

Use of the Game “Mathematical Rods” in the Teaching and Learning of Basic Education in Brazil

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Abstract: As imperceptible as it is, mathematics is fundamental and is present on several occasions in our daily lives, but among 65 countries Brazil still ranks 53rd in education. The lack of investment in primary education has affected students learning since the early years. From this perspective, this paper proposed to verify teaching/learning in mathematics discipline for elementary school students through playful games, a fun method that can be used at various times and aims to review and fix the content in a practical way and interactive. For this, a game named “Mathematical rods” was elaborated a renewal of the hobby “Cat rods”. The operations present in the game are simple, focused on basic mathematics and can still be adapted depending on the level of knowledge of the students. The game was applied to three groups of six 9th grade students of the State College Professor Izidoro Luiz Ceravolo, located in the city of Apucarana, Paraná in Brazil. Therefore, in addition to dynamic and creative, we conclude that this educational interpretation is easy and accessible, a tool that can be used in any public institution, contributing to the learning process of students.

Keywords: Games, Learning, Teaching, Mathematics

Introduction

As we already know mathematics is present in our daily lives, it is everywhere and at the most different moments of our lives, as imperceptible as it is, mathematics is in the most common acts of our daily life, in the

most basic accounts as the counting of time, something that is currently so necessary and discussed. Thus, it is essential to highlight that a good teaching of mathematics is indispensable for a learning more efficient and meaningful, and it is extremely important that everyone learns the content and fix at least the basics while they are in school, even considering that mathematics is one of the subjects that, in general, students present greater difficulty. This fact can be observed in Brazil since the country ranks 53rd in education, however Nacarato (2005) states that the use of differentiated means in the teaching of mathematics began in Brazil around 1920, where recreational activities were already used with apprentices, this is due to the lack of investments in basic education that affects learning students since the early years, being reinforced by Kamii and Devries (1991), young children acquire better knowledge through games than with traditional lessons and exercises.

Thus, the game used as an educational and learning tool can be seen as a strategy that is often ignored by schools that maintains a traditional role, as if this playful activity does not importance and functionality in the learning process (PIAGET, 1998), being confirmed by Santana(2008), the use of games can contribute to the learning, as well as making the process fun and interesting. Contrary to this perspective, several authors have already proven the effectiveness of the use of games and play in the classroom as Falkembach (2006) which says such activities encourage the logic and stimulate the creativity of the participants. According to the analyses of Isidoro and Almeida (2003), in addition to the student creating techniques and strategies through games, it will also train social interaction and the diverse ways of dealing with the social conflicts that arise during execution of this activity, and add that it is among games with similar pairs, whether in the social or cognitive condition, that development has its maximum expression. Similarly Gardner(1961, p.187), a recreational mathematician also states that, “you can say that mathematical games or “recreational mathematics” are mathematical -no matter what kind- loaded with a strong component playful”, are excellent tools that used in the correct way aim in a positive way to complement the good training of the student.

Kishimoto (1995) argues that the game always happens in a certain space and time, and that they contain a sequence of its own, adds on the various possibilities that the word game brings us, and the many questions that arise in the intertwining of the game and learning. For the author, the game is seen in three different senses: first as “the result of a linguistic system that works within a social context” (p.48), which explains that the game is not something simple, that to understand it is necessary to take into account the language that is used as an instrument of a social group, “as a social fact, the game takes on the image, the meaning that each society attributes to it. This is the aspect that shows us why depending on the place and the season, games take on different meanings”, therefore [...] “each social context builds a game image according to its values and way of life, which language” (p.48). The second meaning of the game cited by the author concerns the rules, a sequential structure which at the same time differentiates on game from the other also allows for the trickiness. The last sense is the materialized game, seen as an object.

Based on these ideas, the game presented in this project brings all these meanings, and focuses on adolescents, students who attend teaching in public schools. Thus, the work was elaborated through a literature review and

has as main objective to work with the use of playful games in teaching math learning, as well as, present a game created to train some mathematical skills, directed and applied for three groups of six 9th grade students of the State College Professor Izidoro Luiz Ceravolo, located in the city of Apucarana/PR in Brazil, the operations present in the game are simple, focused on basic mathematics and can still be adapted depending on the level of knowledge of students. The aim is to demonstrate that it is possible to have an exchange of knowledge between students and teachers on a more effective and at the same time pleasant for both of them. Rogers (2001) mentions the idea that it is possible to build and discover new knowledge through a pleasurable learning for those who teaches, as for those who learn.

Method

The game used on this project is titled “Mathematical Rods” being an innovation of the classic game “Cat Rods”, in which each player must should pick up a maximum number of bast without messing with any of the others. This is an easy and affordable educational version due to its tow cost material. The game consists of chips made with colored papers (pink, green, yellow and orange), sticks painted according to the plugs (and may be replaced by crayons or any other material of the proposed colors), a table of values and also by a response card (a table that contains all accounts and their results for the calculation conference). Each color, in addition to the amount of point still establishes a different purpose as revealed in table 1.

Table 1. Score and details about the game.

Colors	Values	Accounts
Pink	15 points	Square root
Orange	10 points	Potency
Green	5 points	Division
Yellow	1 point	Addition and Subtraction

In the game must also have a judge, being he one of the participants, who must be chosen to check if the other will answer the accounts correctly, or also if any of the other rods will move while the player tries to capture the chosen one. To play, just shuffle and play the sticks so that all are randomly scattered on top of each other, the goal of the game is to be able to catch only one rod at a time without moving the others, following all the rules of the game. Basically, the rules of this hobby are: if when trying to catch the stick stir one of the others passes the time, and if you do not resolve or settle the account the rod must be returned to the others and you do not earn any points.



Figure 1- Educational game "Mathematical Rods", manufactured by the author.

After shuffled, if you can pick up any rod without moving the other ones should take u respectively the same color of the captured stick, each of these papers have some kind of basic mathematical account to be resolved, when answered correctly the player must save the rod until the end of the game for somatoria of the points. The game ends when all the sticks of the game are collected, and thus the counting of the point is made according to the values of the table present next to the are collected, and thus the counting of the points is made according to the values of the table present next to the material where all the beads appear, their colors, is value and its respective results so at the end of the game see who is the real winner, thus predicting the amount of sticks collected do not determine the winner of the game, but rather the count of their respective points.

Table 2. Score Table and Conference of the Accounts Present in the Game.

<u>Yellow-1 point</u>	<u>Green-5 points</u>	<u>Orange-10 points</u>	<u>Pink-15 points</u>
$6+9=15$	$8\div 4=2$	$1^{15} = 1$	$\sqrt{9} = 3$
$15+16=31$	$9\div 3=3$	$1^{10} = 1$	$\sqrt{16} = 4$
$17-5=12$	$18\div 2=9$	$2^4 = 16$	$\sqrt{25} = 5$
$18-9=9$	$24\div 2=12$	$2^6 = 64$	$\sqrt{36} = 6$
$34-11=23$	$25\div 5=5$	$2^7 = 128$	$\sqrt{49} = 7$
$36+24=60$	$44\div 2=22$	$3^4 = 81$	$\sqrt{64} = 8$
$45+45=90$	$45\div 5=9$	$3^3 = 27$	$\sqrt{81} = 9$
$50+45=95$	$50\div 10=5$	$4^4 = 256$	$\sqrt{100} = 10$
$78-45=33$	$63\div 3=21$	$5^3 = 125$	$\sqrt{121} = 11$
$78-56=22$	$64\div 2=32$	$6^2 = 32$	$\sqrt{144} = 12$
$89-8=81$	$66\div 2=33$	$7^1 = 0$	$\sqrt{169} = 13$

$96-56=40$	$81\div 3=27$	$8^2=64$	$\sqrt{196}=14$
$125+125=250$	$84\div 2=42$	$9^2=81$	$\sqrt{225}=15$
$150+150=300$	$85\div 5=17$	$10^6=1\text{ million}$	$\sqrt{400}=20$
$230+245=475$	$95\div 5=19$	$18^1=0$	$\sqrt{900}=30$
$256-25=231$	$125\div 5=25$		
$300-150=150$	$150\div 5=30$		
$340+150=490$	$196\div 4=49$		
$740+22=726$	$300\div 2=150$		
$820-300=520$	$486\div 2=243$		

The proposed activity was developed specifically for elementary school students, with simple questions focused on basic mathematics that is used in day-to-day problems such as addition, subtraction, division and multiplication (square root and power). The target audience of the application of the mathematical game were the students of the 9th grade elementary school classes of the State College Professor Izidoro Luís Ceravolo located in the city of Apucarana, Paraná- Brazil.



Figure 2. Educational Game "Mathematical Rods" During Application.



Figure 3- Directors of the State College Professor Izidoro Luis Ceravolo where the application of the game "Mathematical Rods" took place.



Figure 4. Educational Game "Mathematical Rods", Being Applied to Elementary School Students.

Results

In the school period of February 9 and 10, 2022, the game was applied and the analysis was performed on the given classes, the students were divided into 3 groups of 6 people each. The first group "team 1" was formed by five girls and one boy, they finished the game answering the total of 37 questions, including 30 answered correctly and 7 wrong, with a girl as the winner. The second group "team 2" contained four girl and two boys, and ended up having a result similar to the first group with 37 questions, however, there were 28 said veridically and 9 inveridly, with a boy as the winner. The third and final group "team 3" composed of five boys and one

girl, finished the game with 35 of the contested contents, 29 hits and 6 hits, with a winning boy. All teams were able to finish the game with an average of 40 minutes, having an excellent performance to solve the issues and obtained great results with the learning that the game provided. Remembering “little rules” and mathematical tolls to solve the problems they had already forgotten. However, some students had difficulties the main related root accounts square and power, as we can see in detail in table 3:

Table 3. Scores and Details About the Application of the Game.

	Team 1	Team 2	Team 3
Duration	40 min	40 min	40 min
Questions	37	37	35
Corrects	30	28	29
Wrongs	7	9	6
Difficulties	Square root	Potency	Potency

Discussion

Undoubtedly, in the “game, one never knows the directions of the player’s action, which will always depend on internal factors, personal motivations and external stimuli, partners” (KISHIMOTO, 1995, p.53). But above all, it is necessary to take into account its positive effects, mainly as a tool learning and developing cognitive and social skills. Some students raised the fact that they could not remember the materials and present difficulty with some basic math accounts present in the game, thus awakening the interest of seeking to study more about the subjects dealt with, refreshing the memory and remembering issues already applied in the past that ended up being forgotten over time or considered irrelevant ant that time.

That’s why De Paulo (2017) said, games positively change the image of the discipline of mathematics, because they motivate, stimulate reasoning and also by be playful to study, that main positive point of the application of this project was to really awaken the interested and pleasure of the students who end up studying and learning without even realizing that this is actually happening in that moment of play relaxed with classmate. Already applied in the past that ended up being forgotten over time or considered irrelevant at that time.

Vygotsky (1991) discusses that play creates zones of proximal development and that these provide qualitative leaps in the development and child learning. Likewise, Kamii and Devries (1991) claim that young children acquire better knowledge through games than with traditional lessons and exercises.

Conclusion

In view of the research reported in this study, we were able to verify the veracity of the student’s high

development with the use of playful games in teaching mathematics learning, unlike the theoretical classes worked on a day-to-day basis. Cunha (2004), believes that games are a pedagogical option that can be used at various times in the classroom, such as, in order to explain the content, illustrate, review or even to evaluate what has been learned. In addition to this type of play being fun and stimulating, it “contains a reference to the adult’s childhood time with representations memory and imagination” (KISHIMOTO,1995, p.51), awakening the deepest effective memories. Therefore, the game created in this project addition to being worked only with elementary school students with the content of basic mathematics, it also has the possibility of being changed to high school students or even to other subjects, having a lot of very flexible questions the difficulty selected by the applicator, because the use of play can be an extremely efficient tool and used in all modalities and levels of education, whether public or private.

Therefore, in addition to dynamic and creative this educational interpretation is extremely easy accessible, due to its low cost manufacturing material, which can be changed by material that are already easily accessible, that is, a tool that can be used in public schools, contributing to the process of students ensuring accessibility and learning for all, because according to Balbinot, Timm and Zaro (2009) the costs of these games can make its application is not feasible and, in addition, Silva (2006) learning takes place in an extended period, which begins in childhood so that it is possible to fix what is being studied and so that you do not forget easily.

Recommendations

In view of everything that has been pointed out and proven with the use of the proposed playful game, we can perceive that if worked since childhood in schools as a method of teaching present, children may have better personal development in the future with their studies, also a better fixation of the contents during his student career in addition to working a better interest in school and studies for the relaxed and fun way of playing, all of which are reflected in the future of their lives.

Acknowledgments

At the end of this project we can point out our wishes of gratitude to all who were present in this research, in particular the state school Professor Izidoro Luis Ceravolo located in Apucarana, Paraná-Brazil where the game was applied in addition to the participating students who had all the dedication during the execution of the game, the Federal Technological University of Paraná-UTFPR for all support in creation and duration of this work, also the advisor teacher Danielle de Oliveira Prado for the support being present assisting in all stages of this project and all organizers ICEMST event for the opportunity, support and reception.

References

- BALBINOT, Amanda; TIMM, Maria Isabel; ZARO, Milton Antônio. Aplicação de jogos e simuladores como instrumentos para educação e segurança no trânsito. *RENOTE-Revista Novas Tecnologias na Educação*, v. 7, n. 1, 2009. BRASIL. MEC. PCN+: *Orientações educacionais complementares e aos parâmetros Curriculares Nacionais, Ciências da Natureza, Matemática e suas Tecnologias*. Brasília; Ministério Educação e Cultura, 1998
- CUNHA, M. B. Jogos de Química: *Desenvolvendo habilidades e socializando o grupo*. Eneq 028- 2004.
- DE PAULO, Jessé Valério. *O uso de jogos nas aulas de Matemática do Ensino Médio: o que dizem os professores de Matemática*. Dissertação (Mestrado) Universidade Estadual Paulista. Faculdade de Engenharia, Bauru, 2017, 114 p.
- FALKEMBACH, Gilse A. Morgental. *O lúdico e os jogos educacionais*. CINTED-Centro Interdisciplinar de Novas Tecnologias na Educação, UFRGS. Disponível em, 2006.
- GARDNER, M, *Divertimentos Matemáticos*. Tradução Bruno Mazza. São Paulo: Ibrasa, 1961. 187p.
- ISIDRO, A.; ALMEIDA, A. T. M. *Projecto Educar para a convivência social: O jogo no currículo escolar. Cadernos encontro: O museu a escola e a comunidade*. Centro de Estudos da Criança, Universidade do Minho, Braga, 2003.
- KAMII, C.; DEVRIES, R. *Jogos em grupo na educação infantil: implicações da teoria de Piaget*, 312, 1991.
- KISHIMOTO, Tizuko Morchida. *O jogo e a educação infantil*. Pró-Posições. Vol.6, nº 2[17], 46-63, junho de 1995. Disponível em: <https://www.fe.unicamp.br/pf-fe/publicacao/1847/17_artigo_kishimotom.pdf> Acesso em: 24 abril 2022.
- KISHIMOTO, Tizuko Morchida. *O jogo e a educação infantil*. São Paulo: Pioneira, 1994.
- NACARATO, A. M. *Eu trabalho primeiro no concreto*. Revista de Educação Matemática, n. 9, p. 1-6, 2005.
- PIAGET, J. *A psicologia da criança*. 17. ed. Rio de Janeiro: Bertrand Brasil, 1988.
- ROGERS, C.R. *Tornar-se pessoa*. 5. ed. São Paulo: Martins, 2001.
- SANTANA, EM de; REZENDE, Daisy de Brito. O Uso de Jogos no ensino e aprendizagem de Química: Uma visão dos alunos do 9º ano do ensino fundamental. *XIV Encontro Nacional de Ensino de Química (XIV ENEQ)*. UFPR, v. 21, 2008.
- SILVA, D.M.C.; GRILLO, M. *A utilização dos Jogos Educativos como instrumento de Educação Ambiental: O caso Reserva Ecológica de Gurjau- PE*. Contrapontos, v.8, n.2, p.229-238, 2008.
- VYGOTSKY, L. S. *A formação social da mente: o desenvolvimento dos processos psicológicos superiores*. 4ª ed. São Paulo: Martins Fontes, 1991.