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ANALYSIS OF THE MATHEMATICAL LOGICAL THINKING OF FIRST SEMESTER STUDENTS AT THE BACCALAUREATE LEVEL POST PANDEMIC COVID19

ANALYSIS OF THE LOGICAL-MATHEMATICAL THINKING OF FIRST-SEMESTER HIGH SCHOOL STUDENTS POST-COVID19 PANDEMIC

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Abstract Didactic sequences to improve teaching and learning techniques have been innovated in secondary education (EMS). However, it is also necessary to identify the social and economic context of the student to see if there is a correlation with school performance. A diagnostic survey was conducted to identify the social conditions and identify problems in mathematical logic, and at the same time an introspection was made on the type of intelligence that students use most frequently. In the second stage, a didactic sequence with programming using block codes was developed and applied. The activities carried out to promote reflective learning in the students of CETIS 167 and Colegio de Bachilleres 14, first semester, were reviewed. It was identified that the students' families are mostly engaged in commercial activities focused on trades, followed by family members who are engaged in the service sector. The students can only manipulate mathematical expressions with whole numbers, but they do not know how to issue a conclusion correlating the result with the context of the problem, at the end they only mechanize, but they do not reflect.

Keywords: TinkerCAD, Rabbids Coding!, block coding, mathematical logical thinking.

Abstract -- Didactic sequences to improve teaching-learning techniques have been innovating in Higher Secondary education (HSE). However, it is also necessary to identify the student's social and economic context to see if there is a correlation with school performance. A diagnostic survey was carried out to identify social conditions and identify problems in mathematical logic, at the same time introspection was carried out on the type of intelligence that students use most frequently. In the second stage, a didactic sequence with programming using block codes was carried out and applied. The activities carried out to promote reflective learning in the students of CETIS 167 and Colegio de Bachilleres 14, in the first semester, were reviewed. It was identified that the families of the students are dedicated in a greater proportion to commercial activity focused on trades, followed by family members who are dedicated to the services section. Students can only manipulate mathematical expressions with whole numbers, but they do not know how to draw a conclusion by correlating the result with the context of the problem. In the end they only mechanize but do not reflect.

Key words - TinkerCAD, Rabbids Coding!, codeblock, mathematical logical-thinking

INTRODUCTION

There has been much discussion about why authentic learning is not generated in schools. Students are not prepared to successfully solve problems in the real world, since they are only provided with isolated fragments of information, often decontextualized. [1]

There are several factors to which the failure in the teaching of algebra in EMS can be attributed, following are listed: "intrinsic to the object, inherent to the subject itself and that traditional teaching has not brought meaning to algebra." [2]

It is considered that one of the main characteristics that lead to school failure is the communication and language used in mathematics classes, totally excluding the variables attributable to both the teacher and the student; it is the fact that reality is not contextualized with algebra and arithmetic, building a monotonous and often boring expository class. Also, when trying to bring the easy to the classroom, the bases or demonstrations from which the algebraic foundations were conceived are not promoted, an opposite effect occurs where the class and the comprehension is considered to be complicated.

Students also feel frustrated when trying to complete a professional career at the university level because they do not have the ability to think logically and mathematically. The problem is that today, due to the accelerated increase of educational offers, there is no diversity of professions in the country. This causes a

effect of stagnation and frustration in students trying to get involved in the world of work. And that is why they look for simple educational offerings, i.e., that do not contain advanced mathematics. [3]
In the municipalities of Milpa Alta, Xochimilco and Tláhuac, which are the surrounding areas of CETIS 167, there is a degree of conformism or low school achievement, as a direct effect, students who fail to finish high school take up jobs or businesses of their parents or guardians. Many times they only conclude the EMS level out of commitment and not out of conviction, for better job opportunities, or to broaden their outlook. And there has also been the effect that, in spite of finishing their studies, they dedicate themselves to other professional activities in their jobs, because they do not have the specific and disciplinary competencies of the profession studied.
As main characteristics for which they present a failure are that: "*Students often avoid mental effort when understanding mathematics, as the brain tends to seek cognitive efficiency*".
[4] This makes it difficult to understand mathematical reasoning processes, especially deductive ones. Understanding new concepts depends on a solid foundation in previous concepts. Gaps in early learning can have a lasting impact on the child.
Attitudes toward mathematics may depend largely on the quality and motivation of the teachers who teach the subject, according to many mathematicians.
Upon further analysis, it can be observed that mathematics classes, more specifically arithmetic and algebra, are often handled as isolated topics. And not as topics of learning progress. This is also reflected in the intermediate part of knowledge. Since demonstrations and real-world applications and/or comprehensions are omitted.
The purpose of this work is to identify the characteristics by which the students of CETIS 167 present a low achievement in the subject of algebra. And to identify if they have a logical mathematical and algebraic thinking through a didactic sequence, which is attractive and allows students to develop their basic mathematical disciplinary skills, which involves programming in the multiplatform application Rabbids Coding! (RC) and the online design software TinkerCAD.

DEVELOPMENT
A finite population, which is heterogeneous, is considered for the sample size. The confidence is required to be 95%. Since the proportion of the event occurring favorably is unknown, the probability of success and failure are considered equal, i.e. p= 0.5 and q= 0.5; with an error of 7%.
As a point of comparison, support was requested from a group of first semester students from the Colegio de Bachilleres.
number 14 with 39 students, located in Villa Milpa Alta, Milpa Alta, CDMX.
The Hebegogy learning theory will be used, where the active participation of each student will be requested, contrasting the appropriation of the competencies through surveys, with the purpose of covering at least three of the four socio-cognitive resources for mathematical thinking in EMS.
A diagnostic survey was conducted to identify the socioeconomic origin of the students and to determine whether the activity of their family members influences their future labor vision. The test that identifies the types of intelligence of Honey-alonso, to identify whether they have a reflective, pragmatic, and theoretical learning.
The methodology is divided into three stages, in the first stage the basic programming concepts are taught, using RC, with the purpose of identifying that each action block proposed within the application will generate a direct action on the object, in this case a rabbit. The objective of the game is for the user to move a rabbit through a path of defined blocks using a block code or instruction, and at the end be caught in a washing machine. At a later stage this will be useful for programming and graphing in TinkerCAD, where expressions will be made in a Cartesian plane, also using block code programming.
The second stage teaches the concepts of basic arithmetic operations (addition, subtraction, multiplication and division) using grouping signs. The proposed problems are divided into five moments, where the student adapts to the context of the problem by generating an idea of the imagination; in the second moment he/she generates a resolution structure verbally; in the third moment he/she generates the graphic representation; in the fourth moment he/she generates the abstract representation, which he/she solves; and finally he/she expresses the resolution obtained verbally and correlates it. The interface is shown in Figure 1.

Figure 1. Interface of Rabbids Coding!

In the third stage, the algebra variables will be combined with TinkerCAD programming to model proportional expressions. The main focus of each product is for the student to develop the competencies of the mathematics axis, such as: constructing mathematical models, formulating and evaluating the

algebraic proposals, interpret and express the results obtained. Figure 2.
The results obtained for the CR tests will be coded according to the level reached, that is, the lowest number of instruction blocks used, as mentioned below. For the basic level, it will be the participant with the highest number of action blocks used, while the student who obtains the advanced level, will be the one who occupies less instructions or even the repetition blocks. The values will be value 1 for basic, value 2 for intermediate, and value 3 for advanced.

Figure 2. TinkerCAD Interface

For the class stage, the student's writing and verbal expression will be considered, using the technicalities of mathematics. Grades will be quantified by a rubric for solving math exercises. The answers will be obtained from a Classroom.
To review the source code, a rubric for computational logic thinking will be used to check the performance and strategies of the students; it will only be numerical to measure the data obtained. It will be a research where descriptive statistics will be used; to perform the comparison of means, R studio software will be used.

DISCUSSION AND ANALYSIS OF RESULTS

Initial interview

After having carried out the didactic proposal, the following results were obtained: 85 women and 58 men, which corresponds to 59.44% of women and 40.56% of men. See Table 1. From the CETIS, 71 women and 44 men took the survey, while in the Colegio de Bachilleres there were 14 men and 14 women. This corresponds to 49.65% were women and 30.77% were men in the CETIS, while, for the Colegio de Bachilleres, it corresponds to 9.79% for both cases; these data correspond to the total sample.

Table 1. Gender of students.

Genre	number of students		percentage of students	
	CETIS	Bach Cabbage	CETIS	Bach Cabbage
Female	71	14	49.65	9.79
Male	44	14	30.77	9.79

Source: Own elaboration

In contrast, 69.1% of the students only do their studies. While 30.9% of the respondents work and study at the same time. The data are shown in Table 2.
In Mexico, the main reasons for working and studying at the same time are diverse and include economic, cultural, social and labor market insertion. [5] In general, most young students recognize that they work to satisfy their personal economic needs. [6]

Table 2. Students studying and/or working

	Only performs studies	**Work and study**
CETIS	90 59.21%	42 27.63%
Colegio de Bachilleres	15 9.87%	5 3.29%

Source. Own elaboration.

In both schools, the proportion of students who also work is lower. There are 47 students who work, while there are 105 students who are only studying. At least for the subject of mathematics, a greater affectation in the school performance of working girls than their male counterparts is suggested. [7]
The development of learning has shown that the results in educational achievement do not depend entirely on the students' abilities, the family environment or the characteristics of the school. Some of these variables are the socio-demographic characteristics of the students, ' schooling, academic expectations, work, school repetition, among others. [8]
The survey identifies the commercial activity in which the parents or guardians of the students are engaged. Among them, the largest proportion is dedicated to commercial activities such as merchants and community trades, and to service activities such as financial, health, education, transportation and security. In third place are agricultural activities. And in last place are industrial activities and tourism. Table 3.

Table 3. Productive sector of parents.

	Agricultural	**Commercial**	**Industrial**	**Services**	**Tourism**
CETis	18	45	7	43	2
CB	4	8	1	14	1

Source: Own elaboration

Learning styles According to the analysis performed with the Honey Alonso test, students present a greater affinity to active learning, pragmatic learning and theoretical learning. As shown in Figure 3.

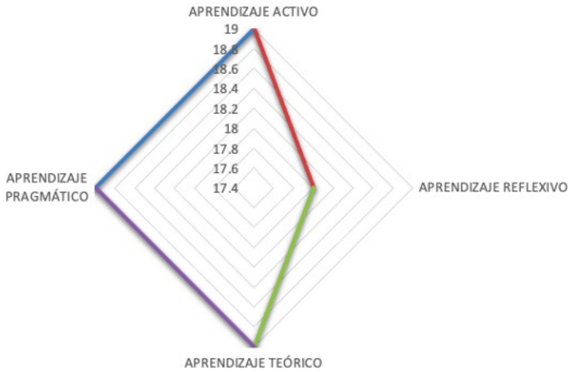

Figure 3. Students' learning styles.
Source. Own elaboration

However, reflective learning is presented at a lower , for all students in general. Reflective learning (RA) is one of the key points to achieve the constant development or transformation of any society. It is a complex thinking process, which disposes the subject to energize his or her cognitive, social and emotional potential. From the reflective learning theory, reflection is conceived as a priority; people need to develop an awareness of what, how and for what purpose they learn. [9] At this stage, it can be seen that students have only been in a system where the aim is to mechanize knowledge. For the area of mathematics, they will only try to reach an objective value, without reflecting on whether the context is congruent or not.
The two phases of what would be reflective learning and the consequence of working on it, such as reflective practice, should be considered. The first is to refer to thinking and conscious analysis of actions. The second is the process of gaining new insights through self-awareness and critical reflection on present and past experiences. [10]
Errors and their persistence arise from the growing cognitive demands of students, which is reflected in a greater demand for skills such as reflection, reasoning and the application of mathematical skills, skills that should have been developed progressively during their schooling, and which have repercussions both when entering and remaining in university.
[11] the main characteristics for the generation of errors are the following:

1. They usually arise spontaneously and surprise the teacher.
2. They are persistent and difficult to overcome, since they require a reorganization of the student's knowledge.
3. They can be systematic or random: the systematic ones are more frequent and reveal the mental processes that have led the student to a wrong understanding, and those committed by chance are occasional. [12]

Students are often unaware of the error because they do not fully understand the meaning of the symbols and concepts they are working with.
Considering the resolution of the problems and the analysis proposed, the students have difficulties in translating common language into algebraic language. On the other hand, they have a very deficient reading comprehension. And in order to issue a conclusion or reason for the value obtained, the objective is not achieved. Therefore, ". . *the classroom environment in which this science is taught and learned* " i.e. mathematics, "*it is possible to promote the reading of texts related to it, which produce aesthetic enjoyment and quench the thirst for knowledge* . . ." [13]
The way to enrich is by using reading comprehension, to understand the proposed context. In this way, the student identify that values numerical values are important and what is the objective of the resolution. Since students are not very reflective about this type of information, it is necessary to reinforce with activities in this sense. The activities that improve this learning are where they can express their ideas, such as forums, blogs, debates and the like. Therefore, it is important to generate strategies to address the deficiencies and difficulties that students in previous grades have. This can be remedied by trying generate participatory classes, which generate a critical debate, encouraging reflective thinking and at the same time generate interest in problem solving [14] ***Session 1*** After manipulating the CR mobile application It can be seen with the trend graph, that the first level is obtained on average 2.79 stars rating, as you move up the level in the video game continues to decline. In the first ten levels an average of 2.5 stars is maintained.
When you reach level 11 where it is necessary to use loops, an average of approximately 2.1 stars is observed. And in that second part the values range from 2 stars to 2.3 stars obtained per level. During the software design process, reflective thinking strategies have a positive impact on improving the learning performance of students, especially the less successful ones. [14] High-performing programmers use various mental activities and support strategies by applying various cognitive, **reflective**, and psychological processes and activities while writing their programs [15].

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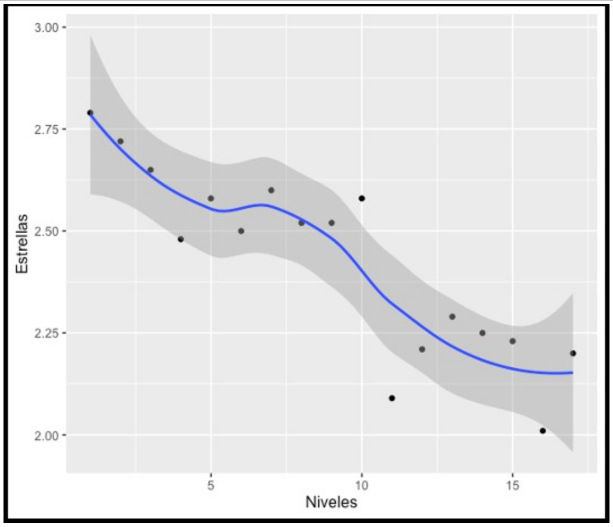

Figure 4. Stars obtained in Rabbids Coding!
Source. Own elaboration.

Likewise, block-based programming tools had positive effects on students' programming attitude and can also promote the cultivation of computational thinking, **reflective** thinking and problem-solving ability. [16]

Session 2 In this session arithmetic exercises are proposed, so that the student identifies the hierarchy of operations and solves the problems using his mathematical thinking. It is observed in the images that the student does not present any chronological order, nor uses directly the hierarchy of operations, but proposes a result, and writes his answer with the context of the problem. Review Figure 5

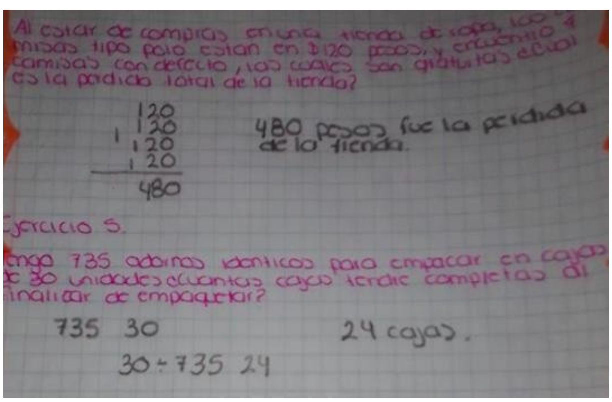

Figure 5. Notebook with response.
Source. Own elaboration.

Another student's work shows that he presents a mathematical algorithm to summarize operations in a single line. His answer text is more extensive. However, he does not use grouping signs such as parentheses, brackets or braces. See figure 6.

It can be seen in the following image that he identifies and names the objects as a variable, that is, he defines the gasoline object as the variable x. She makes the grouping of elements by moments. And he makes a report, which was requested, in order to solve his problem. The relatoría was proposed with the purpose of identifying if the problem was an arithmetic situation or if there is some problem in the translation of the common language to the algebraic language. See figure 7

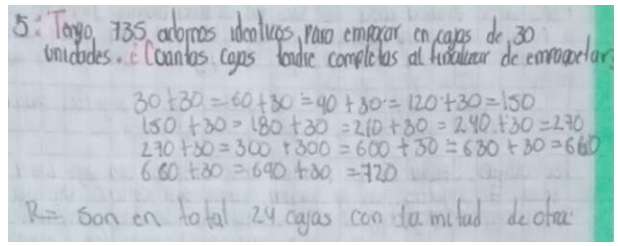

Figure 6. Notebook with response.
Source. Own elaboration.

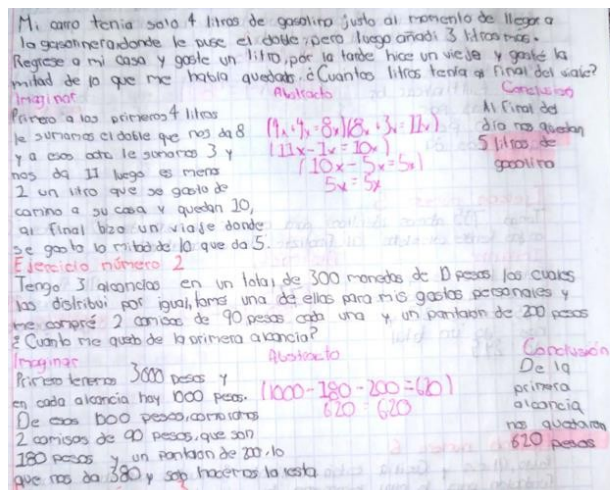

Figure 7. Answers to the arithmetic exercises.
Source. Own elaboration.

It is considered that the student is writing the variables in a formal way, with the purpose of identifying the different elements and making the concept of variables to be used. In the last exercise of this session, a real situation of collecting toys was proposed. Each of the participants used the grouping signs more extensively, with the purpose of reducing them into subgroups and then joining the answers.

The following image shows that each participant of the problem is assigned a variable, such as X, Y and Z. He identifies each of the steps performed, although he partially connects each value. That is, he did not use a single mathematical expression for each participant collector. See figure 8.

Another methodology that was used was to make a small map, to identify each step of the problem, and to be able to give an answer to it.

Where the conjecture is made by colors and grouping keys.
The mathematical ability is there, but the translation or summary of activities is complicated. Despite the data obtained from the diagnostic evaluation, a favorable resolution is observed.

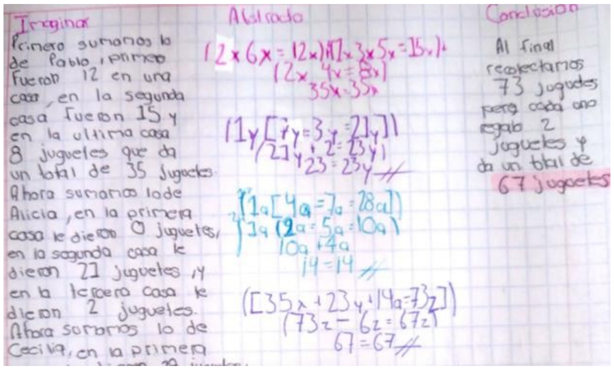

Figure 8. Response to arithmetic exercises**.**
Source. Own elaboration.

For this type of exercise, according to the PISA test, a score of 1b would be obtained, where according to the Program for International Student Assessment
[17] At level 1b, students can understand questions related to familiar contexts that include all relevant information and have short, syntactically simple statements. They are able to follow clearly stated instructions. They can take the first step of a two-step solution to a problem. See Figure 9.

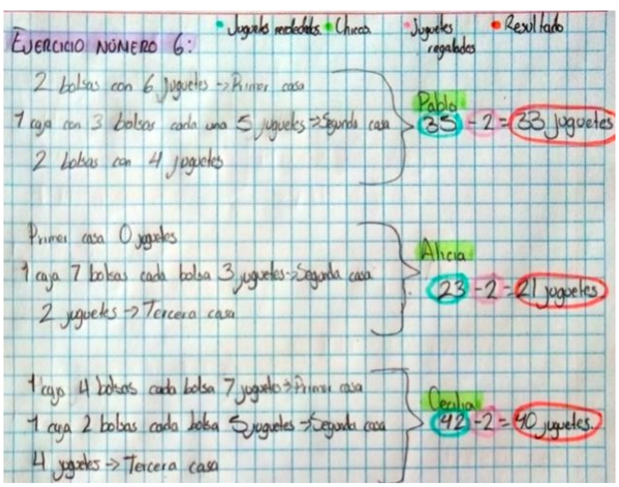

Figure 9. Response to arithmetic exercises.
Source. Own elaboration.

On the other hand, for the evaluation of the data to be obtained in TinkerCAD from the operation $3+\left(2+\sqrt{9}\right)^{-6/2}$ arithmetic operation and , nesting functions were obtained the following activities. The block code is shown in figure 10.

A formal arrangement of variable creation AND assignment of new values to each variable is observed, by dividing the arithmetic operation into sections. A figure is also assigned and the movement within the 3D plane is provided. In a much simpler arrangement the modeling shown in Figure 11 is obtained.

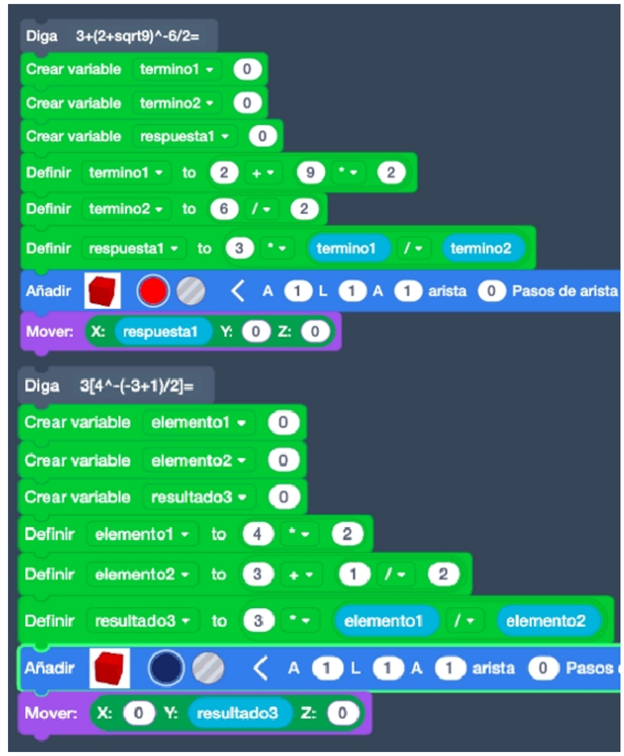

Figure 10. Code for the arithmetic expression.
Source. Own elaboration.

Figure 11. Code of an arithmetic operation.
Source. Own elaboration.

Session 3 The sheet showing the coordinates of a maple sheet was proposed. The student had to plot the various points, without connecting them, in the virtual environment of TinkerCAD. The block code obtained is shown in Figure 12.
It is observed that it identifies them, and makes use of the move , where the X, Y, and Z coordinates are identified. Even the characteristic colors of each vertex are provided. Although only the black vertices were requested, the red ones were also made.

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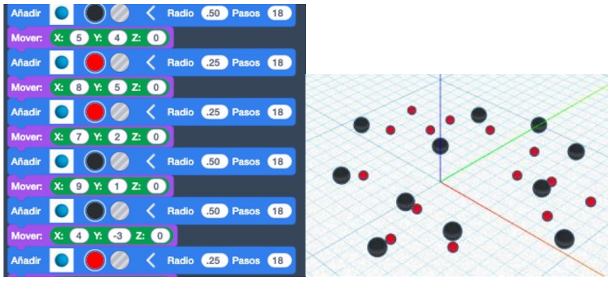


Figure 12. Code for Cartesian coordinates**.**
Source. Own elaboration.

Session 4 It was proposed as an exercise for the student to graph the multiplication tables.
And as a proposal was only to make one table, and it was intended to nest within another loop function a second one. However, it was intended that they would further summarize the code. But it was not possible.
A graph is shown in Figure 13.

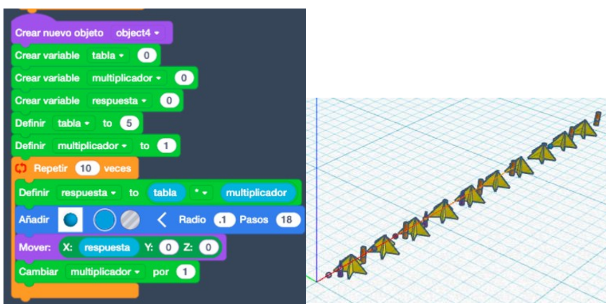


Figure 13. Block code for multiplication tables
Source. Own elaboration.

The use of functions such as create variable, define variable, move, repeat a code n times, and add figures is observed. He performed them in only one direction, and did not change any of the variables Y or Z. Other patterns obtained for the multiplication tables are shown. There were also students who managed to perform the block code representation, and only obtained one repetition. As shown in Figure 14.

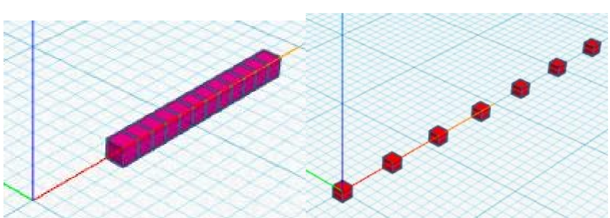
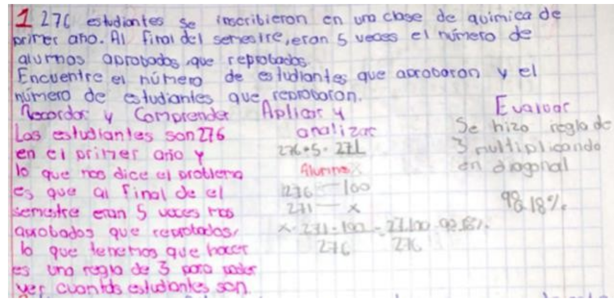


Figure 14. Multiplication table graphs.
Source. Own elaboration.

Session 5 In this session exercises of systems of equations with two unknowns were proposed. In spite of having provided the topic in the classroom, it is observed that a different proposal for solving the system of equations, as it does not considering the two parts of the context, an error in the data is obtained. See figure 15.


1 276 estudiantes se inscribieron en una clase de química de primer año. Al final del semestre, eran 5 veces el número de alumnos aprobados que reprobados.
Encuentre el número de estudiantes que aprobaron y el número de estudiantes que reprobaron.

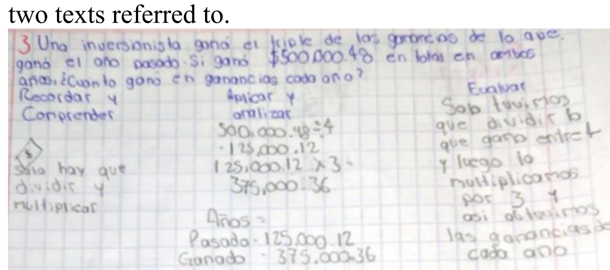
Recordar y Comprender: Los estudiantes son 276 en el primer año y lo que nos dice el problema es que al final de el semestre eran 5 veces mas aprobados que reprobados, lo que tenemos que hacer es una regla de 3 para saber ver cuantos estudiantes son.

Aplicar y analizar: 276-5= 271; Alumnos; 276 — 100; 271 — x; x= 271·100 / 276 = 27100 / 276 = 98.18%

Evaluar: Se hizo regla de 3 multiplicando en diagonal. 98.18%

Figure 15. Response of systems of equations.
Source. Own elaboration.

A deficiency in the reflective part is also observed, since he only intuited what the resolution path could be, but did not meditate on the result obtained. See figure 16. Another resolution proposal is shown, but it does not generate the two equations to be able to correlate the two texts referred to.


3 Una inversionista ganó el triple de las ganancias de lo que ganó el año pasado. Si ganó $500,000.48 en total en ambos años, ¿Cuanto ganó en ganancias cada año?

Recordar y Comprender: Solo hay que dividir y multiplicar

Aplicar y analizar: 500,000.48 ÷ 4 = 125,000.12; 125,000.12 x 3 = 375,000.36; Años = Pasado = 125,000.12; Ganado = 375,000.36

Evaluar: Sab tuvimos que dividir lo que gano entre 4 y luego lo multiplicamos por 3 y asi obtuvimos las ganancias de cada año

Figure 16. Answer of systems of equations**.**
Source. Own elaboration.

On the other hand, another type of resolution was found, despite having the difficulties of expressing mathematical equations in a text editor. See figure 17. Note in detail, the error of wanting to make the difference between a variable and an integer is presented. And in spite of the fact that the statement says that one group is 5 times more than the other, between passing and failing. It does not consider nor generates a conclusion on the modeling performed.

Recordar y comprender	Aplicar y analizar	Evaluar
5x=Alumnos aprobados Y=No aprobados 276=Total de alumnos	5x+y=276 5x=276 – y 5x=275y X=275/5	Al final comprobamos nuestra ecuación con los resultados obtenidos
Necesitamos saber el total de alumnos aprobados y cuantos reprobados, tomando en cuenta que los alumnos aprobados son 5 veces el número de alumnos reprobados	X=55 ----------------------------------- 5(55)+y=276 275+y=276 Y=276-275 Y=1	5(55)+(1)=276 275+1=276 276==276 A=275 R=1

Figure 17. Answer of system of equations.
Source. Own elaboration.

Since in this exercise it would not make sense to say that one student failed and 275 passed, since the condition that one is five times the value of the other is not being met.

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fulfilling. , it can be contrasted that although there are problems with real context and integers. Students pretend to perform something only mechanically, without contemplating whether the solution is correct or not.

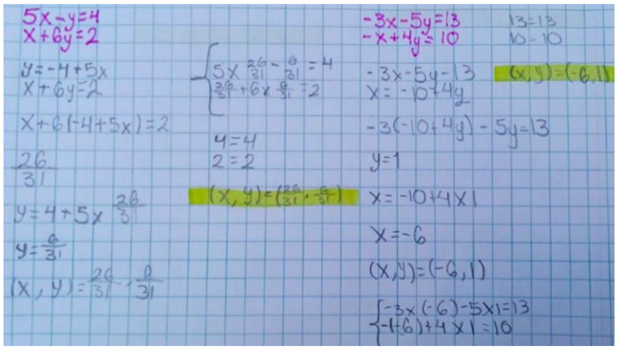

Figure 18. Answers to systems of equations.
Source. Own elaboration.

In the following image, it can be seen that the procedures for representing multiplication are omitted, or in other words, the x sign is used to show multiplication. It is not possible to appreciate a difference between the multiplication sign and the x variable. The latter is very common and in later stages they tend to confuse their own procedure. Review figure 18. The interesting thing is that it can omit clearing steps by intuiting them, but it does not maintain the mathematical formality. At the TinkerCAD stage, no correct resolution was found on the two equations. Since they had to be cleared and then graphed with respect to the x-axis.
There were close proposals, but none were equal to the result. Therefore, it can be identified as having problems in the hierarchy of clearances, and in identifying possible ratio relationships. This last stage was a problem without context. The results obtained are shown in Figure 19.

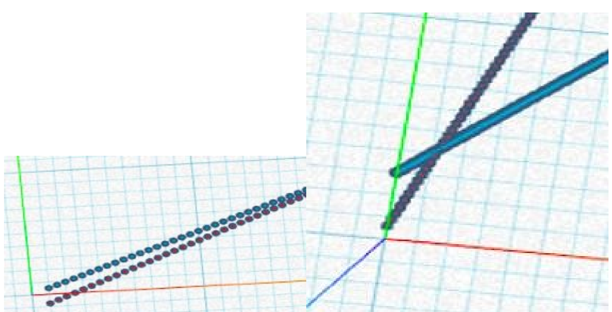

Figure 19. Plotting systems of equations.
Source. Own elaboration.

Disciplinary competencies
Within the study, there are students who already have the automatic procedures and algorithms, since several of the exercises in class already had in a way that they were already familiar with.
the answer in advance. Unfortunately, there are also the effects that the students can solve the algebraic exercises mentally, but at the moment of turning it into something formal they have complications, of translation, of signs, even with the handling of negative numbers.
In spite of the proposed activities, motivation was minimal, since the students come from a pandemic environment. Where they accredited the previous levels without any effort. Such is the contrast that, despite the study, where only 30% of the participants accept having been accredited without submitting any academic work. While the remaining percentage does not know the level of achievement or only performed the activities that were considered correct.
On the other hand, in math class there is a monotony of giving only one numerical value as an answer, so students felt uncomfortable when making a conclusion or expression of the results. It was even necessary to return the assignments to complete them with that competence.
It is not intended to discredit the institution, however, the students do not have the competencies to develop in a work environment. And further studies and the application of the new progression education strategy will be necessary to improve disciplinary competencies.
Although it is also a disadvantage, since several of the students have mobile devices, but refuse to use them, or mentioned that they did not have the economic resources to be able to use a network. And the school's network is limited to teachers, and communication is also limited, since the cell phone signal is lost in different places. The averages of each group were considered in order to observe the use per group. Figure 20 shows the distribution of grades by group.

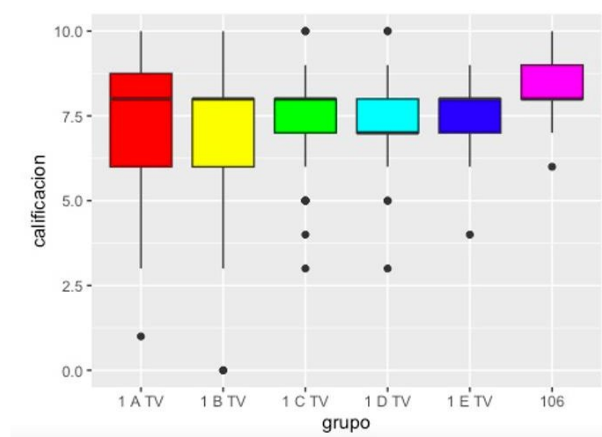

Figure 20. Distribution of ratings by group.
Source. Own elaboration.

It is observed that there is a greater dispersion of scores for 1ATV, and 1 BTV students. For

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In groups 1 CTV, 1 DTV and 1 ETV, there is greater homogeneity with values averaging 7.5. For the Colegio de Bachilleres group, an average of approximately 8 is obtained. It is observed that there are outliers, the presence of which is in failing grades lower than 5, while there are only two outliers, which are of the value 10. Figure 21 shows that the probability is less than 0.05% of significance, therefore, there are at least two means that are different.

```
                         Df Sum Sq Mean Sq F value   Pr(>F)
doe_calificacion$grupo    5   42.6   8.523   4.262 0.000996 ***
Residuals               234  468.0   2.000
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 21. One-factor analysis of variance. **Source:** Own elaboration.

The LSD mean difference test was performed. The results are shown in Figure 22. Through this study it can be observed that the highest academic achievement was by the students of the Colegio de bachilleres. While the lowest average was obtained by the students of group 1BTV, belonging to CETIS. The significant difference value is 1.97 with a degree of significance of 0.05. The groups that presented the greatest similarity among themselves were 1CTV and 1DTV.

```
Study: anova ~ "doe_calificacion$grupo"

LSD t Test for doe_calificacion$calificacion

Mean Square Error:  1.999887

doe_calificacion$grupo,  means and individual ( 95 %) CI

      doe_calificacion.calificacion      std  r      LCL      UCL Min Max
1ATV                       7.152000 1.438429 50 6.757980 7.546020   1  10
1BTV                       6.653000 1.854680 50 6.258980 7.047020   0  10
1CTV                       7.411200 1.357033 50 7.017180 7.805220   3  10
1DTV                       7.331800 1.124860 50 6.937780 7.725820   3  10
1ETV                       7.562222 1.186629 18 6.905523 8.218921   4   9
CB106                      8.227273 1.020356 22 7.633266 8.821280   6  10
Alpha: 0.05 ; DF Error: 234
Critical Value of t: 1.970154

Groups according to probability of means differences and alpha level( 0.05 )

Treatments with the same letter are not significantly different.

      doe_calificacion$calificacion groups
CB106                      8.227273      a
1ETV                       7.562222     ab
1CTV                       7.411200      b
1DTV                       7.331800      b
1ATV                       7.152000     bc
1BTV                       6.653000      c
```

Figure 22. LSD statistical test**. Source:** Own elaboration.

Considering the grades, the students obtained an overall achievement, since in the diagnostic evaluation they obtained an overall average of one based on 10 items.

A curious fact is that the students who were in group 1 ETV, presented a lag and a smaller number of classes, due to the fact that the group started once the first departmental evaluation was concluded. It is also of vital importance to highlight that students are mostly attracted to careers that are currently considered technical, but due to their socioeconomic status it is not possible for them to take such courses. This fact stood out when questioning which career they intended to pursue. Therefore, it will be necessary to strengthen the teaching and learning activities in order to improve the students' academic achievement. Since they come from a remote environment, where for various reasons they did not take advantage of learning. However, it will also be necessary to instruct the teachers of the mathematics academy to use the resources.

CONCLUSIONS

According to the analysis and discussion of results obtained from the algebra didactic sequence with TinkerCAD and Rabbids Coding! the following conclusions were obtained.

Students who enter high school with the proposal "With the right to another option" have deficiencies in critical thinking and reflective learning.

Reflective thinking allows the student to understand any situation, and to meditate in order to propose a method of resolution.

The support of mathematics software should be in an accompanying mode, and provide time for reflection.

Classical teaching, with a lecturer in front, and without the student interacting, must be modified. To generate classes where critical thinking is present in greater proportion.

High school algebra is only a review of the algebra shown in high school, therefore, there is an area of opportunity to work on; as well as to improve the disciplinary competencies of each student.

Despite the fact that the new Common Curriculum Framework for EMS Education proposes a style of work where the student has the freedom to propose methods of resolution. Mathematics is a sequential subject, and therefore no topic can be omitted, and times are tight.

It will be necessary to propose a more extensive explanation of programming fundamentals in the use of the CR application, with the aim of improving the student's programming and mathematical logic.

With the new MCCEMS, it is intended to face everyday problems to promote learning, the limitation will be the proper management of the hierarchy of operations and clearings.

A study habit should be encouraged, as well as special support so that their social problems do not directly influence their school performance. There was a significant improvement in the achievement of the students.

learning obtained, comparing the diagnostic evaluation and the final average obtained.

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CONTRIBUTION ROLE TABLE

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