

Actions for the preparation, with the use of technologies, of mathematically advanced students

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ABSTRACTS

This article shows the results of a research on the preparation, with the use of ICT, of mathematically advanced students. Its objective is to socialize actions for preparation, based on theoretical elements of mathematics didactics and its principles. The main results achieved are in the progress of students in problem solving, knowledge management, motivation towards research, study of sciences and in the protagonism materialized within the teaching-learning process of mathematics in their group, school and community; and the achievement of relevant results in mathematics olympiads.

Keywords: Use of technologies; Learners; Mathematical talent.

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Introduction

The use of ICT is a reality that we cannot change; making it present efficiently in the preparation process of the mathematically talented student is a good thing for teaching

and learning, which makes possible a more effective, differentiated and intentional work in the development of the creative levels of the talented.

The authors of this article consider that the use of technologies is an effective tool for the preparation of talented students and that psycho-pedagogical and didactic orientation is required to achieve the maximum use of the benefits provided by ICT in the development of their abilities; hence, the importance of guiding teachers on how and what actions can be carried out to prepare, with the use of technological means, the mathematically talented student.

This justifies the need to intervene from science in How to prepare, with the use of technologies (ICT), the student with mathematical talent in the Pre-university Vocational Institute of Exact Sciences of Guantánamo (IPVCE)? In this sense, it was possible to design a set of actions to prepare, with the use of technologies, the mathematically advanced student. The objective of this work is to socialize some actions for the preparation of mathematically talented students with the use of technologies (ICT).

Development

How do we know that we are dealing with a mathematically advanced learner?

Regarding the question: what is considered talent? It is recognized that there is still no answer that is accepted without ambiguity. Trying to define talent is not an easy task for those who research the subject. Talent means natural aptitude to do something, understanding or intelligence. To designate talented subjects in the literature different terms are used: gifted, over-gifted, gifted, gifted, best gifted, precocious, genius, prodigy, children of high abilities, intellectually well gifted, super-normal, subject of high capacities, super-talent, excellence, exceptional, fast learner, superior, brilliant, etc. The term talent is usually applied to specialized aptitude in certain areas of activity or in a specific field; it can also refer to that portion of a person's capacity that serves specifically to internalize a concept, is formed by a set of natural abilities, emerges from school and family.

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Therefore, the authors of this paper share the term talent, and from the analysis of several concepts and definitions, it is considered that:

It is a psychological configuration of the personality of cognitive and affective nature that dynamically integrates the general and specific abilities of the individual with a strong motivational energy that manifests itself in the extra and interpersonal levels expressing a high level of creative performance in the area(s) of interest with a dialectical materialistic approach to human psychic development. It is the successful combination of above-average abilities, and in it contemplates creativity and commitment to the task (Renzulli and Ries, 1984, p.40).

This definition takes into account not only the innate abilities possessed by the individual, but also values the motivations and the influence exerted by the social environment on the development of a talented person.

In the first decade (2000-2010), Drs. Raquel Lorenzo García and Marta Martínez Llantara (2003) stand out in Cuba with their contributions to the development of talent and express that the questions under debate can follow in the following aspects.

1. Should attention to talent must be: elitist or democratic?
2. What is the appropriate pathway for talent development: intracurricular or extracurricular?
3. What form should be used in talent preparation: compacted, acceleration, enrichment or segregation?

We assume the criterion of applying to the research the interrelation between them, both in the first and second. In case three, the relationship between the acceleration and enrichment forms is more feasible, although it can be called a combined form. It is important to take into account at what moment the research is developed, to whom it is directed, in what environment we are applying it, what is available for its

implementation, the psychosocial conditions of the learner, the personal needs and the purpose of the research.

The authors of this work consider that the system of actions in the teaching-learning model for talented students should be based on curiosity, imagination, the relationship of ideas, the challenge to skills and intelligence and to superior processes, in interactive projects that motivate their interests, in praxis, etc.

Knowing that compacting is grouping knowledge and is a flexible instructional technique so that they skip what they already know and replace it with challenging content. It is feasible to observe that the application of the compacted and combined form is more favorable for the attention within the diversity and it is taken into consideration the conception of the three rings of Joseph Renzulli that states that talent is the result of the successful interaction of three components: intelligence or above-average skills, creativity and commitment to the task.

It is assumed that the preparation of the mathematically talented student, according to Pérez (2014), is understood as the process of advanced education through which students achieve capabilities and disposition to access the necessary knowledge to successfully face problems of a high degree of difficulty with the resources of elementary mathematics, develop convictions, attitudes and aptitudes that allow them to be inserted in the social, productive and creative life; it is fundamental in the transforming work of society.

In our research we propose to prepare the student with mathematical talent and that is why it is good to see beforehand. What is mathematical talent?

According to Kruteskii (1976) mathematical talent is a simple talent, because it is directly linked to obtaining excellent academic results thanks to the use of unique mathematical skills, and it is characterized by the ability to receive mathematical content and grasp the formal structure of the problem, ability to think in mathematical symbols, to generalize, flexibility of mental processes, economy and rationality of solutions, mathematical memory and mathematical projection of the intellect.

After defining talent and following the theories of Robert Mills Gagné (1996). Mathematical talent has a series of perspectives that differ from each other according to the factor that causes the obtaining and development of such talent. These orientations are:

1) **Innate-oriented mathematical talent:** intelligence is an inherited unitary ability that does not have to be accompanied by good academic results.

2) **Achievement-oriented mathematical talent:** the existence of a level of capacity or ability is advocated as a condition for high performance.

3) **Mathematical talent oriented to the cognitive model:** the need for the existence of thought processes, memory and other mathematical skills that identify and characterize both the individual and the talent.

4) **Mathematical talent oriented to the systematic model:** different elements that may influence the learner's talent, such as family, school, values and beliefs, are integrated.

Within this classification, Benavides (2008) integrates another section, called "**mathematical talent oriented to the interaction between the innate and the environment**", which highlights the different relationships established between the unitary and specific ability of the learner and his or her closest context.

- On the other hand, for authors such as Gutiérrez and Jaime (2013) the characteristics that encompass talent in students for the area of mathematics are reflected in:
- Problem formulation and new activities in a natural way, creative and flexible thinking to approach mathematical problems, ability to connect between proposed problems and mathematical structures, accelerated learning, critical and persevering personality, production of original ideas, capacity for generalization - abstraction and enthusiasm for mathematical work.

In relation to the traits that characterize mathematically talented students, according to Marjoram and Nelson (1988), they point out that:

They are learners with a disposition to like numbers and number games. They enjoy counting so much that they may count almost obsessively. From a very early age, these children may show a fascination with shapes, puzzles, spatial puzzles, drawings and designs, always looking for arithmetical ideas, acquiring a precocious concept of the cardinality of numbers and a taste for rigorous thinking. (p. 220-221)

In any case and on the basis of these ideas and research, it is believed necessary that the use of technologies (ICT) in an appropriate manner, contribute to this purpose of nurturing such capabilities of talents in the field of mathematics.

Why the preparation, with the use of ICT, of mathematical talents?

ICT is the most up-to-date means and resources that we have today and that with its existence has changed, changes and will surely change the increasingly relevant

practices of science and its teaching. It is the most significant means of the last 40 years, on which the human being has relied to predict, test, test, verify, corroborate and build models for the analysis, development and existence of mankind.

The presence of ICT in all areas of life in society makes it an indispensable resource to be used for the improvement of human knowledge, without its presence, our generations will not be able to solve the great problems that challenge humanity and the creativity of human beings. ICTs are increasingly gaining spaces in the educational field, at the same time it is important to recognize the role they have played for Latin American countries in developing relevant digital educational content (RELPE, 2015).

The advantages provided by ICT in the teaching-learning process due to its interactivity and dynamism, make it an effective tool in the construction of knowledge and knowledge, it is considered the use of technological tools, effective means for the preparation of the learner with mathematical talent, since these allow the development of spatial ability, independence, logic, intuition, good memory, optimization of methodologies, reasoning skills, collaboration, communication, superior ability to handle, translate and represent information in an interactive way for problem solving and as Castellanos (2015) said, the advantages of ICTs in generating interest in students, visualizing concepts in an enjoyable way, motivating problem solving in daily life, fostering creativity, promoting collaborative work, making education accessible to the entire population. (p.6)

For the above mentioned, it is considered that applying a set of actions for the preparation of mathematically talented students with the use of ICT constitutes a pertinence in the attention to talent.

Proposal of actions for the attention of talented students.

Next, and taking into account what was previously analyzed, the actions aimed at preparing the mathematically talented student with the use of technology, which were validated in the pedagogical practice, are presented. The definition of Bermúdez and Pérez (2004) is assumed when saying that an action is, "the process subordinated to a representation of the result to be achieved, that is, to a consciously stated goal or objective" (p.66), hence it is considered to be valid and accessible in relation to the objective of this research.

In the teaching-learning process of mathematics, it is possible to structure the class in such a way as to attend to the individual differences of the students and to pay attention outside the framework of the class. In this way, the possibility of conceiving two forms

of differentiation in teaching is inferred: one inside the class (internal or didactic differentiation) and another outside it (external differentiation). (Ballester et al., 2018, p.165).

The actions proposed with the use of ICT for the preparation of the mathematically talented learner have the following structure: title, objective and general guidelines. In its conception, two essential elements were taken into account, the role of the mathematics trainer (the teacher) who leads the process and the role of the one who participates in its realization (the learner(s)). In the proposal there are actions that are carried out in the classroom and others that would be carried out outside that context.

Some of the actions designed and applied in the pedagogical practice are shown below.

Action 1:

Title: Updating of the psycho-pedagogical and social diagnosis of the mathematically talented learner with the use of ICT and using (online tests, app programs, interactive knowledge diagnostics).

Objective: To know the initial state of the learner's preparation, as well as their weaknesses and potentialities, for the implementation of the use of technologies in the preparation, taking into account individual differences.

General guidelines

Consult existing psycho-pedagogical and social diagnostics, as well as online tests, app programs and interactive knowledge diagnostics in order to select the appropriate questions related to what you want to know about the learner. According to the theoretical information analyzed by the learner's teacher, specify the strategies and techniques to be applied with the use of technologies. It is suggested to make a table that reflects the analysis of the diagnosis and that this is done constantly, in each new activity or action, allowing to update the diagnosis of the potentialities, to guide towards its strengthening.

Action 2:

Title: Learning online and interactively. Web search to share knowledge, procedures, strategies and techniques to solve mathematical problems.

Objective: Interact with apps, apk or online platforms where the learner is able to search for contents of proposed topics and then socialize the knowledge, procedure, strategies and techniques to solve mathematical problems of a high degree of difficulty, so that knowledge management, synthesis, creativity, communication and interactive

skills are strengthened through the use of technology and online search engines and interaction with the platforms.

General guidelines

The APPs and platforms have interactive environments, the learner is guided by the teacher through a guide for working with these resources, the learner must draw conclusions and take notes of what he learns and what he does not know, turning it into a curiosity and knowledge that he must then transfer to other learners, here he takes advantage to encourage research skills and manage knowledge making use of the computer technology itself, as well as, regulate his learning by receiving the answer to the problem, which he does instantaneously making it possible to assume a responsible attitude in metacognition.

For the realization of this action, the students will have to: understand the action and the orientations for the realization of the activity and the time available to fulfill the task, to then be able to value the content object of study, so that they can elaborate reports of papers to transmit experiences.

The control and evaluation in many cases will be supported in the selected programs or resources, but the elaboration of a paper and an infographic will be forms of evaluation, the learner can prepare a digital presentation for the exposition of the fundamental ideas.

Action 3:

Title: Modeling of a radio program. Math Talent live.

Objective: To investigate, manage, identify, show and communicate historical elements, curiosities, contests and current events based on a selected topic and where the research using ICT is led by mathematically talented students.

General guidelines

Search in a round table on the web everything related to the selected topic, making each student or group responsible for searching the internet for specific topics on history (precursors and contributions), curiosities, questions of mental agility and current events of the content; then in a meeting with the members of the group and the teacher it is decided what will be taken to the program, the script of the program is decided, the time to be devoted to each topic and where it will appear in the radio program. After the decision is made, the simulation of the program is activated in 20 minutes and is taken to the school radio base to communicate and socialize about the researched content.

This activity is a mathematical celebration in the school. Taking into account that this realization must be led and directed by the students and can be disseminated during

morning, study or break time, in discussions and in other spaces, such as radio stations and telecenters of the territory. In order to carry out this activity, students must know how to search for information on the web.

The control and evaluation of this activity will be done individually and collectively; promoting that there is protagonism and development from individual responsibilities, but also where collaboration, cooperation and collectivism are values to be impregnated in our talents.

Action 4:

Title: Solving problems with mathematical assistants.

Objective: To relate magnitudes or quantities of magnitudes, graphs and properties of plane figures, space and functions, as well as to graph functions to transfer properties from one to another, so that they develop mathematical skills from the use of the mathematical assistant GeoGebra. Cabri, matlab or others.

General guidelines

Elaborate a guide that includes the systematization of the selected functions and specify which of them can be modeled and solved in an advantageous and safe way using the mathematical assistant GeoGebra. Which of the geometric problems can be expressed, graphed, verified by means of the assistants?

For the realization of this action the students should: first analyze and solve with pencil and paper the exercises and problems proposed in the guide; analyze the exercises that can also be solved with the help of the assistants, the time they have for it, as well as the way in which the activity they perform will be controlled and elaborate a presentation to socialize the problems solved with GeoGebra.

Action 5:

Title: Use of video, television, projectors, smart boards and radio technologies to support the teacher's classroom.

Objective: To prepare the mathematically talented student using video, television, projectors, smart boards and radio, with the purpose of attending to individual differences in talent, in order to increase motivation for study, interactivity and collaborative learning of mathematics.

General guidelines

This activity is aimed at supporting classes using films, audiovisuals, digital presentations, infographics and television and radio programs, as well as the use of

projectors to motivate and support the preparation of the student with mathematical talent, with a previous elaboration by the teacher of observation guides.

The radio and television billboard will be managed in advance, in order to take advantage of the spaces that promote the development of talents. Through technology, we get in direct contact with the program producers and we set up a listening and participation guide. For the realization of this action, the students will have to: manage the billboard; they must know how to abstract, be participative and collaborative contributing to these values of their personality.

During the preparation process, it is possible to evaluate using performance evaluations, although it is feasible to evaluate with extra-class work where the family is involved.

Note: this action involves the family in watching a movie and analyzing an infographic or a radio or television program from home.

Action 6:

Topic: Mathematical Messaging (Use of whatsapp, telegram, facebook groups)

Objective: To address the needs of the mathematically talented learner, deep knowledge mastery, skill development, socialization, collaboration and interaction of learners in practice through online and offline messaging.

General guidelines

Messaging is an interactive and collaborative environment. The trainer must ensure that it is possible to interact with all members of the group and that everyone has the communication skills for the groups made. For the realization of this action the students should: understand the action and the orientations to be considered for the realization of the activity and the time available to accomplish the task, in order to be able to evaluate the content under study.

In this action, the learner is guided by the teacher through the completion of tasks and challenges, which he/she must complete in a given time, the speed of the answers will be taken into account. The learner must respond through the private chat or interact with the teacher, with the clarification of any doubts if they exist.

The trainer in this action in the telegram group will also propose online questionnaires, which are tests against the clock, the learner must draw conclusions and take notes of what he learns and what he does not know, turning it into new demands, here the learner receives the answers instantly, making it possible to regulate cognition.

The control and evaluation will be reflected in a table that will leave the places of each one after finishing the tasks, although in an online way it will compete with online evaluators that will reflect the result after finishing the challenges.

Action 7:

Theme: Mathematics in life (contests, company visits, university lectures).

Objective: To elaborate presentations with the use of technological tools where the student relates the mathematical concepts learned in school with practical life, the productive processes of the companies and the scientific life of our science professionals.

The purpose of each task is for each student to recognize how the mathematics they learn at school is present in the productive processes of companies and in daily life, as well as to learn from the experience and knowledge of professionals and scientists dedicated to the transforming works of society.

The students will have to make exhibitions of the work done on painting, photographs and preparation of presentations, infographics, documentaries, audios and audiovisuals, through the use of ICT. The call will be extended to the rest of the students of the center. In order to carry out this action, students must: know the objectives to be evaluated in the contest, as well as the date of completion.

Note: A talented educator, disseminates and guides the call in the morning.

Action 8:

Theme: Collaboration and preparation of a mathematical laboratory.

Objective: To set up a mathematical laboratory, where the student is able to observe, analyze, interact, listen and collaborate with the mathematical contents learned in the classroom.

The purpose of the mathematics laboratory is to provide a mathematical repository space for materials such as: video classes, multimedia, interactive app programs, short films, movies, documentaries, games, media that allow the student to systematize his/her knowledge, so that he/she becomes more interactive and protagonist of his/her own learning. It is a space where motivation and talent move the senses, because the proposed examples and materials show the application of the content they study in the classroom environment.

It is suggested that the student contributes to the laboratory with full knowledge of the objectives of confection. The exchange of knowledge through workshops and comments on what has been done in the laboratory is suggested. It is necessary that the learner

gives his/her criteria of what he/she would like to do in future tasks. It is important to apply different techniques to verify the level of acceptance of the young people in this school environment, as well as to evaluate the group activity by the individual protagonism and the collaboration among all.

Action 9:

Theme: Family workshop for collaboration with the education, teaching and learning of the students with the use of ICT (didactic games, exchanges, making teaching aids).

Objective: Collaboration of the family with the teaching and learning of their children, making them protagonists of the process, where they contribute ideas, provide support and direct help to observe, analyze, interact and collaborate with the creation of games, materials and teaching aids.

The family workshop has the purpose of consolidating the school-family relationship, as a support to conduct the learning process of the student. It provides the family with practical ways and methods that make it possible to contribute to the preparation of their children. It contributes to strengthen the bond between parent and child and to the investigative collaboration, by means of the search in Internet or the use of the computer media, from home.

Parents are the teacher's collaborators to promote the collective exchange and serve as evaluators and controllers of the process. It is suggested to have conversations with the family, where it is explained how they will be protagonists of the collaboration and learning of their children; this will be the moment to obtain the support of the parents to successfully conduct the work with the Internet and with the audiovisual media at home. As part of the evaluation, it is important that the parent offers his/her opinion on the importance of the action developed and proposes other dynamics that can be carried out in the family with the technologies that will support the systematization at home of the contents shown in these activities and the classroom.

Conclusions

The implementation of a set of actions taking into account the use of ICT in the preparation of mathematically talented students, reflects more committed motivated and prepared students for participation in national and international mathematics events. The

wide collaborative movement of the students and the family, the excellent works developed by the students, the investigative spirit, the commitment for the learning of the mathematical content, the interactivity in the management of their knowledge, the motivation for the science careers propitiated by the preparation, with the use of the technologies; are results that endorse that the actions developed taking into account the ICT, represent reasons for which we can affirm that the proposal made in this plan of actions are feasible for the preparation of the student with talent with the use of the technologies.