which the instrument may be tested. The scale in its full version has the potential to serve as an instrument to measure the perceptions that students make about how creativity is treated in math classes, serving as a means for the teacher to assess their pedagogical action seeking promote the creative potential of their students.

REFERENCES

Amabile, T. M. (1983). *The social psychology of creativity.* Nova York: Springer.

Fernandes, L. F. P. (2008). *Clima de sala de aula e Relação Educativa: as representações dos alunos de 3º ciclo*. 2008. 116 f. Dissertação (Mestrado em Observação e Análise da Relação Educativa) - Faculdade de Ciências Sociais e Humanas, Universidade do Algarve, Faro.

Csikszentmihalyi, M. (1988). Society, culture, and person: a systems view of creativity. In: STERNBERG, Robert J. (Org.). The nature of creativity. Nova York: Cambridge University Press., 325-339.

Fleith, D. S. (2010). Avaliação do clima para criatividade em sala de aula. In: Alencar, e. M. L. S.; Bruno-Faria, M. F.; Fleith, D. S. (Orgs.). *Medidas de criatividade: teoria e prática*. Porto Alegre: Armed.

Fleith, D. S. (2011). Creativity in the Brazilian Culture. *Online Readings in Psychology and Culture*, Washington, 4, 3, 1-20.

Fleith, D. S. & Alencar, E. M. L.S. (2005). Escala sobre o clima para criatividade em sala de aula. *Psicologia: Teoria e Pesquisa*, *21*, 85-91.

Gnedenko, B,V (1982): “Sobre la creatividad Matemática”. In: Gnedenko B.V. *Formación de la Concepción del mundo en los estudiantes en el proceso de enseñanza de La Matemática.* Colección Biblioteca del Maestro, Moscol, 94-106.

Gorsuch, R. L. (1983). Factor analysis (2^{nd} ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Haladyna, T.; Shaughnessy, J.; Shaughnessy, J. M. (1983). A causal analysis of attitude toward mathematics. *Journal for Research in Mathematics Education*, Washington, *14*, 1, 19-29.

Hashimoto, Y. (1997). The Methods of fostering creativity mathematical through problem solving. *International Journal on Mathematics Education - ZDM*, *29*, 3, 86-87.

Haylock, D. (1997). Recognising Mathematical Creativity in Schoolchildren. International Journal on Mathematics Education-ZDM, 29, 3, 68-74.

Krutetskii, V. A. (1976). *The Psychjology of Mathematical Abilities in Schoolchildren*. Chicago: The University of Chicago Press.

Lubart, T. (2007). Psicologia da criatividade.Tradução: Márcia Conceição Machado Moraes. Porto Alegre: Artmed.

Pasquali, L. (1999). Testes referentes a construto: teoria e modelo de construção. In: PASQUALI, Luiz (Ed.). *Instrumentos psicológicos: manual prático de elaboração*. Brasília: LabPAM/IBAPP.

Pasquali, L. (2010). *Histórico dos instrumentos Psicológicos*. Disponível Retirado de: http://pt.scribd.com/doc/64819811/LUIS-PASQUALI.

Ramos, M. M. C. (2004). Representações sociais da matemática: a bela ou o monstro? *Sociologia, Problemas e Prática*, *46*, 71-90.

Santos, Clementina de Jesus Alhinho dos. Clima escolar e participação docente: a opinião dos professores da educação pré-escolar e do ensino básico. 2010. 214 f.Dissertação (Mestrado em Ciências da Educação) – Faculdade de Psicologia e Ciências da Educação, Universidade de Coimbra, Coimbra, 2010.

Schoenfeld, A. H. (2013). Reflections on Problem Solving Theory and Practice. *The Mathematics Enthusiast*, California, *10*, 9-34.

Simonton, D. K. (1988). Creativity, leadership, and chance. In Sternberg, R. J. (Org.). *The nature of creativity*. Nova York: Cambridge University Press., 386-426.

Sternberg, R. J. & Lubart, T. (1991). An Investment Theory of Creativity and its development. *Human Development*, Califórnia, *34*, 1-31.

Valdés, C. E. A. (2010). El Desarrollo de La Creatividad em La Educacion Matemática. Congresso Iberamericano de Educacion: Metas 2021, Buenos Aires.