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Creativity in Mathematics and the Supervised Internship: implications for teaching practice

Criatividade em matemática e o Estágio Supervisionado: implicações para a prática docente

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Abstract

The research aims to analyze the perceptions of teachers' trainers concerning the practices that occurred during the Supervised Internship in undergraduate courses in Mathematics about the development of the student's creative process. It is qualitative research, the research subjects are teachers from public higher education institutions in Goiás and the Federal District, and the information was analyzed through content analysis, constituting the case study. Among the results obtained, it stands out that the term creativity is understood in the dimensions of originality and flexibility of thought, that most teachers identify themselves as creative teachers, and that they recognize the creative process in developing their activities. According to the research, the Supervised Internship in Mathematics is a phase of fundamental importance in teacher training, and that can provide an environment for raising students' creative potential.

Keywords: Mathematics degree; Supervised internship; Teacher training; Creativity.

Resumo

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A pesquisa objetiva analisar as percepções de docentes formadores em relação às práticas ocorridas no decorrer do Estágio Supervisionado em cursos de licenciatura em Matemática, no que se refere ao desenvolvimento do processo criativo do estudante. É uma pesquisa de natureza qualitativa, os sujeitos da investigação são professores de instituições de ensino superior públicas em Goiás e Distrito Federal e as informações foram analisadas mediante a análise de conteúdo, constituindo-se o estudo de caso. Dentre os resultados obtidos, destaca-se que o termo criatividade é compreendido nas dimensões, originalidade e flexibilidade de pensamento, que a maioria dos docentes se identifica como um professor criativo e que reconhece o processo criativo no desenvolvimento de suas atividades. Segundo a pesquisa, o Estágio Supervisionado em Matemática é uma fase de fundamental importância no processo de formação docente e que pode propiciar um ambiente de elevação do potencial criativo dos estudantes.

Palavras-chave: Licenciatura em Matemática; Estágio Supervisionado; Formação docente; Criatividade.

Introduction

This research is the result of the inquietudes registered during the years of teaching in undergraduate courses and the Basic Education of the authors involved in this study, as well as aspirations from the readings and reflections carried out in the face of the training course in a graduate program of a university in the central-west region of Brazil. During teaching work and the experiences lived in the teaching-learning process in the Supervised Internship of Mathematics degrees, questions were observed that impel investigations into the teacher training process, specifically on mathematical creativity, the authors' area of study.

In this process of reflection, we sought, together with the Mathematics degrees of the Federal Institutes and public universities of the Federal District and Goiás, information about the perceptions of teachers about the practices carried out in the development of the Supervised Internship in these courses, specifically about the stimulation of the creative process during the training period in this area. It was supported by theorists such as Gatti (2017) and Tardif (2000, 2002), who presented studies and reflections on the importance of this training in undergraduate courses. According to Gatti (2017, p. 734), it is necessary to "[...] reflect on teacher education and build paths that enable the transformation of the current scenario of educational actions that take place in classrooms [...]". For the author, it is necessary to consider the interaction and intersection of multiple conditions intrinsic to this training, considering its consequences and aiming at educational goals.

Authors such as Gontijo (2006, 2007), Gontijo & Fonseca (2020), Fleith (2010), Gontijo & Fleith (2010) and Lubart (2007) theoretically support this study by raising considerations about creativity, such as "[...] creativity is the ability to realize a production that is both new and adapted to the context in which it manifests itself [...]" (Lubart, 2007, p. 16). According to Fleith (2010, p. 34), "[...] despite the numerous barriers to creativity identified in the school environment, it is not possible to ignore the great influence of the school on the development of the creative potential of students and teachers."

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Regarding the importance of the Supervised Internship, we sought in Pimenta & Lima (2010) subsidies for theoretical foundations regarding this stage of teacher training in undergraduate education.

This study investigates the teaching practice of teachers who train Mathematics teachers in the Federal District and Goiás, starting with two motivating questions: Do teachers understand the meaning of creativity in the teaching-learning process in Mathematics? Do these teachers recognize the creative process in the development of the Supervised Internship of undergraduate courses in Mathematics? Based on the content analysis, we sought to categorize the teachers' responses to understand if they understand the meaning of creativity and if they recognize the creative process. This categorization made it possible to relate these responses to the characteristics, fluency, flexibility, and originality and thus answer the questions mentioned.

Given these concerns, there has been discussion about teacher training, listing pertinent considerations in the light of discussions on teacher training (Silva, 2008). In this sense, in order to achieve the purpose of this study defined in the initial questions, the investigation was organized in two crucial moments, namely: in the first, the theoretical approach to teacher education and the understanding of the term creativity and Supervised Internship, and in the second moment, the analysis of the answers of teachers of undergraduate courses in Mathematics to the questionnaires sent to them.

The following topic will address notes on teacher education and creativity in the Supervised Internship in Mathematics.

Teacher training and creativity in the Supervised Internship in Mathematics

Teacher training has been the object of study by researchers in the area, such as Gatti (2017), Saviani (1994), Oliveira *et al*. (2021), and Silva (2008). According to Oliveira *et al*. (2021, p.12), it has been observed that:

> [...] the issues centered on the initial training of teachers, including Mathematics teachers, are far from being resolved since the theme remains highlighted. Even though several current public policies focus on teacher training, they have not yet been able to promote social-quality education in this field.

It is worth noting that the National Curriculum Guidelines of higher education courses from the 1990s were instituted by the Ministry of Education (MEC) in order to ensure greater flexibility about the organization of courses, seeking to meet the previous training, as well as the expectations and interests of students. According to Silva (2008. p. 171-172), it is sought in teacher training courses. This quality teaching can "strengthen a counter-hegemonic

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proposal of society, as it interferes, more or less directly, in the cultural elevation of most of the population."

Teacher training involves discussions such as the position the teacher must assume in the face of the learning process. Gadotti (2002, p. 32) points out that he "[...] will no longer be a lecturer to be an organizer of knowledge and learning [...] a mediator of knowledge, a permanent learner, a builder of meanings, a cooperator, and, above all, an organizer of learning". It is necessary to review the practices that are developed in the classroom, and it is still considered fundamental that, according to Tardif (2000):

> Teachers in their practice must rely on specialized knowledge, and formalized, most often, through the scientific disciplines in a broad sense, including, of course, the natural and applied sciences, but also the social and human sciences, as well as the sciences of education (Tardif, 2000, p. 141).

Also, according to the author, "[...] the teacher can not only "do his job," he must also engage and invest in this work as he is as a person" (Tardif, 2000, p. 141). The teaching work must provide interventions in search of improvements in the teaching-learning process of students.

Considering the teacher's individuality, Tardif (2000, p. 141) points out the relevance of the teacher's personality, stating that "it is an essential component of his work. Let us call it invested or lived work". In addition, it is emphasized that the excellent construction of the teacher's personality can lead to specialized knowledge, which aims at essential characteristics in this formation, such as presenting reflective, creative, and promoting actions of interventions that provide improvements in the learning process of students in Mathematics. The author considers teaching work complex since "[...] its object is the human being and whose realization process is fundamentally interactive, thus calling the worker to present himself 'personally' with everything he is, with his history and his personality, his resources and his limits" (Tardif, 2011, p. 111).

The teacher's personality can influence the development of creativity since, according to Gontijo & Fonseca (2020), the classroom environment can prevent or favor it. The academic work stimulated in an atmosphere aimed at developing creativity is directly related to the strategies and climate provided by the teacher, while the opposite can inhibit its emergence.

When reflecting on the term creativity, one immediately thinks of novelty! What will be new? Students may ask. According to Lubart (2007, p.11), "for a long time, creativity was learned mystically; it took a slow elaboration of a problematic, through a series of diverse approaches, to arrive at the concept [...]". Also, for the author, creativity in a mystical approach is sometimes associated with inspiration, the irrational state of euphoria, and "another denomination of creativity appeared when Aristotle developed the idea that

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creativity has its origins within the individual, within the chain of his mental associations, and not in divine interventions" (Lubart, 2007, p. 12).

Students can develop creativity from stimuli directed by teachers in the classroom. This stimulation can take place, for example, by presenting a task that allows many answers and, thus, verifying if the answers have fluency, flexibility, and originality (Gontijo *et al*. 2019). Several scholars have focused on the writings of interpretations in the search for the approximation of the term creativity, such as Lubart (2007), who states that:

> Creativity is the ability to realize a production that is both new and adapted to the context in which it manifests itself. This production can be, for example, an idea, a musical composition, a story, or even an advertising message (Lubart, 2007, p. 16).

The author also points out that the concept of creativity may vary according to culture or time. Creativity should be understood in a multiple approach, which brings together motivation, capabilities within an area, and a set of mental processes that lead to creative production (Lubart, 2007).

Other scholars also show that motivation plays a determining role in creative production. There are two types of motivation, extrinsic and intrinsic. The first is external to the person, obtained by rewards or threats, for example, while intrinsic motivation is related to passion and interest (Amabile, 1999). In the understanding of the authors Alencar & Fleith (2003):

> [...] intrinsic, task-centered motivation is of inestimable importance for creativity since people are much more likely to respond creatively to a given task when the pleasure of performing it moves them. [...] both types of motivation - intrinsic and extrinsic, are often in interaction, combining with each other to strengthen creativity (Alencar & Fleith, 2003, p.3-4).

Besides motivation, emotions are also related to creativity. According to Lubart (2007), both emotional and mood states and the teacher's personality can influence students' creative performance. According to the author, emotion and creativity can be observed in a more natural view because the way the teacher organizes the activities in the classroom and outside it can, in a certain way, interfere positively with the educational action as well as hinder the students' innovative capacity.

Also, on emotional issues, Lubart (2007, p. 56) points out that "the emotional state is, by definition, very transient. It is a short and intense reaction in response to an external stimulus. It consists of philosophical, behavioral and cognitive components". For him, these emotional states can generate in cognitive processes, perceptions that better activate the level of attention of those involved and can guide their behaviors. It is also considered that the emotional states of teachers and students are also factors that provide stimuli to creative processes that, according to Lubart (2007, p. 93), "refers to the succession of thoughts and actions that lead to original and adapted creations."

DOI: 10.20396/zet.v31i00.8672191

Corroborating this statement, Scomparim (2004) reinforces the idea that it is the role of teachers to identify the activities that students have more affinity with and stimulate the development of creative processes. Moreover, it is believed that the teacher of this century is driven to be more critical and creative, primarily through problem-solving strategies.

Considering the focus of this work, it is worth highlighting what we understand as creativity in the field of Mathematics; we take the proposition of Gontijo (2007), who considers it as:

> [...] the ability to present numerous possibilities of appropriate solutions to a problem situation, so that these focus on different aspects of the problem and/or different ways of solving it, especially unusual ways (originality), both in situations that require the resolution and elaboration of problems and in situations that request the classification or organization of Mathematics objects and/or elements according to their properties and attributes, either textually, numerically, graphically or in the form of a sequence of actions (Gontijo, 2007, p. 37).

The authors also highlight the need to stimulate critical and creative thinking from an academic and economic point of view (Gontijo & Fonseca, 2020). As for creativity in teacher training, Araújo Neto (2022, p. 153) states that "there is still much to be researched on the subject of creativity in Mathematics." According to the author, to increase the quality of teaching, "a change of focus is needed in the process of initial training of teachers in Mathematics and in the organization of their pedagogical work in the classroom, and teacher training in order to enable them to stimulate the creative process and the critical thinking of their students" (Araújo Neto, 2022, p.33-34).

It is necessary to foster discussion about teacher training and, preferably, with the participation of all those involved. In this panorama, Silva (2008, p. 17) says that "the changes that make up the ideology will be effective if there is the participation of the teaching professional."

Corroborating with the author, Gontijo & Fonseca (2022, p.337) emphasize that "teacher training courses include the exploration and investigation of Mathematics ideas to stimulate creative thinking." Also, for the authors, it is essential to be able to "expand the debates on the subject and, in particular, inspire pedagogical practices that contemplate these thinking skills, collaborating with the formation of more critical and creative teachers and, in turn, with students who are also more critical and creative in Mathematics (Gontijo & Fonseca, 2022, p.337-338).

Another alternative regarding teacher training in this aspect is "the need to create a teacher training program to present the concept of critical and creative thinking and allow such professionals to experience strategies to stimulate this type of thinking" (Gontijo & Fonseca, 2020, p.744).

DOI: 10.20396/zet.v31i00.8672191

When thinking about strategies that can stimulate teacher creativity, the internship provides an opening to offer spaces that promote these reflections. Leal and Gontijo (2020, p. 119) affirm that "instituting the centrality of teaching practice through the Internship is a way of breaking with the theory/practice dichotomy and allowing preparation for the exercise of the teaching profession based on knowledge, reflection, and analysis of the various phenomena that occur in the school environment."

In this regard, it is perceived that educational socialization spaces are "[...] conducive to stimulating creativity, because, in the confrontation of ideas, interests, and visions, individual contributions can be added to collectively come up with ideas capable of helping to solve problems" (Leal, Gontijo & Formiga Sobrinho, 2020, p. 122).

As for the diversity offered by educational spaces, it is relevant to reflect on the improvement of processes and on the recognition of teaching that mediates stimuli to creativity. According to Beghetto (2017, p. 549), "to recognize that creative teaching, like all forms, is a polymorphous act" is necessary in this context. However, when reflecting on this polymorphism, Leal, Gontijo & Formiga Sobrinho (2020, p. 122) emphasize that training processes should help individuals "to appropriate the necessary tools to become critical thinkers, resilient learners, and creative problem solvers [...] putting critical and creative thinking into action". As teachers are individuals in the process of training, who can be creative when considering the context of the classroom, Gontijo & Fonseca (2020, p.733) point out that the "creative teacher can be a model for his students, inspiring them to adopt behaviors and practices of creative thinking similar to their actions."

Thus, it is necessary to "change the teacher's posture, who stops working as an expositor of content and assumes the role of mediator in the process of building knowledge and stimulating critical and creative thinking in Mathematics" (Leal, Santos & Gontijo, 2022, p. 53).

In this sense, it is essential to consider stimulating creativity during the Supervised Internship in Mathematics graduation, not only for the interns' development but for the future teacher to promote actions in his professional practice that awaken his students' creativity. It is argued that there are ways to stimulate creativity in the teacher training process, which can be provided by teachers/trainers in this context.

The methodological process used in this research is presented below, with the unfolding and reflections on the analysis of the data collected.

Research Methodology

In order to understand the impressions of teachers who work in the Supervised Internship in Mathematics undergraduate courses regarding creativity, a research was developed based on the assumptions of the qualitative approach; since the interpretation of

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the collected data is focused on the meanings, in order to construct meaning for the relationships that are established (Brasileiro, 2016). Considering its qualitative nature, the research subjects were teachers from public higher education institutions in Goiás and the Federal District.

To select the research participants, the coordinators of the Mathematics courses of the higher education institutions were consulted to obtain information about the teachers who work in the Supervised Internship discipline. Thirty-seven teachers responsible for offering the discipline in the six institutions were identified: University of Brasília (UnB), State University of Goiás (UEG), Federal University of Goiás (UFG), Federal Institute of Goiás (IF Goiano), Federal Institute of Goiás (IFG) and the Federal Institute of Brasília (IFB).

Considering the institutions analyzed, eighteen Mathematics degree courses were detected, sixteen in the state of Goiás and two in the Federal District. In Goiás, there are ten courses at UEG, one at UFG, one at UFCAT, one at UFJ, one at IF Goiano, and two at IFG. There is one course at UnB and one at IFB in the Federal District. The courses are located in the following cities: Anápolis, Brasília, Catalão, Cidade Estrutural, Cidade de Goiás, Formosa, Goiânia, Iporá, Jataí, Jussara, Morrinhos, Porangatu, Posse, Quirinópolis, Santa Helena de Goiás, Urutaí and Valparaíso.

The information collection instrument adopted was the questionnaire, prepared by the researchers, in order to apprehend the subjects' understanding of the object of investigation; composed of questions to identify the profile of the participants and to obtain information about creativity during the development of the Supervised Internship of the degree in Mathematics. In order to preserve the anonymity of the participants, the trainers were named P1, P2, ..., and P14. The research was carried out in 2021, and the questionnaires were made available in electronic format, prepared in Google Forms, and sent by email to the research participants. They were sent to 37 teachers, obtaining 14 responses representing 38% of the sample.

Data analysis was performed through Content Analysis, which was organized into three chronological poles as guided by Bardin (2011). In the first, called pre-analysis, the information obtained in the questionnaires was organized, systematizing the initial ideas. In the second moment, the answers were coded to carry out the next step, which is the analysis itself in which; although statistical analysis was not carried out, since the objectives of the research are focused on the meanings, we sought to create charts and tables in order to highlight the information provided by the analysis.

Data presentation and analysis

The respondents are aged between 35 and 60, and 86% are female. Regarding professional training, 10 have a degree in Mathematics, two have a bachelor's degree in Mathematics, one has a degree in Education in the Field (degree), and one has a degree in

DOI: 10.20396/zet.v31i00.8672191

Pedagogy. As for the title, 10 are doctors, two masters, and two specialists. Regarding the teacher's identity, according to Pimenta and Lima (2010, p. 62), although it is constituted in the course of his professional trajectory, "[...] it is in the process of his formation that the options and intentions of the profession are consolidated". As the majority of those investigated have a degree (86%), it was inferred that these professionals could work in the Supervised Internship. Regarding the information that 64% are doctors, it can be said that the majority sought to improve themselves for teaching.

Regarding the performance in the classroom, it was evidenced that the average teaching time is 22 years (between 8 and 32 years). Regarding the time of teaching performance as a supervisor in the Supervised Internship, 57% are working in this area from one to five years, 29% between 11 and 17 years, and 13% have been working as internship teachers for 20 years. As for the choice of profession, the questionnaire provided some options, making it possible to mark more than one answer. Two groups of answers were identified, one concerning the professional choice, based on the possibilities and opportunities of access, with five answers, and another group related to vocation and dream course, with six answers. It is perceived that teaching is desired by many in the choice of graduation, and rethinking about vocation in this aspect is to emphasize that, in a certain way, it reinforces teaching.

Following the questions about the respondents' profiles, the survey inquired about creativity during the Supervised Internship. At first, the investigated were asked to define the term, and only P14 did not present an answer. In most of the answers obtained, creativity was related to originality, observed by the expressions "ability to invent, create, innovate and make it different," mentioned in the description of the excerpts in Chart 1 below:

Chart 1: Definitions of the term creativity, related to creativity, given by respondents.

Expressions	**Teachers' definition**
To invent	It is being creative, **inventive**, and adapting to difficulties, in general (P1); the ability of an individual to imagine, create, produce, or **invent** concepts and unprecedented things (P2); the ability to fabricate, create and **invent** new ways to express and reflect on historical reality autonomously (P12).
To create	It is to be **creative**, inventive, and adapt to difficulties, in general (P1); Creativity is the ability that the individual has to **build** or develop a project in a different **innovative** way and different from the standard way that develops, thus making it exceptional in what it does (P9); As the ability to fable, **create** and invent new ways to express and reflect on historical reality autonomously (P12).

DOI: 10.20396/zet.v31i00.8672191

To innovate	Ability to **innovate**, reflect, tread new paths, have curiosity, autonomy... (P4); Creativity capacity that the individual has to build or develop a project in a different **innovative** way and different from the standard way that is developed, thus making it exceptional in what it does...(P9); Ability to **innovate** and be creative according to the situation (P10); It is the capacity for originality, to think **innovatively**. The ability to do something different from the previously established standard (P3).
To do it differently	**Doing something different from the routine**, getting out of the routine, involves thought, **reflection**, and study (P5); Expression/action/**different act** among the others in some proposed/exposed situation (P6); - Ability **to do something different** (P7); Creativity is a promising and **differentiated characteristic** in the development of a task (P11); As the **ability to go out differently in the face of everyday life** (P13).

Source: Elaborated by the authors.

Respondents were also asked about the main characteristics that best describe a creative student and that describe a creative teacher. Observing the set of answers to the three questions, the expressions "imagine, create, produce, invent, fabricate, innovate, reflect, different" appear in the excerpts more frequently, which is to say that the understanding of the respondents is consistent in terms of their opinions, in which it is emphasized that doing differently, a reflection of thought, such as the ability to get out of everyday life, points to traits of originality.

Originality, related to the presentation of infrequent or unusual responses, is one of the dimensions of creativity (Gontijo & Fonseca, 2020). According to Amaral (2016, p. 23), "[...] refers to the ability to generate new, valuable and unique ideas in response to a question [...]". It can be inferred that creativity is by this dimension for the teachers mentioned above. In Mathematics, originality is related to unusual ways of presenting the solution to a problem or in situations of classification and organization of mathematical objects (Gontijo, 2006).

Another dimension of creativity is flexibility, related to the ability to alter one's thinking or conceive different response categories (Gontijo, 2007). For Dacey & Conklin (2013), flexibility means the number of relevant ideas given by an individual that are qualitatively different. In the teachers' responses, it was possible to evidence expressions that relate to the flexibility of thought, as highlighted in the following excerpts.

> It is to be creative, inventive, and adapt to difficulties in general (P1).
>
> Create the habit of leaving your comfort zone, constantly exposing yourself to new stimuli, and exploring new realities (P2).

In addition to originality and flexibility, two other dimensions are related to creativity, fluency, which refers to the number of ideas that are generated, and elaboration, which refers to the details associated with an idea, i.e., the characteristics that are used to qualify or describe it (Dacey & Conklin, 2013). These aspects were not identified in the teacher educators' responses.

DOI: 10.20396/zet.v31i00.8672191

Two respondents mentioned problem-solving related to creativity, as highlighted below:

> Questioner, curious, seek to solve problems and be observant. Innovative, observant, solve problems, involve students, improve activities (P1);
>
> Through engagement, motivation, and improvement, the teacher can teach and learn differently, with different solutions to usual teaching-learning problems (P12).

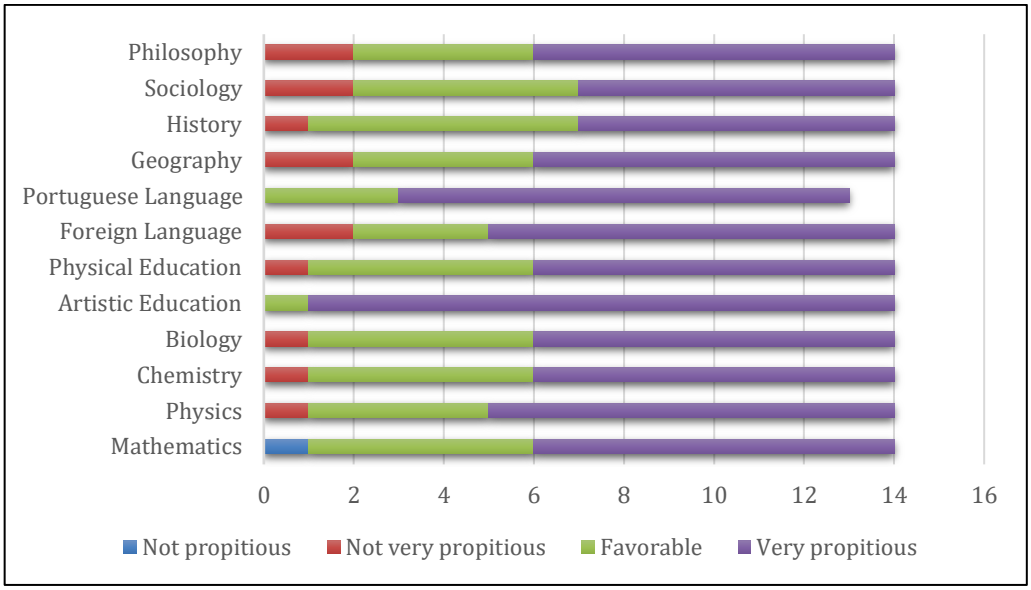
Problem-solving is a strategy to stimulate creativity (Gontijo & Fonseca, 2020). The ability to solve problems is related to the individual's creative capacity because "evidently, problems, whether open or closed, are solved in different ways when it is recognized that there are different ways to do so, as well as the different motivations and the different knowledge that each individual brings with them" (Fonseca & Gontijo, 2021, p. 46). For Alencar & Fleith (2003), a student is intrinsically motivated when his involvement with school activities can be perceived by his interest in performing the task itself. The development of student work with a view to rewards, whether material or social, reveals extrinsic motivation.

Given the obtained answers, it is emphasized that it is essential that the teacher has the characteristics of an engaging, motivating, innovative professional, capable of involving students in the teaching-learning processes, always considering the classroom floor. In this way, the teacher contributes to the development of the creativity of his students.

Following the questionnaire, the teacher educators evaluated their own creativity. In the answers, most say they are creative, and only two teachers (14%) evaluated themselves as "little creative." This feeling may occur because they believe they are not innovative, studious, daring, or even questioning, characteristics mentioned by teachers to define creativity, as shown in Table 1. The option "very creative" was considered by 14%, and only 7% evaluated themselves as "extremely creative." The majority (65%) report being creative because, according to them, this characteristic is also related to originality due to the ability to innovate and create in the classroom and invent and do differently. For Gontijo & Fleith (2010), in addition to originality, creativity in Mathematics should be characterized by fluency, different ideas produced by the same subject, flexibility related to different categories of response, and elaboration related to the large amount of details of an idea.

Regarding the school subjects being conducive for the trainee student to use or show their creativity, Graph 1 shows the responses of the teacher trainers.

DOI: 10.20396/zet.v31i00.8672191



Graph 1: Evaluation of the discipline as conducive for students to use or show their creativity.

Source: Elaborated by the authors

Given these responses, it is noted that teachers consider the subject "Art Education" most conducive for students to use or show their creativity. As for Mathematics, most respondents recognize the discipline's potential for creativity, classifying it as conducive or very conducive. For Valdés (2012), it is impossible to develop students' Mathematics thinking in problem-solving on the margins of creativity since mathematical thinking requires high doses of creativity. It is noteworthy that even though most teacher educators have this perception because "Mathematics," which refers to the object of study, was the only discipline classified as "not being conducive to creativity."This drew attention, given that Mathematics is based on rules, formulas, and definitions; in some moments, in the face of prior planning, it is possible to use differentiated methodologies that stimulate mathematical creativity. "In classroom dynamics, the teaching-learning process that has the development of creative potential as one of its objectives needs to question mechanized attitudes toward Mathematics knowledge" (Gontijo *et al*. 2019, p. 59).

The various Mathematics manipulations by students can express differentiated results, developing their creative potential. With the mediation of the teacher in this process, the student will be stimulated in the construction of reasoning, which can lead him to venture into the world of Mathematics, providing more excellent explorations and showing new situations so that this discipline is seen with a sensitive look by those involved (teachers and students), showing that it can also be conducive to creativity. In addition, "it is important to reformulate the time and school spaces in which learning takes place, making it possible to reinvent the roles assigned to the teacher and the student" (Gontijo *et al*., 2019, p. 59).

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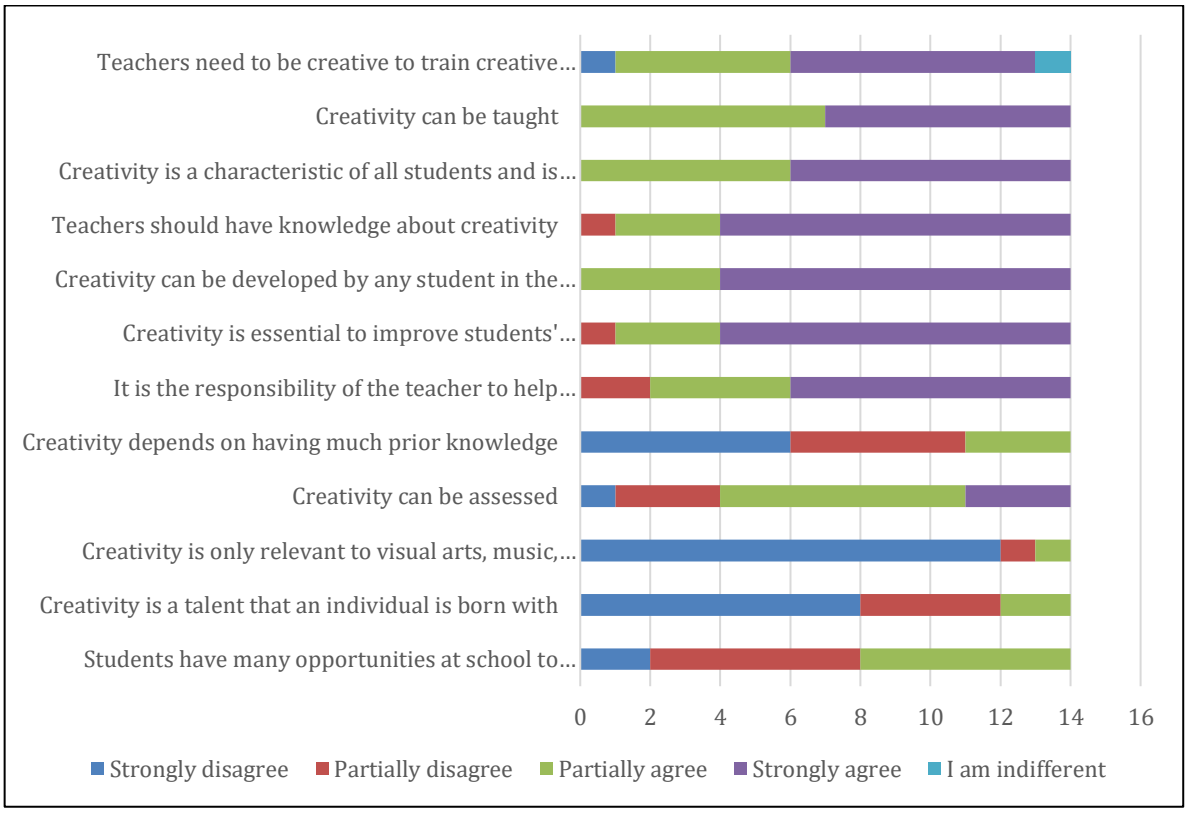
It is worth mentioning that in this analysis, it was also observed that five teacher educators rated all disciplines as very conducive to creativity, and one teacher answered that all are conducive to creativity.

Another question on the form asked the teacher educators about their agreement with the statements on creativity. Graph 2 below shows these results.



Graph 2: Level of agreement - creativity.

Source: Elaborated by the authors.

According to the given statements, only one respondent agrees that "it is indifferent that there is a need for the teacher to be creative to form creative students (P4)". The majority (more than 50% of the respondents) agree that teachers must be creative and have knowledge about creativity, that creativity can be taught, that creativity is a characteristic of all students and not a rare phenomenon, that any student can develop it, that it promotes learning, and that it can also be assessed, and that it is the teacher's responsibility to help students promote their creativity. As stated by Gontijo *et al*. (2019, p. 101) when they emphasize "the importance of encouraging the construction of a classroom climate conducive to creativity in Mathematics, [...] so that students have a productive life and a pleasant journey in the conceptual understanding of Mathematics."

Regarding the factors that they consider inhibitors to the promotion of student creativity, it is perceived that the gaps in the training process can be a relevant inhibiting

DOI: 10.20396/zet.v31i00.8672191

factor, as well as the lack of time for teaching activities due to excessive workload, and there is still evidence of teacher accommodation and intolerance to innovative proposals.

As for the expression of creativity being part of the requirements evaluated in the activities and work carried out during the Supervised Internship, 60% said it was part of it, and 40% said it was not. For six respondents, this evaluation question is informed by the course or teaching plan of the discipline. Two teachers indicated the evaluation instruments, as shown in the following excerpts, but did not inform how students are aware of this criterion.

> Theoretical readings on the influence of creativity in the teaching-learning process, project development, creation of laboratory materials, experimentation classes, etc. (P3).
>
> Through a space where they present mini-classes (P11).

One teacher educator explained that it is possible to be creative, using examples, as highlighted below, but also did not describe how their students know creativity is a criterion to be evaluated.

> As a supervisor, I realized the need to show my experience as a teacher, and there is a creative possibility to develop something new and attractive like fables [...] (P10).

The variety of teachers' work, according to Gontijo *et al*. (2019, p. 102), in the planning of activities and works "that aim to stimulate the development of creative expression in the field of Mathematics in the various age groups" are of fundamental importance in stimulating creativity.

When asked how prepared teachers feel to evaluate students' creativity in the development of a Supervised Internship, half of the teachers say they are well prepared, and the other half are not very prepared. To Gontijo *et al*. (2019, p. 80), "When looking for ways to assess creativity, we are interested in understanding the dynamics of the creative process and, based on the results found, encouraging students to self-reflect on their own creative abilities." Also, for the authors, this reflection can lead to a change in behavior.

This process involves a sensitive look when referring to the search for the evaluation of the creativity of the students in the perspective of the unfolding of the Supervised Internship in the undergraduate course in Mathematics because the supervising teacher assumes the role of mediator of the stimulus to creativity, promoting interactive actions that provide creative processes. For Gontijo (2007), developing creative skills and attitudes in the educational process is essential. For this, the dimensions of creativity, fluency, flexibility, originality, imagination, elaboration of ideas, and inventiveness in educational objectives should be included.

Considerations

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The research sought to present the researchers' analysis of the teaching perceptions of supervising teachers of Supervised Internship in Mathematics Degree courses. Ascertaining these perceptions through an online questionnaire made it possible to identify the most relevant responses of the respondents. The teacher educators understand the meaning of the term creativity in the teaching-learning process, especially regarding the dimensions of originality and flexibility, and most of them recognize themselves as creative teachers. Most participants considered mathematics favorable to the development of creativity; however, it was the only discipline cited as not conducive to creativity. The teaching focused on rules and formulas, with the valorization of memorization and reproduction of concepts, does not contribute significantly to developing creative potential. It is necessary to seek teaching-learning methodologies that favor creativity and, as highlighted by Gontijo *et al*. (2019), an adequate curriculum capable of developing creative skills such as fluency, flexibility, and originality of thought.

In light of Gontijo *et al*. (2019), it was also possible to conclude that the teacher educators recognize the creative process in developing activities carried out during the Supervised Internship. For these teachers and supervisors of the Internship, there are possibilities of stimulating creativity when the classroom environment favors the development of activities centered on the objects of knowledge and the trainees.

Analyzing the data collected, the researchers realized the relevance of teacher-student relationships, a decisive factor in the teaching-learning process. The mediation of processes so that the student becomes curious, observant, innovative, questioning, and capable of seeking solutions to problems, as mentioned in previous statements, can expand the dimensions of creativity about fluency, flexibility, and originality of thought, as well as stimulating imagination and the elaboration of new ideas, as emphasized by Gontijo *et al*. (2019). The teaching action must be improved with engaging activities full of motivation so that teaching and learning occur differently from the usual ones in the teaching-learning process, always considering the context of the classroom floor during the stages of the Supervised Internship.

It is also emphasized that creative production, in any area of knowledge, must be understood and stimulated from a view that transcends the individual characteristics of each person, as highlighted by Gontijo & Fleith (2010), and must integrate with society and symbolic context generated in cultural opportunities.

It can be concluded that the Supervised Internship in Mathematics degree courses are a phase of fundamental importance in the teacher training process and can provide an environment of elevation to students' creative potential. It is a stage in which theory is consolidated with practice and favors moments of exchange of experiences, interactions between the student interns and the student at the school, provides the construction of

DOI: 10.20396/zet.v31i00.8672191

pedagogical didactic resources in a creative way, and the implementation of lesson plans that differ from teaching based on memorization and reproduction of concepts and formulas.

References

Alencar E. M. L. S., & Fleith D. S. (2003). Contribuições Teóricas Recentes ao Estudo da Criatividade. *Psicologia*: Teoria e Pesquisa, 19(1), 1-8.

Amabile, T. M. (1999). Como (não) matar a criatividade. *HSM Management*, 2(12), 111-6.

Amaral, N. A. R. (2016). *A criatividade matemática no contexto de uma competição de resolução de problemas*. Tese de doutorado em Educação. Lisboa: Universidade de Lisboa, Instituto de Educação.

Araújo Neto, L. da C. (2022). *Concepções e práticas acerca da criatividade em Matemática*: movimentos na formação de um grupo de estudantes de licenciatura em Matemática. Tese de doutorado em Educação. Brasília: Universidade de Brasília.

Bardin, L. (2011). *Análise de conteúdo.* São Paulo: Edições 70.

Brasileiro, A. M. M. (2016). *Manual de produção de textos acadêmicos e científicos*. São Paulo: Atlas.

Beghetto, R. A. (2017). Creativity in Teaching. In: J. C. Kaufman, V. P. Glaveanu & J. Baer (Eds.), *The Cambridge Handbook of Creativity Across Domains* (pp.549-564). Cambridge: Cambridge University Press.

Conselho Nacional de Educação (CNE). (2019). *Parecer CNE/CP nº 22, de 7 de novembro de 2019.* Institui Diretrizes Curriculares Nacionais para a Formação Inicial de Professores para a Educação Básica e Base Nacional Comum para a Formação Inicial de Professores da Educação Básica (BNC-Formação). Ministério da Educação e Cultura, Brasília.

Dacey, J., & Conklin, W. (2013). *Creativity and the standards*. Huntington Beach: Shell Education.

Fleith, D. S. (2010). Desenvolvimento da criatividade na educação fundamental: teoria, pesquisa e prática. In S. M. Wechsler & V. L. T. Souza (Orgs.), *Criatividade e aprendizagem*: caminhos e descobertas em perspectiva internacional (pp. 33-52). São Paulo: Loyola.

Fonseca, M. G., & Gontijo, C. H. (2021). *Estimulando a criatividade, motivação e desempenho em Matemática*: uma proposta para a sala de aula. Curitiba: Editora CRV.

Gatti, B. A. (2017). Formação de professores, complexidade e trabalho docente. *Rev. Diálogo Educação*, 17(53), 721-737. https://doi.org/10.7213/1981-416X.17.053.AO01

Gadotti, M. (2002). A boniteza de um sonho: aprender e ensinar com sentido. *Abceducatio*, 3(17), 30-33.

DOI: 10.20396/zet.v31i00.8672191

Gontijo, C. H. (2006). Resolução e Formulação de Problemas: caminhos para o desenvolvimento da criatividade em Matemática. *Anais do SIPEMAT* (pp. 1-11). Recife: Programa de Pós-Graduação em Educação-Centro de Educação, Universidade Federal de Pernambuco.

Gontijo, C. H. (2007). *Relações entre criatividade, criatividade em matemática e motivação em matemática de alunos do ensino médio*. Tese de Doutorado em Psicologia. Brasília: Instituto de Psicologia, Universidade de Brasília.

Gontijo, C. H., Carvalho, A. T. de, Fonseca, M. G. & Farias, M. P. de. (2019). *Criatividade em Matemática*: conceitos, metodologias e avaliação. Brasília: Editora Universidade de Brasília.

Gontijo, C. H., & Fleith, D. S. (2010). Avaliação da Criatividade em Matemática. In E. M. L. S. Alencar, M. F. Bruno-Faria & D. S. Fleith (Orgs.), *Medidas de criatividade:* teoria e prática (pp. 91-111). Porto Alegre: Artmed.

Gontijo, C. H., & Fonseca, M. G. (2020). O lugar do pensamento crítico e criativo na formação de professores que ensinam matemática. *Revista Brasileira de Ensino de Ciências e Matemática*, 3(3),732-747. https://doi.org/10.5335/rbecm.v3i3.11834

Gontijo, C. H., & Fonseca, M. G. (2022). Oficinas de pensamento crítico e criativo na formação docente em matemática: uma experiência com estudantes do Pibid. *Revista Paradigma*, 43(1), 318-341. 10.37618/PARADIGMA.1011-2251.2022.p318-341.id1174

Leal, M. R., & Gontijo, C. H. (2020). Estágio supervisionado em Matemática: contribuições do campo da criatividade em matemática para a formação docente. In A. Kochhann (Org.), *Formação docente e trabalho pedagógico*: debates fecundos (pp. 121-140). Goiânia: Editora Scotti.

Leal, M. R., Gontijo, C. H., & Formiga Sobrinho, A. B. (2020). A criatividade no ensino e na aprendizagem de geometria plana: um estudo com pedagogos. In A. Kochhann (Org.), *Educação*: diálogos avançados e caminhos traçados (pp. 121-138). Goiânia: Editora Scotti.

Leal, M. R., Santos, C. R. dos, & Gontijo, C. H. (2022). Oficina de Pensamento Crítico e Criativo em Matemática com Estudantes do 9º Ano do Ensino Fundamental Envolvendo Poliedros. *Ensino Da Matemática Em Debate*, 9(3), 51-70. https://doi.org/10.23925/2358-4122.2022v9i358813

Lubart, T. (2007). *Psicologia da Criatividade*. São Paulo: Artmed.

Oliveira, A. F. de, Fontes, L. S., & Rosa, D. E. G. (2021). Temas e problemas nas dissertações do PPGECM/UFG 2009-2010. *Revista Profissão Docente*, 21(46), 1-15. https://doi.org/10.31496/rpd.v21i46.1399

Tardif, M. (2000). Saberes profissionais dos professores e conhecimentos universitários: elementos para uma epistemologia da prática profissional dos professores e suas consequências em relação à formação para o magistério. *Revista Brasileira de Educação*, (13), 05-24. Recuperado em 12 de agosto de 2023, de http://educa.fcc.org.br/scielo.php?script=sci_arttext&pid=S1413-24782000000100002&lng=pt&tlng=pt.

DOI: 10.20396/zet.v31i00.8672191

Tardif, M. (2002). *Saberes docentes e formação profissional*. Petrópolis, RJ: Vozes.

Tardif, M. (2011). *Saberes docentes e formação profissional* (12ª ed.). Petrópolis, RJ: Vozes.

Pimenta, S. G., & Lima, M. S. L. (2010). *Estágio e docência*. 5. ed. São Paulo: Cortez.

Saviani, D. (1994). O trabalho como princípio educativo frente às novas tecnologias. In: Ferretti, C. J., Zibas, D. M. L., Madeira, F. R., & Franco M. L. P. B. (Orgs.), *Novas tecnologias, trabalho e educação*: um debate multidisciplinar (pp.151-169). Petrópolis, RJ: Vozes.

Scomparim, V. (2004). A construção de conceitos e as habilidades matemáticas: Solucionando problemas. *Anais do I Encontro de Escolas da Rede Companhia da Escola*. Available in: http://www.ciadaescola.com.br/eventos/encontro2004/arquivos/oficina%20de%20Matem%C3%A1tica%201a%20a%204a1.pdf.

Silva, K. A. C. P. C. da. (2008). *Professores com formação Stricto sensu e o desenvolvimento da pesquisa na educação básica da rede pública de Goiânia*. Tese de doutorado em Ciências Humanas. Goiânia: Universidade Federal de Goiás.

Valdés, J. E. N. (2012). Sobre a história da matemática: um enfoque baseado nos problemas matemáticos. In: Danyluk, O. S. (Org). *História da Educação Matemática*: escrita e reescrita de histórias (pp. 109-146). Porto Alegre: Sulina.